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# INEQUALITY AND HUMAN CAPITAL IN APPALACHIA: 1960-2000

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## ABSTRACT

This paper examines changes in the earnings distribution of men age 25-64 between 1960 and 2000 in Appalachia and in the remainder of the U.S. Because Appalachia is more rural than the remainder of the U.S. we also examine changes in the earnings distribution in rural vs. urban areas. Our central finding is that there have been large differences in the evolution of the earnings distribution in rural vs. urban areas and this is the principal reason that Appalachia's earnings distribution differs to some degree from the remainder of the U.S. We find that the bottom of the earnings distribution increased in rural counties between 1960 and 1980 while there was a small decrease in the bottom of the earnings distribution in urban areas. Between 1980 and 2000, urban areas exhibited far more bifurcation of earnings than rural areas. The level and the return to education may play an important role in understanding these patterns. At the bottom of the distribution there was a large increase in education in rural areas relative to urban areas between 1980 and 2000. The relative rise at the top of the earnings distribution in cities is likely caused by men in the upper part of the earnings distribution being much more likely to have a college degree combined with a rapid rise in the return to college education.

## I. INTRODUCTION

When President Lyndon B. Johnson signed the Appalachian Regional Development Act in 1965 (which created the Appalachian Regional Commission), analysts could indeed classify Appalachia as economically distressed—particularly when compared to the rest of the United States. Per capita income in the region was \$1,267 in 1960, 77 percent of the national average. Nearly one-third (31 percent) of Appalachian residents lived below the federal poverty line, compared to just over one-fifth (22 percent) of all Americans.<sup>1</sup> Labor force and employment levels in Appalachia also compared unfavorably with those in the rest of the United States.

The results of the most recent decennial census, however, have shown evidence that economically, Appalachia in some dimensions more closely resembles the rest of the United States than it did in 1964. For example:

- Per capita income in 1999 was \$18,200, 84 percent of the national average of \$21,600.<sup>2</sup> In 14 Appalachian counties, per capita income exceeded the national average.
- At 13.6 percent, Appalachia's poverty rate in the 2000 census is less than half its level 40 years earlier. Moreover, the rate is just 1.3 percentage points higher than in the rest of the United States.
- Appalachia's labor force participation rate in 2000 was 67 percent for men and 53 percent for women—only slightly less than the rates outside the region (71 percent and 58 percent, respectively). And the 2000 census found that 5.8 percent of Appalachia's civilian labor force were unemployed, almost identical with the 5.7 percent rate in the rest of the country.
- The typical Appalachian county had a median household income (\$32,500) that was 89 percent of the median for the typical U.S. county.<sup>3</sup>

Many of the cited statistics on economic well-being are measured at the family or household level. This means that shifts in household composition, in female labor supply and earnings and in male labor supply and earnings all might have contributed to this convergence. Models of human capital suggest that an individual's level of human capital should be related to

earnings capacity. In order to focus on issues of human capital we first need to shift the analysis from the family or household level to the individual level.

We focus on the earnings of men aged 25-64 in 1960 through 2000. First, we ask “What has been the *average* earnings of men in Appalachia relative to the remainder of the U.S.?” Of course changes in average earnings potentially obfuscate important changes in earnings at different points in the earnings distribution. For example, even if there was no change in the average earnings of men in Appalachia relative to the remainder of the U.S., the interpretation of this stasis is quite different if earnings inequality grew within Appalachia, leaving the poorest Appalachians relatively worse off. The Appalachian Regional Development Act and the War on Poverty were not born out of a concern about *average* earnings; the chief concern was the earnings (and earnings potential) of the bottom part of the income distribution. For this reason we move on to examine the earnings of men in Appalachia relative to the remainder of the U.S. *at different points in the earnings distribution.*

Besides understanding whether the poor in Appalachia have gotten richer since 1960, there is another reason to examine the relative change in the earnings distribution. Several studies have documented that starting in the late 1970s and going through the middle 1990s, earnings at the bottom of the distribution fell while earnings at the top of the distribution rose. Most of this evidence is about earnings trends in the U.S. as a whole but some analysis has shown that this bifurcation of the earnings distribution holds by census region. What we know much less about is whether within regions, bifurcation of the earnings distribution holds in all areas equally or whether it holds more in urban areas than rural areas. Knowing this could be important. The most prevalent explanation for this earnings bifurcation, skill-biased technological change (SBTC), suggests that a shift in production technology that favored skilled

over unskilled workers increased the relative demand for skilled workers and their earnings. As we show, in rural areas, education is lower at all quantiles of the earnings distribution; a considerable number of men at the top of the earnings distribution, in fact, have relatively low levels of education historically; and at the bottom of the distribution, education levels in rural areas in general and Appalachia specifically are astonishingly low. This suggests that if SBTC is important, all else equal, the top end of the earnings distribution should rise faster in urban areas than in rural areas and the bottom end of the distribution should fall faster in rural areas than in urban areas. Of course shifting levels of education at various quantiles also effect the relative earnings distribution.

We show that while the three sub-regions of Appalachia show very different trends, average male earnings in Appalachia as a whole has remained at a constant of about 80% of the National Average for the forty years. While there has been no improvement in *average* male earnings, there was an impressive rise in the bottom of the earnings distribution between 1960 and 1980 for Appalachia. Interestingly, the convergence of Appalachia in the bottom of the earnings distribution towards the remainder of the U.S. appears to be driven almost entirely by a convergence of rural areas in the U.S. towards urban areas in this part of the distribution. In fact, we show that between 1960 and 1980, a rising fraction of men in urban areas were in the bottom of the distribution while a falling fraction of men in rural areas were in the bottom of the distribution. Between 1960 and 1980, the upper end of the earnings distribution was increasing similarly in inside and outside of Appalachia

Since average earnings remained constant over the entire period of 1960 to 2000 while relative earnings in the bottom of the earnings distribution increases between 1960 and 1980, this means that either the upper end of the earnings distribution was rising faster outside of

Appalachia or the bottom end of the distribution was falling faster inside of Appalachia after 1980 or both. On balance, we find evidence that the most important factor was that Appalachia has a smaller fraction of people in urban areas and between 1980 and 2000 there was rapid rise in the upper end of the earnings distribution in cities. Our general conclusion from this analysis is that the changes over time in earnings distribution are pronounced between rural and urban areas; what drives differences between earnings inside and outside Appalachia is simply that a somewhat higher fraction of Appalachian men living in rural areas.

While our data is more limited, we then turn to the degree to which changes in the relative level of human capital and the relative return to human capital can explain these changes in relative earnings at different points in the earnings distribution. We find that the rise in education plays an important role in explaining the rise in earnings at the bottom of the earnings distribution between 1960 and 1980; at the top of the earnings distribution it plays much less of a role. However between 1980 and 2000 both the level and return to education are important explanations for the relative rise in the upper tail of the earnings distribution outside of Appalachia, and more specifically in cities.

The remainder of this paper is as follows. In Section 2 we discuss a small fraction the literature on the time series and regional patterns of income inequality in the U.S. In Section 3 we discuss the data we use for our study and especially the data limitations for conducting analysis on regions that do not follow State boundaries. In Section 4 we discuss our method for estimating quantiles of the earnings distribution for Appalachia from summary data on the distribution of earnings within each county in the U.S. In Section 5 we first discuss our results on relative *average* earnings of men in Appalachia and then discuss the relative earnings at various

points in the earnings distribution. We then turn to the role that education plays in explaining these patterns. Section 6 is a conclusion.

## **II. LITERATURE REVIEW**

There are now dozens of studies on changes in wage and income inequality in the U.S. since 1970. This literature is summarized in Katz and Autor (1999). They identify a set of facts about income inequality on which there is considerable agreement:

1. Wage dispersion increased substantially for both men and women from the end of the 1970s to the mid-1990s. The weekly earnings of the 90th percentile worker relative to the 10<sup>th</sup> percentile worker increased by over 25 percent for both men and women from 1979 to 1995.
2. Wage differentials by education, occupation, and age (experience) have increased. The relative earnings of college graduates and those with advanced degrees increased dramatically in the 1980s.
3. Wage dispersion expanded within demographic and skill groups. The wages of individuals of the same age, education, and sex (and even those working in the same occupation and industry) were much more unequal in the mid-1990s than two decades earlier.
4. Since these wage structure changes occurred in a period of rather slow mean real wage growth, the real earnings of less-educated and lower-paid workers (especially young, less educated) males appear to be lower in the 1990s than those of analogous workers two decades earlier. The employment rates of less skilled workers also appear to have fallen relative to those of more skilled workers [Juhn (1992), Levinson (1998), Murphy and Topel (1997)].

There is a great deal of debate on the causes of these changes in the wage and income distribution. Labor economists have emphasized two explanations. The most prominent theory is that skill-biased technological change, often thought to be associated with the adoption of computer and automation technology, caused an increase in the demand for more skilled workers [Berman, Bound, and Griliches (1994), Autor, Katz, and Krueger (1998)]. A second explanation used by labor economists focuses on the supply of skill to the market. For example, Borjas, Freeman, and Katz (1992) argue that inflows of less-skilled immigrants increased the supply of

less-skilled workers, particularly workers with less than a high school education. They estimate that 30%-50% of the fall in wages of high school dropouts is due to immigration. Katz and Murphy (1992) and Card and Lemieux (2000) emphasize the relative changes in the supply of college graduates as a potential source for explaining both the rise in the returns to education and increased wage inequality. In contrast, trade economists have emphasized falling barriers to international trade and its effect on manufacturing employment in the U.S., long a bastion of high paid jobs for lower skilled workers. Wood (1994) made a dramatic calculation adjusting skill intensities to account for low-skilled goods that had been totally transferred to developing countries. He estimated that 100 percent of the rise in the skilled/unskilled wage ratio could be attributed to increased North-South trade. Finally, there are a set of studies that emphasizes the role institutional factors, such as changing rates of unionization or falling minimum wages DiNardo, Fortin, and Lemieux (1996), Freeman (1996), Lee (1999).

In this paper we examine earnings inequality which is a function of both a changing wage structure and changes in the number of hours worked. There is also now a large literature on changes in labor supply of prime aged men over the last 30 years. Juhn and Potter (2006) give a thorough review of this literature. Part of the labor market dropout literature emphasizes the same factors as the wage inequality literature and suggest that falling wages for some groups have lead to falling labor supply. This is especially true for low-skilled labor markets, especially for young, Black urban workers (Edleman, 2006). But labor market dropout of prime-aged men also seems to have increased since the 1970s. Autor and Duggan (2006) suggest that a rise in the after-tax Social Security Disability income replacement rate strengthened the incentives for workers to seek benefits and leave the labor market a result consistent. For workers over the age of 45, there is also evidence of increased rates of early retirement.



There is only a small literature on regional income inequality within the U.S. Robert Topel (1994) offers some evidence on variation in income inequality by Census region in the US. He estimates wage inequality between the 84<sup>th</sup> and 16<sup>th</sup> percentile of the wage distribution and finds that the West, North Central and Atlantic regions of the U.S. had higher growth in wage inequality between 1972 and 1990 than other regions. The change in wage inequality between the 50<sup>th</sup> and 16<sup>th</sup> percentile play a large role in the high growth in inequality in these regions. Topel's central conclusion is that what explains regional differences in the growth in inequality lies on the supply side. In the West he finds evidence of immigration affecting the wages of low skilled men; he also finds evidence that increased female labor force participation decrease men's wages. He specifically rejects that demand factors such as deindustrialization in the Atlantic and North Central region played a role in differences in the regional growth in inequality.

The paper that is most closely related to ours is Wheeler (2001). He develops a model where capital and worker skill are complementary in production that formalizes the idea that urban agglomeration will generate more efficient but segregated matches between workers and firms. As a result, market size will not only be positively correlated with average productivity, it will also generate greater between-skill-group wage inequality and higher returns to market skills. He tests the wage inequality prediction using a cross-section from the 1980 Public Use Micro sample of the U.S. Census that identifies 286 metropolitan areas. While Wheeler does not look directly at measures of wage inequality, he does present evidence that city size significantly increases wages and does so more for more educated workers. This is consistent with his sorting model where larger markets generate more stratified matches, allocating high-skilled workers to

more productive firms. This leaves low-skilled workers in less productive firms and raises wages of skilled workers relative to unskilled workers.

To our knowledge, there are no papers that directly address the *growth* in income inequality in urban vs. rural areas. To the degree that this issue has been addressed it has been addressed in a single cross section. And typically because of the limited geographic detail on public use data files, rural areas are typically not analyzed at all. Our contribution is to describe the evolution of earnings inequality across time and between rural and urban areas. One area of particular interest is Appalachia.

### **III. APPALACHIA AND THE DECENNIAL CENSUS**

We will use the definition of Appalachia employed by the Appalachian Regional Commission (ARC), a federal-state government partnership designed to improve conditions in the Appalachia. The 410-county ARC region covers all of West Virginia and parts of New York, Pennsylvania, Ohio, Maryland, Virginia, the Carolinas, Tennessee, Kentucky, Georgia, Alabama, and Mississippi. In addition to examining the entire region, we will analyze convergence levels and patterns in Appalachia's three subregions: (1) northern Appalachia (from southern New York state through most of West Virginia); (2) central Appalachia (southern West Virginia, eastern Kentucky, and part of Appalachian Virginia and Tennessee); and (3) southern Appalachia (from southwestern Virginia southward).<sup>4</sup>

The data in this report come from the two sources. The first is a summary file on the earnings distribution for men for each county in the U.S. that is derived from the long forms of the U.S. decennial censuses from 1960 through 2000. We begin with the 1960 census because the data in that survey capture the conditions that ultimately led President Johnson to sign the bill forming the ARC. Since 1970, the U.S. Census Bureau has tabulated county-level statistics on

various measures of housing and consumption and made these publicly available in electronic form. Two reasons, however, prevent us from using these files for this particular analysis: 1) the files do not measure the same statistics consistently over time or measure statistics on the wrong population subgroup; and 2) no such public statistics are available for the 1960 data.

As a result, we use a special tabulation prepared for the ARC from the Census Bureau's internal long-form data files from 1960 to 2000. The tabulation reports for each U.S. County the mean earnings as well as the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, and 90<sup>th</sup> percentile of the earnings distribution for men 25-64 (and for women 25-64). Earnings were defined as wage and salary earnings and earnings from farm and business enterprises. The tabulation reports this for all men (and women) and for full-time full year workers. It also reports the fraction of men (and women) working full-time full year and the fraction not in the labor force at any time in the year before the Census ("zero earners"). This tabulation was done on 25 percent of all U.S. households in 1960, 20 percent of households in 1970, and 16.7 percent (one in six) of households in the remaining three census years. The tabulation is cleared for public release through the Census Bureau's Disclosure Review Committee.

Unfortunately, without accessing the confidential long form data directly, no microdata is available that identifies a person's county of residence. The summary data poses a problem for describing the evolution of quantiles of the earnings distribution and for examining the role of education in explaining it. The first issue we deal with statistically as outlined below. The second issue we address in an imperfect form. Using public use micro data from the 1960-2000 Census, we have shown that the aggregate patterns for rural Appalachia are remarkably close to the aggregate patterns for men living in the rural part of two states – Kentucky and West Virginia. All 55 counties of West Virginia are part of Appalachia, but only 51 of the 120 counties in

Kentucky lie within Appalachia. These two States comprise over one-fourth of the counties of Appalachia. While 69 counties in Kentucky lie outside of Appalachia, the rural counties appear to be remarkably similar to the Appalachian counties of Kentucky.

#### IV. METHODS FOR CALCULATING INCOME QUANTILES

With micro data, calculating the quantiles of the earnings distribution for any subregion of the U.S. is straightforward. The challenge we face is that the micro data at our disposal does not have enough geographic detail to identify residents of Appalachia. The best we can do is use the summary data described above but this poses a challenge.

##### *Estimation of Earnings Distributions from Summary Data*

Appalachia (or any other subregion) is a collection of U.S. counties. If we know the mean earnings for men 25-64 and the number of men 25-64 in each county then we can calculate the mean earnings of a collection of counties by calculating a weighted sum of each county's mean earnings. The weights are simply the fraction of men 25-64 for a collection of counties that reside in any specific county  $c$ . Unfortunately, this weighted approach does not apply to other moments of a distribution. For example, the median earnings in Appalachia is not equal to a weighted average of the median earnings of each county in Appalachia.

There is a straightforward way to estimate the income level at a given percentile of earnings in Appalachia. Let  $F_{ct}(i) = \Pr(I \leq i) = P_i$  be the cumulative distribution function (CDF) for county  $c$  in year  $t$ . A specific percentile of the earnings distribution,  $x$ , for that county, is defined as the value of  $i$  such that  $F_{ct}(i) = x$ . For example the 25<sup>th</sup> percentile is defined as the value of  $i$  such that  $F_{ct}(i) = 0.25$ . If this value of  $i$  is denoted  $i_{25}$  then  $i_{25} = F_{ct}^{-1}(0.25)$ . Now for any collection of counties,  $A$ , the CDF is equal to  $F_{At}(i) = \sum_{c \in A} w_{ct} F_{ct}(i)$  where  $w_{ct}$  is the fraction

of the relevant population (men 25-64) in county  $c$  in year  $t$ . Therefore for any collection of counties,  $A$ , the  $x$  percentile of the earnings distribution is  $i_x = F_{A_t}^{-1}(x)$ . This gives a straightforward way of calculating the level of earnings at each percentile of the earnings distribution in Appalachia; first calculate the CDF for Appalachia by calculating a (weighted) average at each  $i$ ; then invert this CDF at specific percentiles of interest.

Unfortunately we do not have the entire CDF for each county in each year. What we do have is the level of earnings at the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> percentile; we also know the fraction of men that are zero earners. That is, for each county and year, we potentially observe 6 points on the CDF but do not observe the CDF at income levels between any known percentiles. We need to know the CDF for each county at all levels of  $i$  in order to calculate the CDF for the collection of counties.

We estimate the CDF for each county for each year using a 5-part spline. We allow the CDF to have a different slope between the intercept (fraction of the population with earnings equal to zero) and the income level at the 10<sup>th</sup> percentile; between the income level at the 10<sup>th</sup> percentile and the income level at the 25<sup>th</sup> percentile, etc. Specifically we model:

$$\log\left(\frac{P_i}{1-P_i}\right) = \begin{cases} \gamma_{ct} + \beta_{0-10} * i & \text{if } i < i_{10} \\ \gamma_{ct} + \beta_{0-10} * i_{10} + \beta_{10-25} * (i - i_{10}) & \text{if } i < i_{25} \\ \vdots \\ \gamma_{ct} + \beta_{0-10} * i_{10} + \beta_{10-25} * (i - i_{10}) + \beta_{25-50} * (i - i_{25}) + \beta_{50-75} * (i - i_{50}) + \beta_{75-90} * (i - i_{75}) & \text{if } i \geq i_{75} \end{cases} \quad (1)$$

Because we have 6 points on the CDF for each county and each year, we solve for the 6

parameters above. Clearly when  $i = 0$ ,  $\gamma_{ct} = \log\left(\frac{P_0}{1-P_0}\right)$  or the log of the fraction of zero

earners over positive earners; when  $i = i_{10}$ ,  $\beta_{0-10} = \left[ \log\left(\frac{P_0}{1-P_0}\right) - \log\left(\frac{0.10}{1-0.10}\right) \right] / i_{10}$ , etc.

This method ensures that the level of income at known the points on the CDF lie by definition on

our estimated CDF; the points in between are interpolated by assuming that between each known percentile, the function follows a logistic form linear in income.

We report the changes in the earnings distribution over time inside and outside of Appalachia in two ways. One way answers the question “What is the earnings at a given percentile for one area relative to another area?” For example, “In 1960, what were the earnings at the 25<sup>th</sup> percentile of the earnings distribution in Appalachia vs. in the remainder of the U.S.?” This statistic is calculated as:

$$D_{x,t}^{A,B} = i_{x,t,A} / i_{x,t,B} \quad (2)$$

where  $A$  and  $B$  are specific areas of comparison and  $x$  is a percentile of interest, in this case  $x=0.25$ . A complementary statistic is the growth rate in a percentile within an area -

$$D_{x,t,t-1}^A = i_{x,t} / i_{x,t-1} \text{ where } t \text{ and } t-1 \text{ are specific years of comparison.}$$

A second way of reporting our results answers a slightly different question – “How much has the fraction of the population below (or above) some specified level of earnings changed over time and has it changed differently across areas?” This statistic is calculated as:

$$P_{A,t,t-1}(i^*) = F_{A,t}(i^*) / F_{A,t-1}(i^*) \quad (3)$$

where  $i^*$  is the level of income of interest.

### ***Micro Data and Estimating Education Distributions and the Return to Education***

The Micro data from the Censuses and ACS provides challenges for researchers because of item nonresponse on the long-form data. Respondents will occasionally not answer questions about their ages, sex, or education levels and will much more frequently not answer questions about their hours worked or, even more frequently, about their wage and salaries earnings. Our

approach is to drop respondents who do not answer question about their sex, age, education, education, or earnings, but then reweight the data to impose the identical distribution of age, sex, and education as observed in the PUMS within that state (or city for the urban analysis). To be precise, we estimate the probability of a nonresponse, or

$$\Pr(NR = 1 | X = x^0) = F(x^0) \quad (4)$$

where  $x$  indexes the age-race-education-location cell, and then we construct weights,  $w_1$ ,

$$w_1(x^0) \equiv \frac{w_0}{1 - F(x^0)} \quad (5)$$

where  $w_0$  are the initial Census weights. Thus, if half the people in cell do not respond to at least one of the earnings, education, sex, or age questions, the responders within the cell have their weights doubled; see Wooldridge (2007). This procedure implicitly assumes that data are, conditional on the age-sex-education-location cell, missing at random.

In addition, there is considerable evidence of substantial measurement error in these data. Focusing on the 1990 Census, Black, Sanders, and Taylor (2003) document that the Census degree questions have much measurement. For instance, they report that among men that report a bachelor's degree in the 1990 Census 91.2 percent of respondents confirm a bachelor's degree in a subsequent report, only 86.1 reconfirm a Master's degree, and only 77.4 percent confirm a professional's degree. Thus, the data are quite noisy.

If we wish to know how people with a bachelors fare relative to high school degree with the same distribution of observables we need only calculate

$$\Delta = \int (E(y_{BA,i} | X) - E(y_{HS,i} | X)) dF_{BA}(X) \quad (6)$$

where  $F_{BA}(X)$  is the distribution of observables (age and location within area) for a given area.

The parameter  $\Delta$  answer the question: "What are the earnings of bachelor's degree holders in the

data compare to the earnings of high school graduates with the same distribution of observables within an area?” It is important to keep in mind that the estimate contains not only the impact of the observables but also the impact of unobservables. Given the paucity of covariates, it seems inconceivable that distribution of the unobservables would be the same across these education levels.

In principle, one could directly estimate equation (6) by calculating the conditional means at each point in the distribution of covariates. We implement a somewhat easier estimator. Consider the conditional probability of being a bachelor’s degree holder ( $BA$ ) given by

$$p(x^0) = \Pr(BA | X = x^0) \quad (7)$$

This probability can be calculated for each point in the data, and then we may define the weights

$$\begin{aligned} w_2(x^0) \equiv w_1(x^0) &\equiv \frac{w_0}{1 - F(x^0)} \quad \text{if worker has a bachelors degree} \\ w_2(x^0) = w_1(x^0) &\frac{p(x^0)}{1 - p(x^0)} = \frac{w_0}{1 - F(x^0)} \frac{p(x^0)}{1 - p(x^0)} \quad \text{if worker has a high school degree} \end{aligned} \quad (8)$$

Thus, high school graduates who have characteristics more like the bachelor’s degree holders in the sample are weighted more highly, and high school graduates who based on their observed characteristics are unlikely to be bachelor’s degree holders are weighted less.

Given the weighting scheme in equation (8), we may now simply run weighted ordinary least squares on the equation

$$y_{k,i} = \alpha + \Delta BA_i + \varepsilon_i \quad (9)$$

and the estimated  $\Delta$  will be identical to the direct estimation of  $\Delta$  from estimating the difference of means at each point in the  $X$  and aggregating over the distribution  $F_{BA}(x)$  as in equation (6).

The intuition for why this procedure provides an estimate of  $\Delta$  is that the reweighting scheme given in equation (8) makes the distribution of covariates in the sample of high school graduates



identical to the distribution of covariates in the sample of bachelor's degree holders. In the matching context, this is often referred to as "inverse probability weighting;" see Hirano, Imbens, and Ridder (2003) and DiNardo, Fortin, and Lemieux (1996) for extended discussions of inverse probability weighting with continuous variables. See Black, Haviland, Sanders, and Taylor (2006, 2008) for applications to discrete data.

## **V. RESULTS**

### ***(a) Mean Income and Year-Round Employment, 1960 to 2000***

*Income.* At first glance, the last 40 years of the 20th century showed little convergence between the average income of working-age men in Appalachia with that of their counterparts in the rest of the country. Appalachian men between ages 25 and 64 earned, on average, 81 percent of the incomes of men outside the region in 2000 (\$37,600 to \$46,600, in 2006 dollars), compared to 80 percent in 1960 (\$28,500 to \$35,500).

But this masks two stories: evidence of convergence between 1960 and 1980 and divergence afterwards (see Figure 1). In 1980, men's mean income in Appalachia was \$35,300, which was 85 percent of the \$41,400 men outside the region earned that year.<sup>5</sup> This convergence coincided with the boom in the coal industry in during the 1960s and 1970s—a boom from which Appalachia (particularly central Appalachia) benefited significantly. Similarly, the post-1980 divergence in men's income coincided with the shift away from Appalachian coal and similar products. (Income for Appalachian men, even when adjusted for inflation, continued to rise in the 1980s and 1990s; the income for men outside the region simply rose even faster during those decades.)

Among the subregions, central Appalachia (especially reliant on the coal industry) followed the above pattern. Between 1960 and 1980, the average income of central Appalachian

men ages 25 to 64 rose from 57 percent to 72 percent of that for non-Appalachian men. By 2000, however, central Appalachian men were earning 58 percent of men outside the Appalachian region—almost their proportion in 1960. In fact, the average income for central Appalachian men (when accounting for inflation) actually *fell* 9 percent between 1980 and 2000.

By contrast, both northern and southern Appalachia took different patterns. Men's incomes in northern Appalachia, which on average were 90 percent those of men outside Appalachia in 1960, stayed at about that level through 1980, then fell to about 80 percent by 2000. Meanwhile, incomes of men in southern Appalachia have converged toward those of men in the non-Appalachian United States throughout the past 40 years—from 70 percent in 1960, to 81 percent in 1980, to 86 percent in 2000.

***Employment.*** Employment patterns among men yield similar evidence of economic convergence between residents of Appalachia and those in the rest of the country. Take, for example, year-round employment—considered a key barometer of how a population's skills matches with community's economic opportunities. In 1960, just 64 percent of men in Appalachia ages 25 to 64 were employed during the entire year, compared to 75 percent for working-age men in the rest of the United States. Just 10 years later, the share of Appalachian men with full-year employment had risen to 76 percent, much closer to the 80 percent share outside Appalachia. During the 1970s and 1980s, year-round employment among men has slipped at similar paces for both regions, although it rebounded slightly during the 1990s. In 2000, 70 percent of Appalachian men and 72 percent of men outside the region had full-time employment.

Each sub-region exhibited the same pattern. Between 1960 and 1970, the full-year employment rate for men rose from 65 percent to 78 percent in northern Appalachia, from 49

percent to 61 percent in central Appalachia, and from 67 percent to 77 percent in southern Appalachia. By 2000—after slight declines in the 1970s and 1980s followed by small rebounds in the 1990s—these shares stood at 70 percent for northern Appalachian men, 56 percent for central Appalachian men, and 73 percent for southern Appalachian men. southern Appalachian working-age men actually were slightly more likely to be employed year-round than men outside Appalachia.

There has been rapid changes in the fraction of men age 25-64 not in the labor force. This labor market drop out among prime aged men has been noted by several studies but the regional pattern has not been well documented. In 1960, outside of Appalachia, 5.3% of men 25-64 were out of the labor force; within Appalachia, 8.3% were out of the labor force and in Central Appalachia 14.7% were out of the labor force. Figure 3 shows the rate of non-employment of Appalachia relative to non-Appalachian counties; In 1960 Appalachia's rate of non-employment was 56% higher than outside Appalachia and Central Appalachia had a rate that was 176% higher than outside Appalachia. By 2000, the fraction of men not in the labor force rose dramatically in all regions; in 2000, 11.9% of men outside of Appalachia and 15.5% of men in Appalachia were out of the labor force; for Central Appalachia this figure exceeded 28%. Because of the rapid rise in non-employment outside of Appalachia, the Appalachian rate of non-employment regressed towards the mean of the U.S.

***(b) The Distribution of Earnings and the Importance of Urban Areas***

Figure 1 displayed the changes in the relative *average* earnings in Appalachia versus outside of Appalachia and in subregions of Appalachia. Except for a notable increase in earnings in Central Appalachia between 1970 and 1980 and an offsetting decline between 1980 and 1990 there was remarkable stability in Appalachia's relative earnings at 80% of the other areas.

Table 1 shows this analysis at different points in the earnings distribution. There are several findings to note. First while mean earnings in Appalachia did not improve between 1960 and 1970, there was substantial improvement in relative earnings at the bottom of the income distribution. As a whole Appalachian earnings at the 25<sup>th</sup> percentile improved from 64% to 77% of other areas. This was driven largely by a rise in earnings in Southern Appalachia and a small improvement in Central Appalachia.

Second, the rapid rise in average earnings in Central Appalachia between 1970 and 1980 driven by the coal boom hardly affected the earnings in the lower part of the earnings distribution at all but it did raise the median, 75<sup>th</sup> percentile and 90<sup>th</sup> percentile of earnings a great deal. The most likely explanation is that coal mining wages are relatively high and hours of work dictate annual earnings to a large degree. In 1970, underemployed miners were likely above the 25<sup>th</sup> percentile of earnings; the boom in 1980 then increased their earnings causing a rise in the higher earnings quantiles.

Third the relative earnings of Appalachians in the 90<sup>th</sup> percentile declined a small amount between 1960 and 2000; as a percentage of earnings at the 90<sup>th</sup> percentile outside of Appalachia, the 90<sup>th</sup> percentile of earnings in Appalachia was 87.0% in 1960, 85% in 1980 and 83.3% in 2000. The rapid rise in the upper tail of the earnings distribution implies real declines in the absolute level of earnings in Appalachia vs. other areas. The most impressive rise within Appalachia at the top of the earnings distribution was in Southern Appalachia.

Figure 4 graphs the relative earnings in Appalachia vs. outside Appalachia at all points in the earnings distribution from the 25<sup>th</sup> percentile to the 98<sup>th</sup> percentile. Moving along any of the plotted lines shows how the relative earnings change across quantiles within a year. The distance between any two lines shows how the relative earnings changed at that quantile across any two

years. In general, each line is inverted “U” shaped showing that the highest relative earnings for Appalachians are in the middle of the earnings distribution. The more interesting issue is the relative change in earnings across years at various points in the earnings distribution. The first interesting pattern is a substantial rise in the bottom of the earnings distribution between 1960 and 1970, prior to the coal boom but during the time of government programs aimed at aiding poor families. While the earnings below the 55<sup>th</sup> percentile improved between 1960 and 1970, relative earnings declined above the 55<sup>th</sup> percentile (dark blue vs. red line). Then between 1970 and 1980 the coal boom had the pronounced effect of raising earnings everywhere in the distribution but by increasing amounts at higher quantiles (red line vs. green line).

As discussed above, there is a large literature on the increase in earnings at the top of the earnings distribution and the decrease at the bottom between in the post-1980 period. These patterns are clear in Table 1. Outside of Appalachia, earnings at the 25<sup>th</sup> percentile fell from \$22,200 in 1980 to \$18,900 in 2000, a decline of \$3,300 or 15%; at the same time earnings in the 90<sup>th</sup> percentile rose from \$85,900 in 1980 to \$106,000 in 2000, an increase of \$20,100 or 25%. In Appalachia, the bottom end of the distribution (25<sup>th</sup> percentile) declined more (from \$16,900 in 1980 to \$13,200 in 2000 or 22%) while the top end (90<sup>th</sup> percentile) of the earnings distribution rose from \$73,700 to \$88,300 or 20%).

One difference between Appalachia and the remainder of the U.S. is the fraction of the population that is rural. Of the 410 counties in Appalachia, all but 37 had less than 100,000 residents in 1960. Outside of Appalachia there are some very large cities. While the largest city in Appalachia in 1960 was Pittsburgh (population 604,332 and population rank 16), New York had almost 8 million residents, Chicago 3.5 million residents and Los Angeles, 2.5 million residents. In 1960, 66% of residents of Appalachia lived in counties with less than 100,000

residents. By contrast, 41% of people outside of Appalachia lived in counties with fewer than 100,000 residents.

In order to investigate the role of urban density in changes in the earnings distribution we focus our attention on Rural Appalachia, Rural counties outside of Appalachia and Urban counties outside of Appalachia. This includes 373 (out of 410) counties comprising Rural Appalachia, 2,391 rural counties outside of Appalachia and 273 urban counties outside of Appalachia. We define an urban county as a county with more than 100,000 residents in 1960. Again to give some context, the four counties with closest to 100,000 residents in 1960 are Tazwell Co., IL (city of Perkins), York Co. ME, (towns of York, Lebanon and Kennebunkport), Rockingham Co., NH (towns of Derry, Salem, Londonderry and Portsmouth) and Kenosha, WI (city of Kenosha). Figure 5 plots the relative earnings of urban non-Appalachia and rural Appalachia relative to rural areas outside of Appalachia. While there are some differences, the earnings of rural residents of Appalachia appear to be nearly a constant fraction of the residents of other rural areas of the U.S. varying between 75% and 90% over the earnings distribution. The coal boom between 1960 and 1980 clearly raised the earnings of the lower end of the earnings distribution relative to other rural areas in the U.S. but this reversed by 2000.

The big story is the relative earnings in rural areas vs. urban areas. In 1960, low earning urban residents earned substantially more than low earning rural residents; the 25<sup>th</sup> percentile of earnings of urban residents was 80% higher than rural residents in 1960. As you moved up the earnings distribution, the relative earnings between rural and urban residents converged; in 1960, at the 90<sup>th</sup> percentile, urban residents earned 20% more than rural residents. By 1980, the relative earnings of rural residents increased substantially at the bottom end of the distribution. Much of this was driven by increasing labor market drop-out in cities as well as relatively lower earnings

among workers. In 1980, regardless of the point in the earnings distribution, urban residents earned about 20% more than rural residents. Between 1980 and 2000 a clear pattern developed; the relative earnings of rural residents at the bottom of the earnings distribution continued to rise while the relative earnings of rural residents at the top of the earnings fell. Put another way, there was more bifurcation of the earnings distribution in urban areas than rural areas.

Figures 6 through 8 show the spatial distribution of earnings inequality for 1980 to 2000. Figure 5 shows the counties that comprise Northern, Central and Southern Appalachia and shows all of the counties with more than 100,000 residents in 1960. Figure 6 the location of Appalachia and the location of the 237 urban counties. The 40 largest cities in the U.S. are also labeled. Figure 7 shows the growth in the 90<sup>th</sup> percentile of the earnings distribution by county. What is clear is that the 90<sup>th</sup> percentile of the earnings distribution is rising much faster in urban than rural areas. County level rises in the 90<sup>th</sup> percentile are pronounced on both coasts, running from the greater Boston area down through New York, Philadelphia, Washington D.C., Charlotte and down to greater Atlanta. On the west coast the entire area between San Diego and San Francisco experienced a large rise in the 90<sup>th</sup> percentile of the earnings distribution. Other large cities including Phoenix, Portland, Seattle, Denver, Dallas, Milwaukee, Chicago and Detroit all had a rapid rise in the 90<sup>th</sup> percentile of the earnings distribution. In many rural areas, the 90<sup>th</sup> percentile of the earnings distribution actually fell between 1980 and 2000 including most of the middle of the U.S. as well as Northern and Central Appalachia. The one area of Appalachia that did experience a rise in the 90<sup>th</sup> percentile of the earnings distribution was the counties surrounding the Charlotte, NC and Atlanta, GA areas.

In general, the bottom of the earnings distribution fell more in urban than rural areas but the pattern is somewhat complicated. Figure 8 shows the growth (decline) in earnings at the 25<sup>th</sup>

percentile for each county. While it is clear that many cities lead the decline in earnings, for example Detroit, Cleveland, Chicago and Milwaukee, other growing cities had large increases in the 25<sup>th</sup> percentile of earnings. Many rural areas of the Midwest had the largest increases in the 25<sup>th</sup> percentile of earnings. The case of Appalachia is also complicated. Central Appalachia had declines in the 25<sup>th</sup> percentile as did Northern Appalachia; southern Appalachia, especially the counties surrounding Atlanta, GA and Charlotte, NC were among the places with the fastest growth in the bottom end of the earnings distribution. Overall, the 25<sup>th</sup> percentile of earnings for rural Appalachia changed in a way that was remarkably similar to rural areas in the U.S. as a whole.

The bifurcation of the earnings distribution since 1980 has received a great deal of attention. The results above suggest that this bifurcation was more pronounced in cities than in rural areas. But the statistics above could occur for a second reason. Since the upper quantiles of the earnings distribution were higher in cities in 1980, if earnings increases rose with their level then the upper tail of the earnings distribution would rise more in urban areas than rural areas. Because the 90<sup>th</sup> percentile of earnings is lower in rural areas, it is likely that skills of men in the 90<sup>th</sup> percentile are also lower in rural areas and if SBTC is important we would expect more skilled men to benefit more. We examine the level of education at various quantiles of the earnings distribution below but before we look at skill directly we examine the following question – “How has the fraction of men above (and below) a cut-off level of income changed in urban and rural areas?” That is “How has the CDF of earnings changed over time for urban and rural areas?” Figure 9 and Table 2 addresses this question. In Figure 9 we look at the CDFs for urban and rural areas outside of Appalachia. In Figure 9, the vertical lines mark the 25<sup>th</sup> (\$24,500) and 90<sup>th</sup> (\$91,500) percentile of the earnings distribution for men in urban areas in



1980. Focusing on the top of the earnings distribution, it is clear that the fraction of men earning above \$91,500 increases significantly more in urban areas than in rural areas. Table 2 shows that between 1980 and 2000 outside of Appalachia, there was a 35.7% increase in men earning above \$91,500 in rural areas; in urban areas this increase was 68.1%. Looking at the bottom of the distribution in Figure 9 it is clear that the fraction of men earning below \$24,500 rises faster in urban areas than in urban areas. Table 2 shows that the fraction of the rural population earning less than \$24,500 increased by only 4.3% between 1980 and 2000; in urban areas this increase was 13.8%.

Figure 10 compares the CDFs of rural areas inside and outside of Appalachia for 1980-2000. Figure 10 shows that rural areas inside and outside of Appalachia have remarkably similar earnings distributions and changes in distribution. Even though the CDF for rural areas outside of Appalachia stochastically dominates the CDF for Appalachia for 1980 and 2000 they display remarkably similar changes in distribution. Table 2 shows that Appalachian rural areas and rural areas outside of Appalachia had remarkably similar increases in the fraction of men earning less than \$24,500 (4.3% and 4.5%). Similarly the fraction of men earning more than \$91,500 increased 31.5% in rural Appalachia and 35.7% in rural areas outside of Appalachia.

Figure 11 plots the CDFs for rural and urban areas outside of Appalachia for 1960 and 1980. While it appears that both areas experience a substantial rise in the fraction of men at the top of the earnings distribution, urban and rural areas had very different patterns at the bottom of the earnings distribution. While urban areas show an *increasing* number of men at the bottom of the earnings distribution, rural areas show a *decreasing* number. Table 9 shows that while the fraction of men earning less than \$24,500 increased from 22% to 25% in cities (a 13.6% increase) it decreased from 40% to 29.8% in rural areas (a 25.5% decrease). Figure 12 and Table

9 show that rural Appalachia and rural areas outside Appalachia had extremely similar decreases in the fraction of men in the bottom part of the earnings distribution between 1960 and 1980.

*(c) The Level of Education and its Return*

Table 3 shows the level of education in rural Appalachia, in other rural areas of the U.S. and in urban areas outside of Appalachia at various quantiles of the earnings distribution. Table 3B shows the growth between 1980 and 2000 in the fraction of the population with a given level of education in rural Appalachia relative urban areas. A primary reason for differential changes in the earnings distribution at a quantile might be because of differential changes in the skill composition of the population.

What is clear is that in 1980, residents of rural Appalachia had lower levels of education at every point in the earnings distribution. At the 25<sup>th</sup> percentile, 86% of men in rural Appalachia had a high school degree or less. In other rural areas this was 77% and in urban areas 61%. What is also clear is that in Appalachia in 1980 it was possible to be at the top of the earnings distribution without a college degree. The fraction of men at the 90<sup>th</sup> percentile that had a college degree in Appalachia was 19%; in urban areas more than 50% of men in the 90<sup>th</sup> percentile of earnings had a college degree. Some of this difference in the distribution of education across areas stems from urban areas having higher earnings at any percentile of its distribution. Table 4 presents the distribution of education for men who earned approximately \$25,000 annually, approximately \$50,000 annually and approximately \$100,000 annually. There are still large differences in the education distribution between Appalachia and other areas even among men with identical earnings. For example, among men earning around \$100,000 annually in Appalachia in 1980, 33% had a college degree (almost identical to other rural areas); in urban areas, 55% of men earning around \$100,000 had a college degree. Among men in rural

Appalachia earning around \$25,000 annually, 83% had a high school degree or less (similar to other rural areas); in urban areas 61% had a high school degree or less.

Table 3 also shows how the education distribution changed over time by quantiles of the earnings distribution and Table 3B focuses specifically on the period between 1980 and 2000. Looking at Table 3B, it is clear that educational attainment rose in rural Appalachia relative to urban areas in the U.S. at the bottom of the earnings distribution. There was a precipitous decrease in the fraction of men who were high school dropouts (a decline of 26 percentage points) and a strong gain in the fraction who were high school graduates (an increase of 14.3 percentage points). Of course there was also a drop in the fraction of men who were high school dropouts in urban areas and a small increase in the fraction who were high school graduates. On net, the fraction of men who were high school dropouts at the 25<sup>th</sup> percentile fell 11.9 percentage points faster in rural Appalachia than in urban areas and the fraction who were high school graduates rose 12.4 percentage points faster. There were smaller relative changes in the fraction of the population who had some college or were college graduates but the most important trend was a great deal of upskilling among the least educated. Since high school graduates earn considerably more than high school dropouts (20% more in 1980 and 29%-38% more in 2000) this shift in relative education is no doubt a primary reason that the low end of the earnings distribution declined less in Appalachia and other rural areas relative to urban areas.

The story at the upper end of the earnings distribution is more complicated. What is remarkable is the fraction of men in 1980 in Appalachia in the 90<sup>th</sup> percentile of the earnings distribution who had very low levels of education. Over time, men in Appalachia at the top of the earnings distribution were more likely to be college graduates. For example, the fraction that were college graduates increased by 9.9 percentage points between 1980 and 2000 (see Table

3B). But at the same time, the fraction of men who were college graduates at the 90<sup>th</sup> percentile of the urban earnings distribution increased even faster (16.2 percentage points). Overall, at the 90<sup>th</sup> percentile, Appalachia had relatively fewer high school dropouts and relatively fewer college graduates at the top of the earnings distribution.

Another way to characterize the education distribution is to ask what the education distribution looks like at specific levels of earnings. Table 4 and Table 4B displays the education distribution for rural Appalachia, other rural areas and urban areas for 1980, 1990, 2000, and 2007 for men earning around \$25,000, \$50,000 and \$100,000. This corresponds to approximately the 25<sup>th</sup> percentile, 65<sup>th</sup> percentile and the 92<sup>th</sup> percentile of the urban men's earnings distribution in 1980. By examining the educational distribution and fixed earnings levels we eliminate the differences between areas in education distributions that are associated with the same percentile having different levels of earnings in different areas. For example, in Table 3 we compared the distribution of earnings in the 90<sup>th</sup> percentile of the rural Appalachia and urban non-Appalachia distributions but the 90<sup>th</sup> percentile in 1980 of the rural Appalachia earnings distribution was approximately \$70,000 while it was approximately \$91,000 in urban areas. Table 4 and 4B shows a clearer picture about the rise in education levels. At all three levels of earnings examined there is a rise in the relative level of education for rural Appalachian men. At \$25,000 and \$50,000, rural Appalachian men reduce their prevalence of being high school dropouts and increase their prevalence of being high school graduates relative to urban men without much change in the relative fraction of men who have some college or are college graduates. At \$100,000, rural Appalachian men reduce their prevalence of being high school dropouts and high school graduates and increase their prevalence of being college graduates relative to urban men.

The rise in relative education levels at the bottom of the earnings distribution may help explain why the bottom of the earnings distribution fell faster in urban areas than rural areas. However, it still leaves two puzzles. First, if education was rising (for both urban areas and for rural Appalachia) why was the bottom of the earnings distribution falling? Second, if the level of human capital at the upper end of the distribution was not rising substantially more in urban than in rural Appalachian areas, why was the upper tail of the earnings distribution rising faster in urban areas. Table 5 shows earnings of male high school dropouts, men with some college, men with associate's degrees, men with bachelor's degrees men with master's degrees and men with professional degrees relative to high school graduates. Table 5 shows that the earnings deficit for not completing high school has increased substantially in all areas but particularly in Appalachia. Had it not been for the substantial increase in the quantity of education, especially the rapid reduction in the fraction of men who were high school dropouts it is likely that the bottom of the earnings distribution in rural Appalachia would have fallen relative to urban areas? Table 5 also shows that the return to college education has also been rising rapidly, doubling between 1980 and 2007. And there is also evidence that rural areas in general did not experience the rapid rise in the returns to college education that urban areas did. One notable pattern however is that Appalachian rural counties did experience a precipitous rise in the return to college education that is similar to the returns for urban areas. But even without a differential rise in the return to college education, the much higher levels of college education in urban areas at the upper end of the earnings distribution meant that the general rise in the return to education raised the upper tail of the earnings distribution in urban areas more than in rural areas.

## **VI. Discussion**

The basic results in this paper show that working-age men in Appalachia still lag behind the rest of the United States in terms of income and employment—and that on average the relative income differences are only slightly better in 2000 than they were in 1960. This result however covers up substantial sub-region trends and substantial changes in earnings at some points in the earnings distribution. Northern Appalachia, an area that was had average male earnings at 90% of male earnings outside of Appalachia in 1960 has had average earnings fall substantially, especially since 1980. Southern Appalachia, on the other hand has had a substantial improvement in average earnings. Much of this appears to be driven by the fate of the largest cities that either comprise or influence these areas. The demise of Pittsburgh, PA, and Morgantown and Wheeling, WV in the north and the growth of Atlanta, GA and Charlotte, NC appear to have a heavy influence on these patterns. Central Appalachia had a period of relative prosperity in the 1980s but average earnings now are approximately what they were in 1960 relative to the remainder of the U.S.

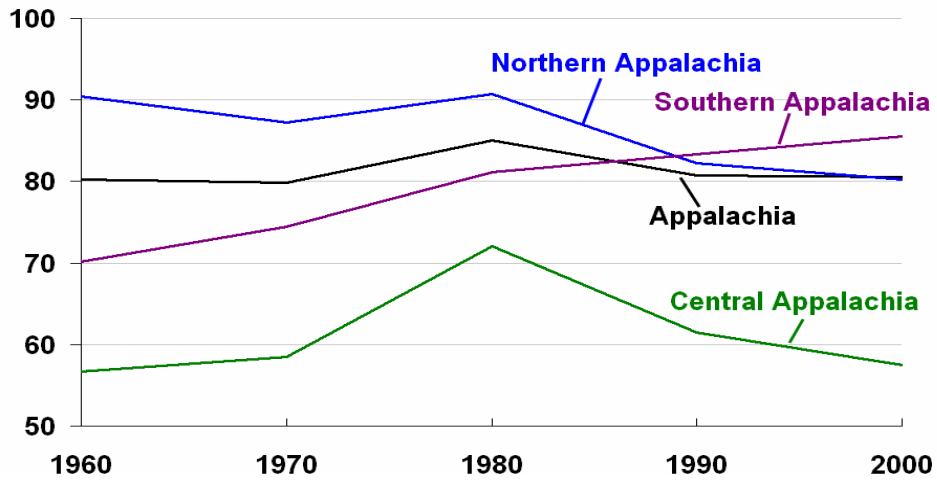
Averages do mask substantial relative progress at the bottom of the earnings distribution for some areas. Rural Appalachia, like other rural areas of the U.S. has experienced relative growth at the bottom of the income distribution. This “growth” should be kept in perspective however. There was real earnings growth between 1960 and 1980 in rural Appalachia as there was in other rural areas, a pattern not true in urban areas. But between 1980 and 2000, earnings in urban areas at the bottom of the income distribution fell dramatically where as in rural areas it fell only slightly. This is the sense in which there has been relative progress at the bottom of the earnings distribution.

One interesting finding is on changes at the upper end of the earnings distribution. While all areas of the U.S. experienced substantial growth in the fraction of high earners (say more than

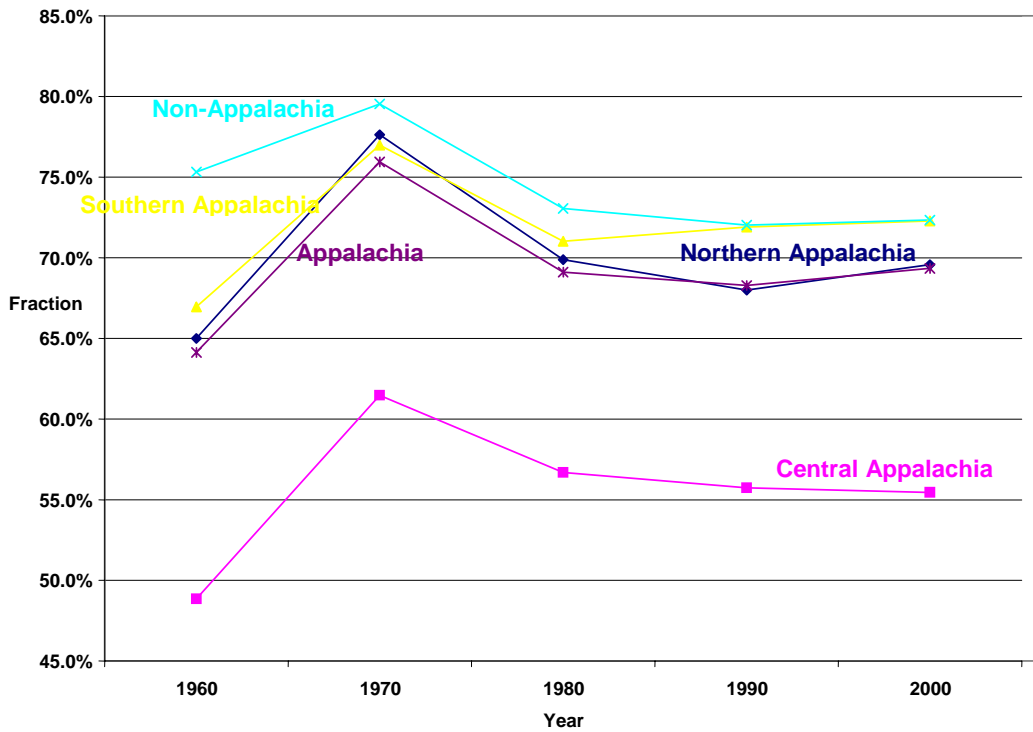
\$91,500) between 1960 and 2000, the growth in this fraction was nearly double in cities as it was in rural counties between 1980 and 2000. We show that skill levels in cities were higher at various percentiles of the earnings distribution and at important levels of income. For example, in rural Appalachia in 1980, 64% of men earning in the 90<sup>th</sup> percentile of Appalachian earnings had a high school degree or less; in urban areas in 1980 only 31% of men earning in the 90<sup>th</sup> percentile of urban earnings had a high school degree or less. Some of this no doubt stems from the 90<sup>th</sup> percentile of earnings being higher in urban areas than in rural Appalachia. But in 1980, among men who earned \$100,000, 52% of rural Appalachian men had a high school degree or less while 27% of urban men had a high school degree or less. Clearly, education was more important historically in cities for achieving high earnings than it was in rural areas.

We also find ample evidence of a rising return to education as has been found elsewhere in the literature. While we find that the return to a high school degree and a college degree in 1980 are similar between urban and rural areas, there is clear evidence that the return to a college has risen more in rural than urban areas (although the return in Appalachia has risen in a way that is similar to urban areas). The combination of urban areas having higher levels of education and a more rapid rise in the return to education likely explains much of the relative rise in earnings at the top of the earnings distribution in cities. Changes in the bottom of the earnings distribution are reflect a rise in the penalty for being a high school dropout combined with a shrinking number of high school dropouts. Because the fraction of high school drop outs at the bottom of the earnings distribution fell faster in rural Appalachia than in cities, there was generally a smaller fall in earnings at the bottom of the distribution there.

**Figure 1:**  
**Mean Income of Appalachian Men Ages 25-64, as Percentage of Income of Men Ages 25-64 in the Non-Appalachian United States**



**Figure 2:**  
**Fraction of Men Employed Full-time Full Year, 1960-2000**





**Figure 3:**  
**Fraction Not in Labor Force as a Fraction Not in the Labor Force, Non-Appalachian United, States, Men 25-64**

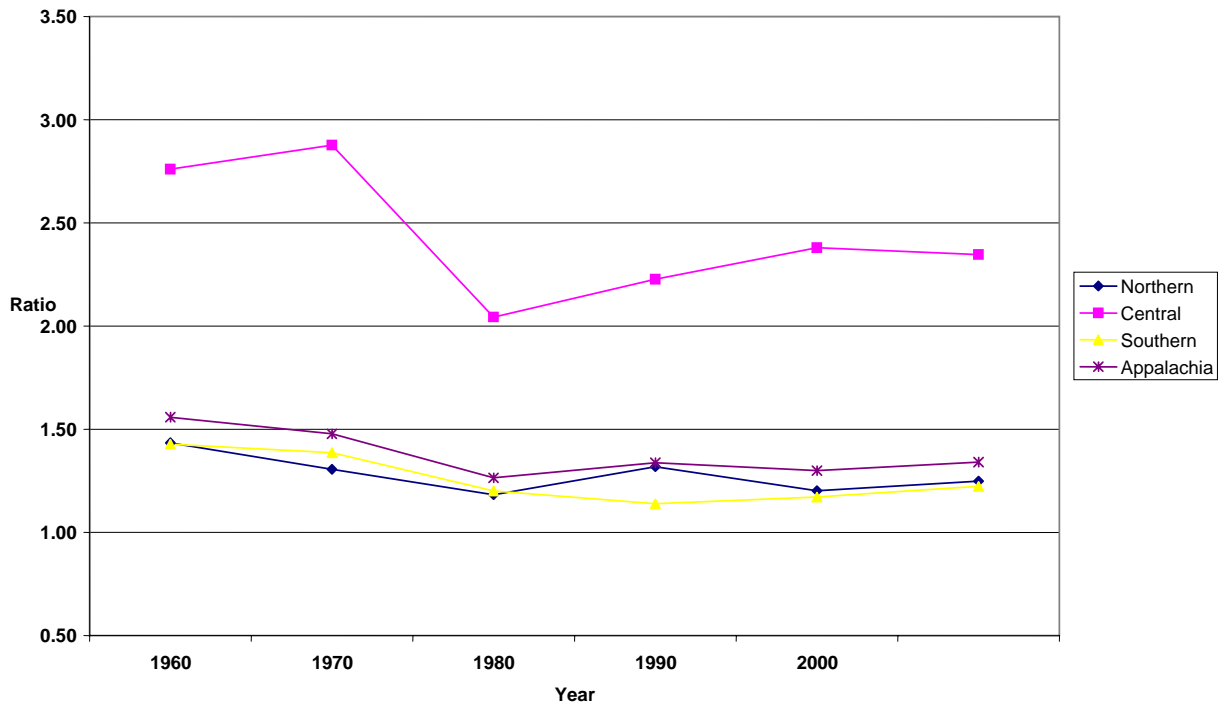


Figure 4:  
Earnings of Appalachia Relative to Non-Appalachia,  
Men 25-64

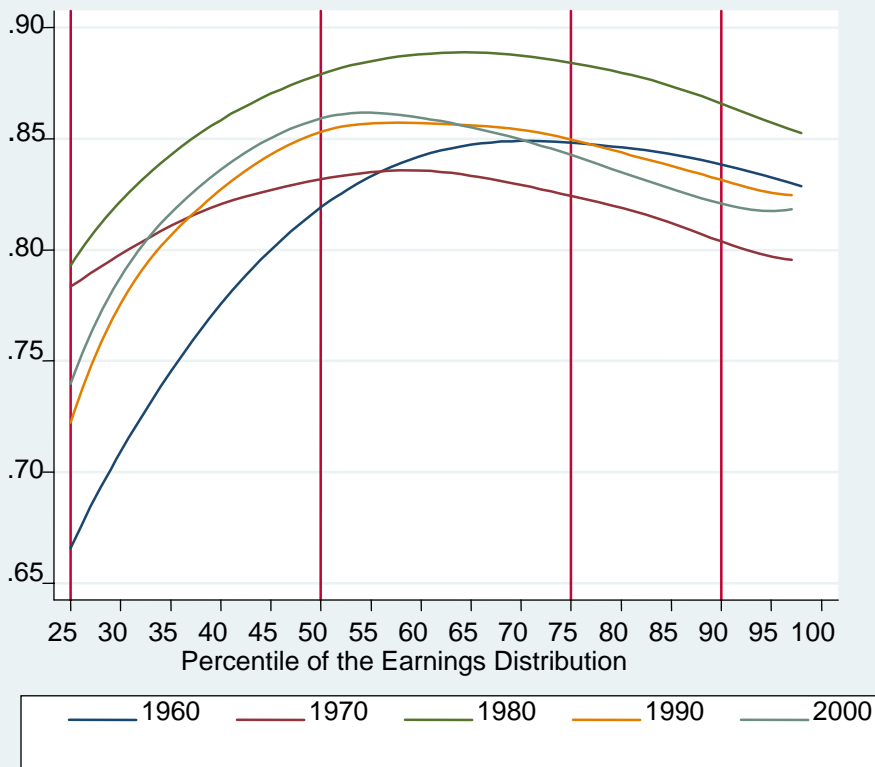
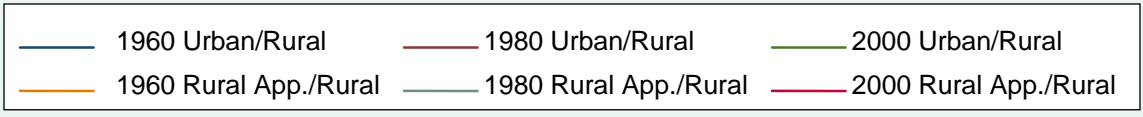
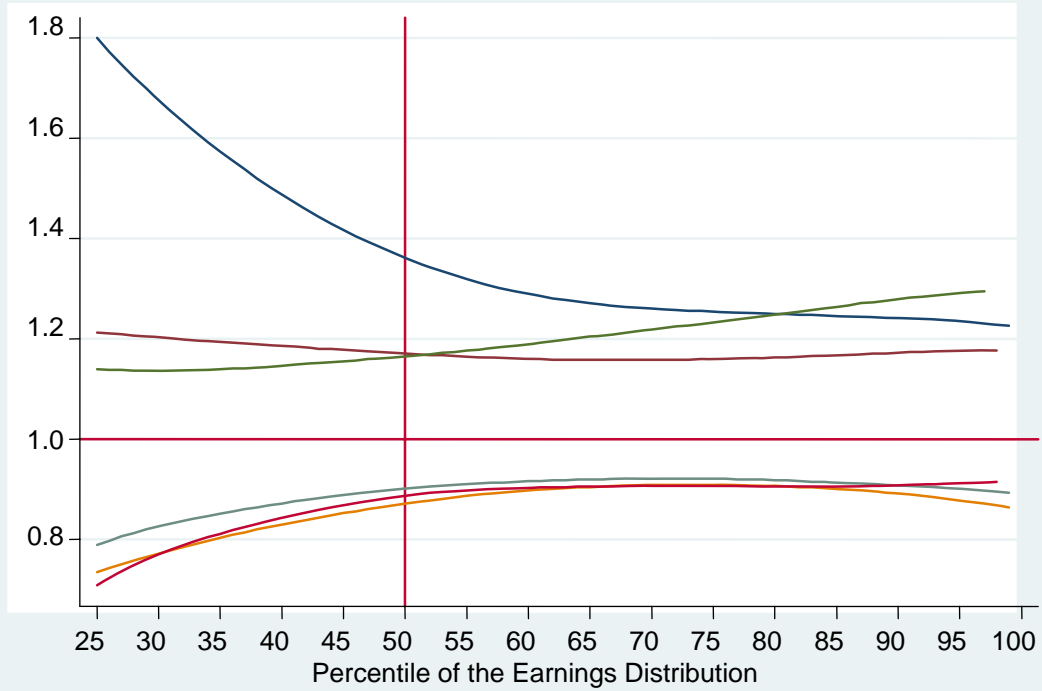


Figure 5:  
Earnings of Rural Appalachia and Urban Non-Appalachia  
Relative to Rural Non-Appalachia, Men 25-64



*Figure 6:*  
 Counties with Population over 100,000 in 1960 and Appalachia

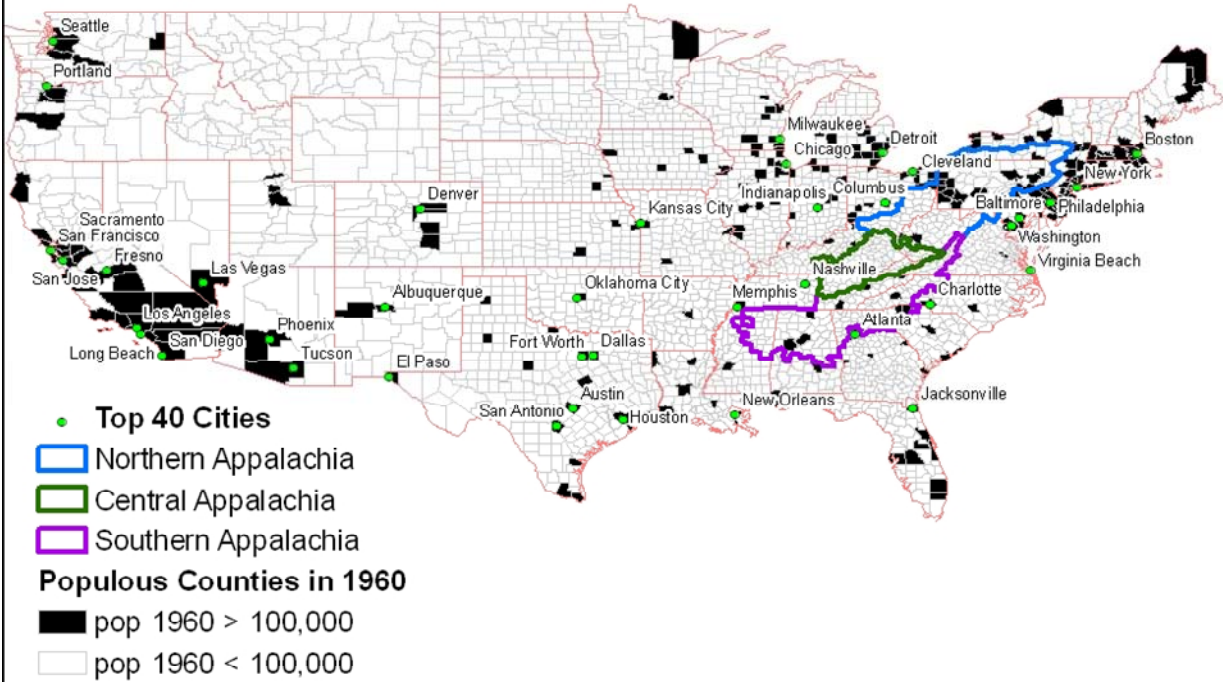
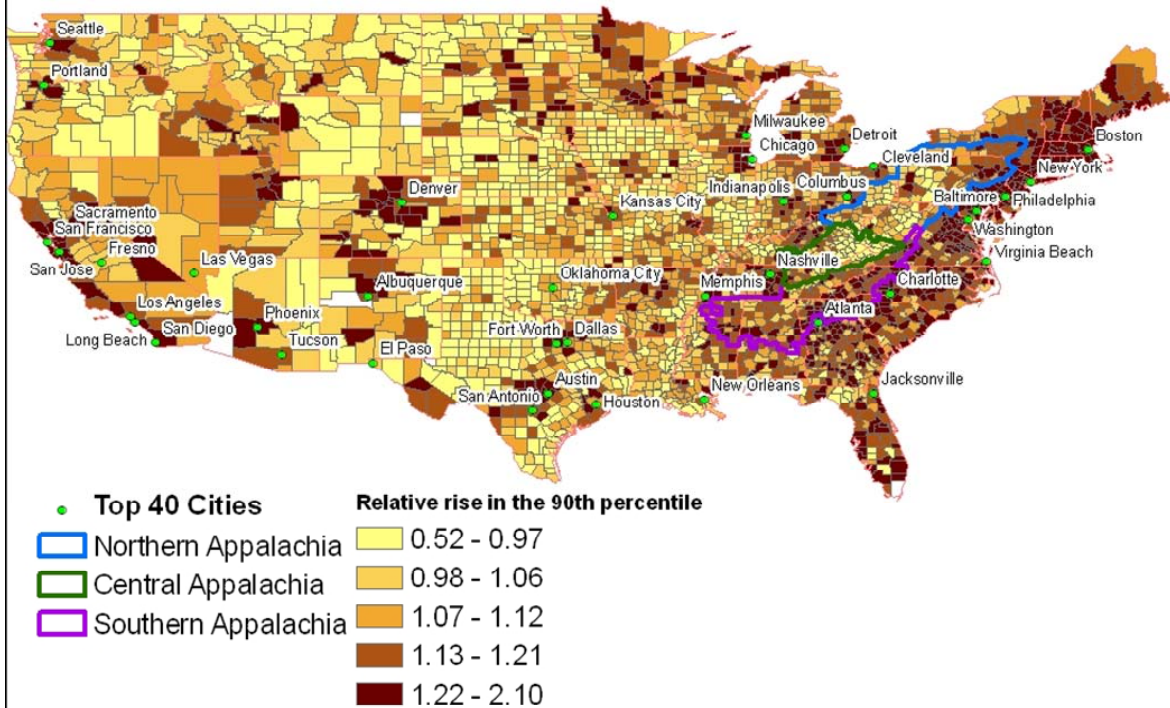


Figure 7:

Growth in the 90th Percentile of the Earnings Distribution: 1980 to 2000



Growth in Earnings at the 25th Percentile of the Earnings Distribution:  
1980 to 2000

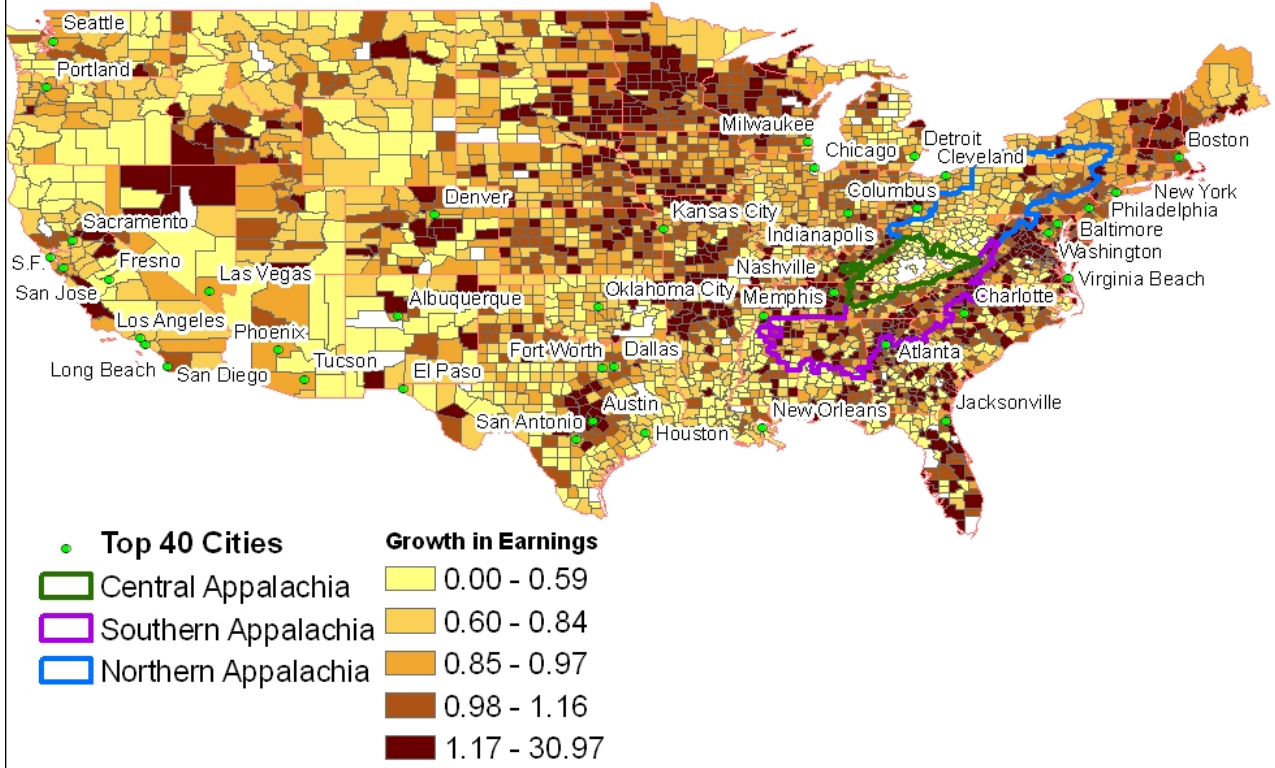
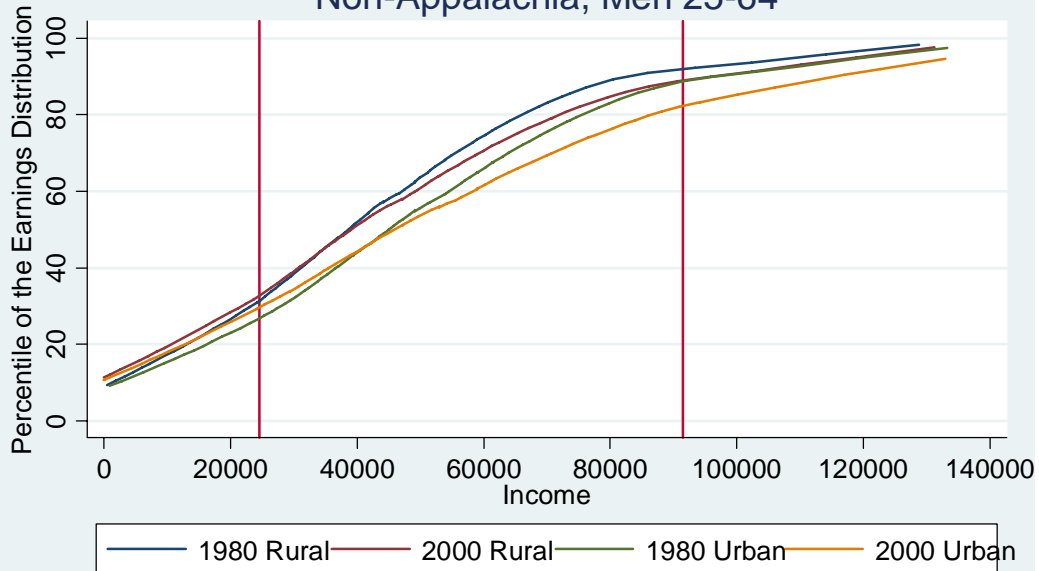
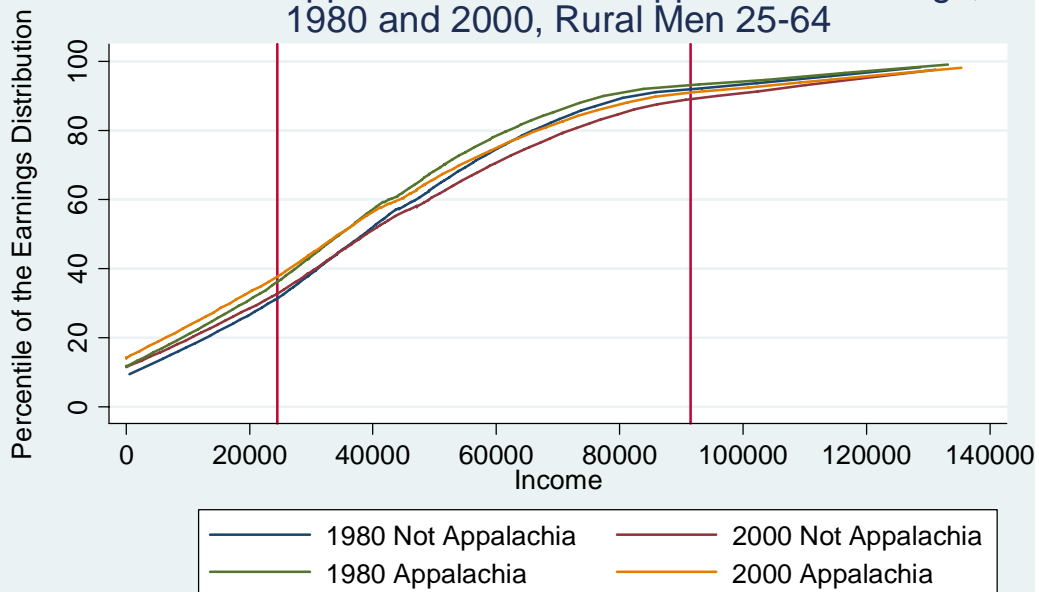


Figure 9:  
CDFs of Urban and Rural Earnings, 1980 and 2000  
Non-Appalachia, Men 25-64



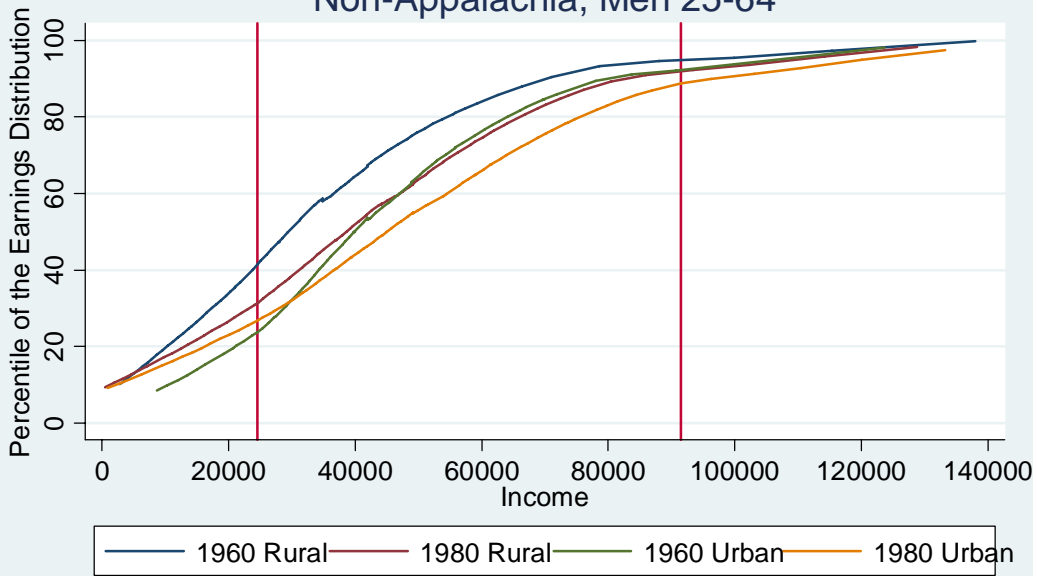
Note: Vertical lines are 25th and 90th percentile for Urban Men in 1980

Figure 10:  
CDFs of Appalachia and Non-Appalachia Earnings,  
1980 and 2000, Rural Men 25-64



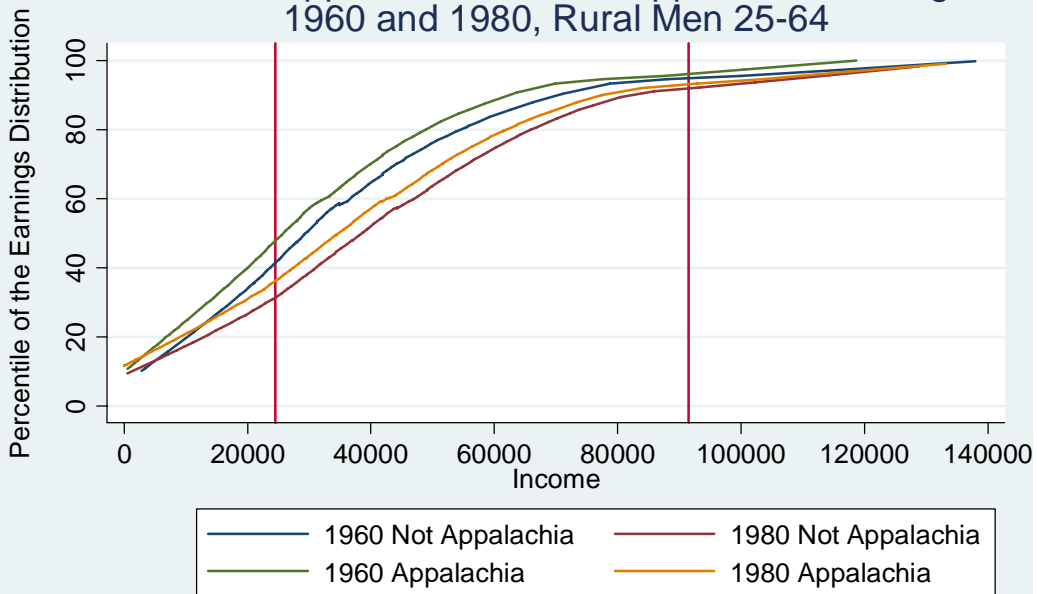
Note: Vertical lines are 25th and 90th percentile for Urban Men in 1980

Figure 11:  
 CDFs of Urban and Rural Earnings, 1960 and 1980  
 Non-Appalachia, Men 25-64



Note: Vertical lines are 25th and 90th percentile for Urban Men in 1980

Figure 12:  
 CDFs of Appalachia and Non-Appalachia Earnings,  
 1960 and 1980, Rural Men 25-64



Note: Vertical lines are 25th and 90th percentile for Urban Men in 1980



**Table 1:  
Earnings and Earnings relative to Non-Appalachia, Men 25-64  
Appalachia and Subregions**

Year	Earnings (2006 \$s)		Relative Earnings Appalachia/Non-Appalachia	Earnings (2006 \$s)			Relative Earnings		
	Non-Appalachia	Appalachia		Northern Appalachia	Central Appalachia	Southern Appalachia	Northern Appalachia	Central Appalachia	Southern Appalachia
<i>10th Percentile</i>									
1960	\$5,600	\$1,400	25.0%	\$3,100	\$0	\$1,300	55.4%	0.0%	23.2%
1970	\$8,800	\$2,300	26.1%	\$5,700	\$0	\$2,800	64.8%	0.0%	31.8%
1980	\$700	\$0	0.0%	\$0	\$0	\$0	0.0%	0.0%	0.0%
1990	\$0	\$0	.	\$0	\$0	\$0	.	.	.
2000	\$0	\$0	.	\$0	\$0	\$0	.	.	.
<i>25th Percentile</i>									
1960	\$22,100	\$14,100	63.8%	\$21,000	\$4,300	\$10,900	95.0%	19.5%	49.3%
1970	\$31,000	\$23,700	76.5%	\$30,000	\$7,500	\$21,000	96.8%	24.2%	67.7%
1980	\$22,200	\$16,900	76.1%	\$20,000	\$5,600	\$15,800	90.1%	25.2%	71.2%
1990	\$20,100	\$13,900	69.2%	\$14,600	\$2,300	\$16,600	72.6%	11.4%	82.6%
2000	\$18,900	\$13,200	69.8%	\$14,200	\$0	\$16,100	75.1%	0.0%	85.2%
<i>Median</i>									
1960	\$36,500	\$30,900	84.7%	\$34,900	\$18,100	\$25,400	95.6%	49.6%	69.6%
1970	\$47,900	\$39,900	83.3%	\$42,600	\$28,000	\$35,900	88.9%	58.5%	74.9%
1980	\$42,700	\$37,200	87.1%	\$41,100	\$29,600	\$34,400	96.3%	69.3%	80.6%
1990	\$42,300	\$36,000	85.1%	\$37,200	\$25,500	\$36,200	87.9%	60.3%	85.6%
2000	\$42,100	\$35,600	84.6%	\$36,500	\$25,300	\$37,700	86.7%	60.1%	89.5%
<i>75th Percentile</i>									
1960	\$50,300	\$42,700	84.9%	\$47,000	\$35,300	\$39,900	93.4%	70.2%	79.3%
1970	\$63,800	\$53,200	83.4%	\$58,000	\$45,900	\$53,200	90.9%	71.9%	83.4%
1980	\$61,400	\$54,300	88.4%	\$56,500	\$50,600	\$51,600	92.0%	82.4%	84.0%
1990	\$65,100	\$56,300	86.5%	\$57,800	\$47,500	\$56,100	88.8%	73.0%	86.2%
2000	\$67,700	\$58,300	86.1%	\$58,900	\$47,200	\$58,900	87.0%	69.7%	87.0%
<i>90th Percentile</i>									
1960	\$69,800	\$60,700	87.0%	\$65,500	\$49,600	\$55,800	93.8%	71.1%	79.9%
1970	\$93,000	\$74,400	80.0%	\$79,700	\$63,200	\$74,400	85.7%	68.0%	80.0%
1980	\$85,900	\$73,700	85.8%	\$75,600	\$69,800	\$73,700	88.0%	81.3%	85.8%
1990	\$96,600	\$80,700	83.5%	\$80,300	\$70,300	\$84,400	83.1%	72.8%	87.4%
2000	\$106,000	\$88,300	83.3%	\$84,900	\$75,400	\$92,800	80.1%	71.1%	87.5%

**Table 2:  
 Fraction Earning below \$24,500 and Fraction Earning above \$91,500 by Appalachia  
 and Urban Status, Men 25-64**

	Fraction Earning < \$24,500	Fraction Earning > \$91,500
<b>Urban Non-Appalachia</b>		
<b>1960</b>	0.220	0.069
<b>1980</b>	<b>0.250</b>	<b>0.100</b>
<b>2000</b>	0.285	0.168
<b>% Change 1960-1980</b>	13.6%	44.6%
<b>% Change 1980-2000</b>	13.8%	68.1%
<b>Rural Non-Appalachia</b>		
<b>1960</b>	0.400	0.047
<b>1980</b>	0.298	0.073
<b>2000</b>	0.311	0.098
<b>% Change 1960-1980</b>	-25.5%	55.5%
<b>% Change 1980-2000</b>	4.3%	35.7%
<b>Urban Appalachia</b>		
<b>1960</b>	0.290	0.044
<b>1980</b>	0.274	0.075
<b>2000</b>	0.304	0.115
<b>% Change 1960-1980</b>	-5.4%	69.4%
<b>% Change 1980-2000</b>	10.8%	54.4%
<b>Rural Appalachia</b>		
<b>1960</b>	0.463	0.037
<b>1980</b>	0.339	0.062
<b>2000</b>	0.354	0.081
<b>% Change 1960-1980</b>	-26.9%	66.7%
<b>% Change 1980-2000</b>	4.5%	31.5%

**Table 3:  
Educational Distribution at Various Quantiles  
Rural KY and WV, All Rural US, Urban US**

<b>Panel A: Rural Kentucky and West Virginia</b>				
<b>25<sup>th</sup> percentile</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	57.14	40.05	31.14	23.31
High school	28.59	38.53	42.91	45.13
Some college	7.03	14.13	17.16	20.27
Bachelor's degree or more	7.25	7.29	8.79	11.28
<b>50<sup>th</sup> percentile</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	32.84	24.27	15.69	8.63
High school	41.48	44.88	52.33	58.84
Some college	11.83	20.22	21.76	22.31
Bachelor's degree or more	13.85	10.63	10.23	10.23
<b>75<sup>th</sup> percentile</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	27.58	13.22	7.33	6.83
High school	45.54	45.20	46.31	41.25
Some college	13.40	24.15	28.16	29.95
Bachelor's degree or more	13.47	17.43	18.19	21.98
<b>90<sup>th</sup> percentile</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	24.07	11.18	4.49	3.97
High school	39.79	36.42	36.52	35.52
Some college	16.34	27.49	29.35	29.82
Bachelor's degree or more	19.80	24.91	29.65	30.68
<b>Panel B: Rural USA</b>				
<b>25<sup>th</sup> percentile</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	39.55	24.02	18.92	15.09
High school	37.59	44.66	45.12	46.68
Some college	13.48	22.04	25.00	26.27
Bachelor's degree or more	9.38	9.28	10.96	11.96
<b>50<sup>th</sup> percentile</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	25.57	15.25	10.21	8.12
High school	42.84	45.65	46.47	46.69
Some college	15.34	26.21	30.05	31.16
Bachelor's degree or more	16.25	12.89	13.27	14.02
<b>75<sup>th</sup> percentile</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	19.46	8.54	5.58	5.05
High school	44.22	38.89	37.41	35.65
Some college	16.98	29.06	33.57	34.20
Bachelor's degree or more	19.35	23.51	23.43	25.10
<b>90<sup>th</sup> percentile</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	15.03	5.41	3.22	2.89
High school	39.35	28.88	28.49	25.99
Some college	17.24	28.62	31.79	31.04
Bachelor's degree or more	28.37	37.09	36.50	40.08

<b>Panel C: Urban USA</b>				
<b>25<sup>th</sup> percentile</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	24.21	13.43	10.10	8.54
High school	36.87	38.99	38.83	39.36
Some college	19.54	31.34	32.49	31.24
Bachelor's degree or more	19.39	16.24	18.58	20.86
<b>50<sup>th</sup> percentile</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	17.99	8.14	4.68	3.74
High school	38.77	34.48	32.58	33.82
Some college	20.79	32.81	35.35	33.80
Bachelor's degree or more	22.44	24.57	27.38	28.64
<b>75<sup>th</sup> percentile</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	12.19	3.90	2.15	1.45
High school	34.51	23.15	21.05	17.79
Some college	21.16	31.40	32.62	29.78
Bachelor's degree or more	32.15	41.55	44.17	50.98
<b>90<sup>th</sup> percentile</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	7.24	1.99	1.05	0.86
High school	23.40	12.20	9.99	7.68
Some college	18.55	24.41	21.90	17.70
Bachelor's degree or more	50.82	61.41	67.06	73.75

Notes: Sample is white, non-Hispanic, men 25 to 64, inclusive. Earnings percentiles are based on wage and salary, farm, and self-employment data. Data are weighted to reflect both sampling and the IPW reweighting for missing data.

**Table 3B:  
Educational Distribution at Various Quantiles  
Rural KY and WV, All Rural US, Urban US**

	<b>1980-2000 Rural Appalachia</b>	<b>1980-2000 Urban Non- Appalachia</b>	<b>D-in-D</b>
<b>25<sup>th</sup> percentile</b>			
Less than high School	-0.260	-0.141	-0.119
High school	0.143	0.020	0.124
Some college	0.101	0.130	-0.028
Bachelor's degree or more	0.015	-0.008	0.024
<b>50<sup>th</sup> percentile</b>			
Less than high School	-0.172	-0.133	-0.038
High school	0.109	-0.062	0.170
Some college	0.099	0.146	-0.046
Bachelor's degree or more	-0.036	0.049	-0.086
<b>75<sup>th</sup> percentile</b>			
Less than high School	-0.203	-0.100	-0.102
High school	0.008	-0.135	0.142
Some college	0.148	0.115	0.033
Bachelor's degree or more	0.047	0.120	-0.073
<b>90<sup>th</sup> percentile</b>			
Less than high School	-0.196	-0.062	-0.134
High school	-0.033	-0.134	0.101
Some college	0.130	0.034	0.097
Bachelor's degree or more	0.099	0.162	-0.064

**Table 4:  
Educational Distribution at Various Income Levels  
Rural KY and WV, All Rural US, Urban US**

**Panel A: Rural Kentucky and West Virginia**

<b>\$20,000 to \$30,000</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	47.91	25.66	17.78	11.14
High school	34.95	48.25	51.72	56.08
Some college	9.79	18.11	21.47	24.24
Bachelor's degree or more	7.35	7.98	9.02	8.53
<b>\$45,000 to \$55,000</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	29.84	13.43	7.60	5.78
High school	43.82	46.39	45.26	40.68
Some college	13.31	23.04	27.99	30.43
Bachelor's degree or more	13.03	17.13	19.15	23.11
<b>\$95,000 to \$105,000</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	19.81	8.00	5.21	0.47
High school	32.37	23.88	22.08	13.53
Some college	15.17	25.39	25.49	22.52
Bachelor's degree or more	32.65	42.73	47.23	63.48

**Panel B: Rural USA**

<b>\$20,000 to \$30,000</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	50.44	34.89	26.60	25.26
High school	35.02	45.16	48.98	49.03
Some college	8.52	14.14	17.67	20.38
Bachelor's degree or more	6.02	5.80	6.75	5.34
<b>\$45,000 to \$55,000</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	29.62	19.10	13.80	7.11
High school	42.74	47.60	50.11	58.97
Some college	12.16	20.59	24.28	22.35
Bachelor's degree or more	15.48	12.71	11.80	11.57
<b>\$95,000 to \$105,000</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	12.19	3.90	2.15	1.45
High school	34.51	23.15	21.05	17.79
Some college	21.16	31.40	32.62	29.78
Bachelor's degree or more	32.15	41.55	44.17	50.98

<b>Panel C: Urban USA</b>				
<b>\$20,000 to \$30,000</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	25.47	13.90	10.12	8.31
High school	36.61	38.82	38.91	39.99
Some college	19.75	30.90	32.51	31.69
Bachelor's degree or more	18.16	16.38	18.46	20.01
<b>\$45,000 to \$55,000</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	17.90	7.56	4.15	3.46
High school	38.90	33.25	31.19	30.99
Some college	20.47	33.02	35.61	33.82
Bachelor's degree or more	22.74	26.17	29.05	31.73
<b>\$95,000 to \$105,000</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Less than high School	6.46	2.03	1.17	0.75
High school	20.97	12.45	12.18	11.30
Some college	17.73	24.83	24.26	21.53
Bachelor's degree or more	54.84	60.68	62.39	66.42

Notes: Sample is white, non-Hispanic, men 25 to 64, inclusive. Earnings percentiles are based on wage and salary, farm, and self-employment data. Data are weighted to reflect both sampling and the IPW reweighting for missing data.

**Table 4B:**  
**Educational Distribution at Various Income Levels**  
**Rural KY and WV, All Rural US, Urban US**

	<b>1980-2000 Rural Appalachia</b>	<b>1980-2000 Urban Non- Appalachia</b>	<b>D-in-D</b>
<b>\$20,000 to \$30,000</b>			
Less than high School	-0.301	-0.154	-0.148
High school	0.168	0.023	0.145
Some college	0.117	0.128	-0.011
Bachelor's degree or more	0.017	0.003	0.014
<b>\$45,000 to \$55,000</b>			
Less than high School	-0.222	-0.138	-0.085
High school	0.014	-0.077	0.092
Some college	0.147	0.151	-0.005
Bachelor's degree or more	0.061	0.063	-0.002
<b>\$95,000 to \$105,000</b>			
Less than high School	-0.146	-0.053	-0.093
High school	-0.103	-0.088	-0.015
Some college	0.103	0.065	0.038
Bachelor's degree or more	0.146	0.076	0.070



**Table 5:**

**Relative Return to Education Levels Relative to High School Graduates  
Rural KY and WV, All Rural US, Urban US**

**Panel A: Rural Kentucky and West Virginia**

	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Return to 10 <sup>th</sup> grade	-0.193	-0.316	-0.383	-0.489
Return to some college	---	0.205	0.236	0.253
Return to associates degree	---	0.253	0.325	0.342
Return to bachelor's degree	0.352	0.597	0.825	0.897
Return to master's degree	---	0.445	0.802	0.964
Return to professional degree	---	2.182	3.110	3.130

**Panel B: Rural USA**

	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Return to 10 <sup>th</sup> grade	-0.197	-0.259	-0.289	-0.346
Return to some college	---	0.133	0.177	0.169
Return to associates degree	---	0.179	0.240	0.262
Return to bachelor's degree	0.365	0.516	0.644	0.685
Return to master's degree	---	0.540	0.773	0.863
Return to professional degree	---	1.895	2.649	2.680

**Panel C: Urban USA**

	<b>1980</b>	<b>1990</b>	<b>2000</b>	<b>2007</b>
Return to 10 <sup>th</sup> grade	-0.191	-0.249	-0.294	-0.337
Return to some college	---	0.185	0.238	0.249
Return to associates degree	---	0.211	0.277	0.301
Return to bachelor's degree	0.428	0.627	0.876	1.018
Return to master's degree	---	0.738	1.131	1.345
Return to professional degree	---	1.859	2.587	3.055

Notes: Sample is white, non-Hispanic, men 25 to 64, inclusive. Earnings percentiles are based on wage and salary, farm, and self-employment data. Data are weighted to reflect both sampling and the IPW reweighting.

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## NOTES

<sup>1</sup> Lawrence E. Wood and Gregory A. Bischak, “Progress and Challenges in Reducing Economic Distress in Appalachia: An Analysis of National and Regional Trends Since 1960” (Washington, D.C.: Appalachian Regional Commission, 2000): 15, table 3. Appalachia’s income figure is in 1960 dollars.

<sup>2</sup> These figures are in 2000 dollars.

<sup>3</sup> Dan A. Black and Seth G. Sanders, “Labor Market Performance and Income Inequality in Appalachia,” *Demographic and Socioeconomic Change in Appalachia* (Washington, D.C.: Population Reference Bureau and Appalachian Regional Commission, 2004): 33, table 5.

<sup>4</sup> For a more detailed description of the Appalachian region, see Kelvin M. Pollard, “Appalachia at the Millennium: An Overview of Results from Census 2000,” *Demographic and Socioeconomic Change in Appalachia* (Washington, D.C.: Population Reference Bureau and Appalachian Regional Commission, 2003): 2.

<sup>5</sup> These figures are in 2006 dollars.