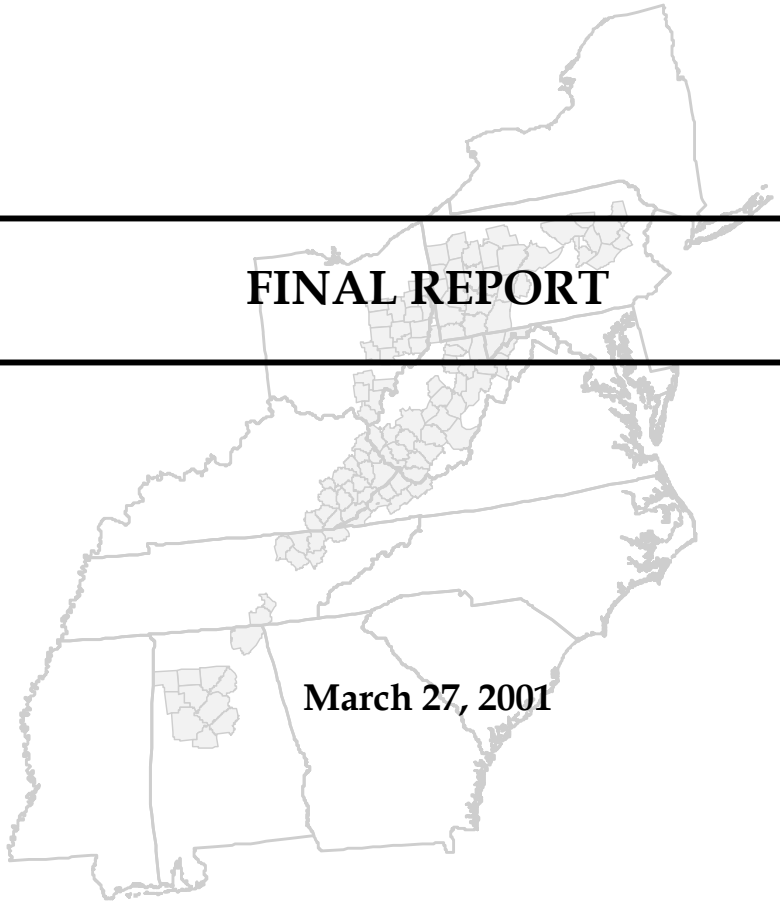
A Study on the Current Economic Impacts of the Appalachian Coal Industry and its Future in the Region



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Executive Summary

Few topics are capturing national attention more today than energy. The urgency of the issue in 2001 is nearly as great as it was in the mid-1970's and early 1980's, and the awareness of its importance is likely to endure. Of the energy-supplying sectors in the United States, coal is surely the most volatile. Even though its contribution to energy supply has declined in recent years, it remains the only abundant domestically produced energy resource and represents the primary fuel used by a large segment of industry. In Appalchia, coal mining is a vital part of the economy. Because of this importance, the region's economy and its residents remain vulnerable to changes in the industry's fortunes. In some counties, coal mining represents such a significant part of the economy that even small changes in demand and output often have a dramatic impact on the well-being of the residents. In recent years, improvements in mining productivity, competition from Western U.S. coal, coal imports from abroad, and environmental legislation all have contributed to substantial job losses in Appalachia. They have also reduced local business opportunities and have generally undermined social well-being in the region.

This report examines the current significance of the coal industry within Appalachia, and its prospects for the future. It was conducted by the University of Kentucky Center for Business and Economic Research (CBER) under contract with the Appalachian Regional Commission. The report identifies the areas within Appalachia where the coal industry is currently most active, and the local and regional economies where the industry has the largest impact on the overall economy. The report also addresses the expected future for the industry within Appalachia. How is the impact of the industry expected to change in the next decade? How would that change in impact vary under alternative macroeconomic scenarios for the economy, or under alternative environmental regulations? Which areas within Appalachia would be most affected by expected future changes in the coal mining industry?

The study examines 1997 data from 118 major coal-producing counties within Appalachia. Coal production and price data are from the Department of Energy's Energy Information Administration while employment and earnings data are from the Department of Commerce. The year 1997 was used as the "current" year due to lags in the data. The study also reports results for the industry within three regional groups: Northern Appalachia (PA, OH, MD, and Northern WV); Central Appalachia (KY, VA, and Southern WV); and Southern Appalachia (AL and TN). Forecast scenarios are based on the Energy Information Administration publications *Annual Energy Outlook 1999*, and *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*. The forecast scenarios used in the report about the Kyoto Protocol include a baseline scenario as well as six scenarios where greenhouse gas emissions are a certain percentage of their 1999 levels. These include 24%, 14%, and 9% above the 1990 levels,

as well as 3% and 7% below the 1990 levels. The final scenario is one of stabilization at the 1990 level of emissions.

The following are the main findings of the study:

- Coal mining employment is concentrated in the region composed of the intersection of Kentucky, Virginia, and West Virginia. Additionally there is a small pocket of high employment in Alabama as well as several counties in Pennsylvania. Coal mining earnings in the ARC region follow a similar pattern with the highest concentration of earnings from coal mining occurring in the region of the intersection of Kentucky, Virginia and West Virginia. In 1997, Kentucky had five counties with coal mining earnings of more than $50 million, including Harlan, Knott, Leslie, Perry, and Pike; Virginia had two counties, including Buchanan and Wise/Norton; and West Virginia had eight counties, including Boone, Kanawha, Logan, Mingo, Raleigh, and Wyoming in the southwestern part of the state and Marion and Marshall in the northern part of the state.

- The coal mining industry currently is a large share of the economy, measured in terms of the percentage of coal mining gross county product to total gross county product, in selected counties throughout the region, and in many counties in Central Appalachia. These counties include Knott County (54.0%) and Pike County (34.3%), Kentucky, Boone County (71.9%) and Mingo County (51.9%), West Virginia, and Buchanan County (39.4%), Virginia.

- The total economic impact of the coal mining industry was $18.4 billion in output in 1997 in the 118 Appalachian coal-producing counties while the direct impact was approximately $12.4 billion. The total earnings impact was $6.2 billion per year, while the direct impact was approximately $4 billion. The total employment impact was 135,000, while the direct impact was 60,000 jobs. The total annual impact on severance, income, and sales tax revenue was $559.5 million. The total impact of the coal mining industry accounted for 4.4% of 1997 employment and 5.1% of 1997 worker earnings in these 118 counties overall, but accounted for 29.9% of employment and 27.6% of earnings in the Central Appalachia region.

    - Regionally, the total economic impact accounted for 3.1% of employment, 3.4% of earnings, and 2.7% of value-added in the Northern Appalachian Region. In the Central Appalachian region, the total impact accounted for 29.9% of employment, 27.6% of earnings, and 29.8% of value-added. Finally, in the Southern

Appalachian region, the total impact accounted for 2.7% of employment, 3% of earnings, and 3.2% of value-added.

- The study found that even under moderate baseline conditions for future growth in the economy, the impact of the coal mining industry can be expected to drop in the next decade, particularly with respect to employment and earnings. Coal industry earnings and employment are expected to drop by 25% to 30%. The tax impact of the coal mining industry, including coal severance taxes, income and payroll taxes, and retail sales taxes, is expected to decline by 20%.

    - Regionally, the expected decline in tax revenue is largest in the Southern Appalachian region (33.9%). Declines in the other regions are 16.6% in the Northern Appalachian region and 20.4% in the Central Appalachian region

    - Population, under the baseline scenario, is expected to decline the most in the Central region (1.34%). Declines of 0.21% and 0.12% are forecast for the Northern and Southern regions, respectively.

- The relative size of the drop will be large in selected counties throughout the region, but many of these counties are located in Central Appalachia. The total economic impact of the coal mining industry will decline by the equivalent of 6.5% of regional employment and 6.1% of earnings in Central Appalachia under the baseline scenario. At the same time, transfer payments, including AFDC, SSI, Food Stamps, Unemployment Insurance, OASDI, and medical transfers (Medicare and Medicaid), for "income maintenance" programs would be expected to rise by between 5% and 15% in Central Appalachia under the baseline scenario.

    - Increases in transfer payments are generally expected to be the largest in the Central Appalachian region with approximately 5% increases in TANF and SSI payments and an approximate 11% increase in Food Stamps payments. Increases are also forecast to be significant for UI payments (15.78%) and medical transfer payments (2.49%).

    - Increases in transfer payments are substantially less in the Northern and Southern regions where TANF and SSI payments are forecast to increase less than 1%. Food Stamps payments in these two regions are forecast to grow slightly more than 1.5%. Forecasts for growth in UI payments and Medical Transfer payments are substantially smaller than the forecasted growth for the Central

region. UI payments are forecast to grow around 2% and Medical Transfer payments less than 0.5%.

- The forecast decline in the economic impact of the coal mining industry varies little between the baseline forecasts and four alternative macroeconomic scenarios. In the macroeconomic scenarios, the same regional pattern also is evident, with the largest percent losses in earnings and employment occurring in Central Appalachia, where the economy is most dependent on the coal mining industry. The loss of earnings in Appalachia overall is less than 1% in all macroeconomic scenarios, and the percent losses are roughly 0.5% in both Northern and Southern Appalachia. The following provides details behind the basic assumptions of some of the macroeconomic scenarios:

    - The baseline case reflects considerable optimism about the potential for worldwide supply. Production from countries outside OPEC is expected to show a steady increase, reaching almost 47 million barrels per day by the year 2000 and increasing gradually thereafter to more than 55 million barrels per day by 2010. The total U.S. gross oil imports increase from 10.2 million barrels per day in 1997 to 14.1 million in 2010.

    - The high economic growth rate scenario includes higher growth rates for population, labor force, and labor productivity resulting in higher industrial output, lower inflation and lower interest rates. As a result, GDP increases at an average rate of 2.6 percent a year from 1997 to 2020, compared with a growth rate of 2.1 percent a year in the reference case. Total energy consumption in the high economic growth case is 129.4 quadrillion Btu in 2020, compared with 119.9 quadrillion Btu in the reference case.

    - The low economic growth case assumes lower growth rates for population, labor force, and productivity; resulting in higher prices, higher interest rates, and lower industrial output growth. In the low growth case, economic output increases by 1.5 percent per year from 1997 through 2020, and growth in GDP per capita slows to 0.9 percent per year. With lower economic growth, energy consumption in 2020 is reduced from 119.9 quadrillion Btu to 110.5 quadrillion Btu, and carbon emissions are 1,826 million metric tons, or 8 percent, lower than in the baseline case.

- The decline in the economic impact may vary a great deal under the new Kyoto protocol environmental initiative to reduce the emission of

greenhouse gasses including carbon dioxide (CO_2), nitrous oxide (N_2O), methane, sulfur hexaflouride, perfluorocarbons, and hydrofluorocarbons. The percentage losses can be much higher than the baseline in several of the Kyoto scenarios

- The Kyoto Protocol scenarios include scenarios of 24%, 14%, and 9% above the 1990 level of emissions, as well as 3% and 7% below the 1990 level of emissions. The final scenario is one of stabilization at the 1990 level of emissions. The scenarios reflect alternative assumptions about the level of emissions reduction that will be required. The exact impact of implementing the Kyoto Protocol on emissions reduction is unknown. Implementing the protocol could require emissions to fall to or below 1990 levels in the United States, but smaller reductions may be possible if emissions trading or other innovative approaches are allowed. Although, larger emissions reductions may be required even in this case. The decline in the coal mine industry, and its economic impact, could be between two and three times greater if emissions must be reduced severely. However, none of these scenarios consider the possible mitigating effects of compensatory workforce and community adjustment programs on the employment and income repercussions associated with these scenarios.

    - Percent losses are much higher in the more restrictive Kyoto emissions reduction scenarios. The percent loss of earnings in the coal mining industry is near or above 2% in the Kyoto scenarios where emissions return to 1990 levels, or lower, while the employment loss is above 1%. In these same scenarios, the percentage losses are most substantial in Central Appalachia where industry losses account for near or above 8% of regional earnings and 5.5% to 6.1% of regional employment. The industry losses in these more restrictive emission scenarios also rise rapidly for Northern Appalachia, but never rise above 1.5% of earnings or 0.8% of employment.

    - Percent losses are less severe under the less restrictive Kyoto emissions reduction scenarios, particularly in Northern and Southern Appalachia. However, in Central Appalachia, the loss of earnings in the industry accounts for 6.0% of regional earnmings even under the scenario where emissions are able to rise to 14% above 1990 levels. Earnings and job losses are only somewhat higher than those of the baseline forecast in the scenario where emissions are able to rise 24% above 1990 levels.

Overall, the findings suggest that the coal mining industry remains a significant part of the Appalachian economy, and is a major part of the economy in selected counties and even whole regions within Appalachia. Significant losses in the industry have the potential to yield great changes to both the employment picture and aggregate socioeconomic indicators in those areas where the industry is most important. This said, however, it should be remembered that under all of these forecast scenarios, the reductions in employment, earnings, tax revenues, and population that are discussed, along with the increases in transfer payments, are forecast changes due to the coal mine industry alone, with other factors held equal. Once again, it should be noted that no special workforce or community economic adjustment programs are examined to determine how they might alter the estimated employment, income or transfer payment impacts. In addition, external factors, such as the growth in existing non-mining industries and the introduction of new ones, do change, which could have a substantial impact on the fortunes of these regions a decade from now.

Introduction

The coal mining industry has long been a vital part of the economy of Appalachia. Many residents of the Appalachian region are employed in the coal mining industry or are employed in other industries that depend upon coal mining for their business. In some major coal-producing counties within Appalachia, the overall employment in coal mining and related businesses is large enough to account for a significant share of the total local employment and earnings. Coal industry activity also can make a significant contribution to the tax base of some Appalachian states, and can significantly influence the rate of population growth and poverty in coal-producing regions. Taken together, this suggests that the coal mining industry can have a large and widespread impact on the economy in coal-producing regions, particularly in areas where coal mining is the main industry.

Many Appalachian residents benefit directly or indirectly from the significant coal mining industry in the region. The importance of the industry in the region, however, makes the region and its residents vulnerable to any changes in the industry that reduce local employment or business opportunities. Indeed, in recent years the industry has suffered some declines in employment as production technologies have changed and as demand for some types of Appalachian coal has decreased. Such changes should continue into the future, leading to additional reductions in earnings and employment opportunities in the industry within the region. In addition, there are new environmental regulations proposed for implementation over the next decade which could dramatically affect the coal mining industry, and therefore, the economies of many counties in the Appalachian region.

All of this suggests the need for a detailed accounting of the significance of the coal industry within Appalachia, and its prospects for the future. Such an assessment should examine where the industry is currently most active within the Appalachian region, and in which local and regional economies the industry has the largest impact on the overall economy. The assessment also should examine the expected future for the industry within Appalachia. How is the impact of the industry expected to change in the next decade? How would that impact change under alternative macroeconomic scenarios for the economy, or under alternative environmental regulations? Which areas within Appalachia would be most affected by expected future changes in the coal mining industry?

This study is a comprehensive economic impact analysis of the coal mining industry in the Appalachian region of the United States. The study examines both the existing impact of the coal mining industry within the Appalachian region, and the expected future impact of the industry in the year 2010 under a number of alternative scenarios for industry change over the next decade. The study was conducted by the

University of Kentucky Center for Business and Economic Research (CBER) under contract with the Appalachian Regional Commission.

The study begins with an analysis of the current economic impact of the coal mining industry in the coal-producing counties of Appalachia. Given lags in the release of industry data, data from the year 1997 is used to described the "current" situation in the coal mining inudstry. In Section 1 of the report, we provide estimates of the coal industry's share of total output, employment, and worker income as a part of each county's overall economy. These estimates are used to generate indirect and induced economic impacts for various groups of counties. Indirect effects can best be described as those changes in inter-industry purchases in response to the new demands of the industries that are directly affected. Induced effects are effects that reflect the changes in household spending as income or popluation changes due to changes in production. These effects, also called "multiplier" effects, are combined with direct industry output, employment, and worker earnings to estimate both the total impact of the coal mining industry to the counties under study and its importance to other industries in the region as they are affected by activity in the coal mining industry. Moreover, we estimate potential tax revenue impacts that are attributable to the coal mining industry, including coal severance taxes, personal income taxes, and sales tax revenue. Changes in the coal mining industry can also dramatically affect other economic indicators such as participation in social welfare and disability programs and population growth. We provide a current description of these indicators in the coal-producing counties.

Each aspect of the above analysis is provided for a list of 118 major Appalachian coal-producing counties. That list was developed based on a list of Appalachian Counties with coal production in the year 1997, but amended to exclude counties where production was being phased out and to include counties with significant production in earlier years but unmeasured production in 1997 due to exceptional reasons. Total or average results for all 118 counties also are presented, as are results in three regional groupings within Appalachia: Northern Appalachia, Central Appalachia, and Southern Appalachia.

Section 2 of the report examines forecasts for the coal mining industry in the year 2010. Coal industry change is examined for the 1997 to 2010 period for a number of measures of industry activity and economic impact. These measures mirror the types of information that was gathered in Section 1 of the report. The direct change in industry output, price, employment, earnings and value-added from 1997 to 2010 is examined, along with the change in the total impact of the industry over time on each of the 118 counties, the counties in total, and in each of the three regional groupings. The report also examines how changes in industry activity over time are expected to change the impact of the industry on tax revenue in the region and on population growth and participation in social welfare programs.

Change is examined under a baseline forecast for the economy as well as under 10 alternative forecasts. This report utilizes Energy Information Administration forecasts for coal mining production, price, labor productivity, and wages for baseline and alternative scenarios. Forecast information is utilized to calculate information on the industry's economic impact in the year 2010, using the same approach as in Section 1 of the report.

The baseline forecast reflects changes in the industry resulting from expected changes in demand growth for coal, industry labor productivity, and existing environmental regulations. Two sets of alternative economic forecasts are examined. The first set includes four alternative forecasts under alternative assumptions about the macroeconomic conditions in the economy through the year 2010. These alternative assumptions include a high economic growth and low economic growth assumption for the national and world economies as well as a high world oil price and low world oil price assumption. These alternative forecast scenarios are the same as those in the U.S. Department of Energy Energy Information Admininstration's (EIA) *Annual Energy Outlook 1999*.

The second set of alternative forecasts reflect alternative scenarios related to the Kyoto environmental protocol to reduce greenhouse gas emissions. The scenarios reflect alternative assumptions about the level of emissions reduction that will be required. Reductions may require emissions to fall to or below 1990 levels in the United States, but smaller reductions may be possible if emmisions trading or other innovative approaches are allowed. Although, larger emissions reductions may be required even in this case. The forecast for the Appalachian coal industry through 2010 is examined under 6 alternative emission scenarios, ranging from a requirement that emissions drop to 7 percent below 1990 levels by around 2010 to a requirement that emissions may average 24 percent above 1990 levels. These 6 alternative scenarios are the same as those examined in the EIA publication *The Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*. No workforce or community economic adjustment programs are examined to determine how these might alter the estimated employment, income or transfer payment impacts of the six scenarios.

All analyses contain comparisons between the baseline forecast and each of the 10 alternative forecasts. The result is a detailed forecast of the changing impact of the coal mining industry in the coal-producing regions of Appalachia under the baseline scenario, alternative macroeconomic conditions, and under alternative implementation rules for the Kyoto environmental protocol.

Section 1: Economic Impact Analysis — The Current Role and Status of the Coal Industry in the Region's Economy

Coal mining has always been an integral part of the Appalachian region and its economy. For many years, the coal industry has provided high-paying jobs to thousands of miners and other workers and has indirectly supported jobs at other businesses that are needed to supply the coal mining industry. Indeed, the coal mining industry represents a significant, and many times, majority, share of the economy for many counties in the Appalachian region. Moreover, the coal industry provides substantial tax revenue for many states in the form of coal severance taxes and indirectly through income taxes and sales taxes. In addition, because the coal mining industry represents such a significant share of the economy for many Appalachian counties, changes in the industry can drastically change many economic conditions in the county. For these reasons, it is important to analyze the economic impact of the coal mining industry on the Appalachian region.

Section 1 of this project provides a comprehensive economic impact analysis of the current conditions of the coal mining industry in 118 major coal-producing counties in Appalachia. These counties fall within eight states within the boundaries of the Appalachian Regional Commission (ARC): West Virginia, Kentucky, Pennsylvania, Alabama, Virginia, Ohio, Maryland, and Tennessee. In Part 1.1, we revalidate a list of major Appalachian coal-producing counties using both federal and state data sources. In Part 1.2, we then construct economic profiles of the coal industry's share of total employment, output, and income in the region. In Part 1.3, we provide estimates of the direct, indirect, and induced economic impacts that occur in the region. Part 1.4 addresses the tax revenue impacts from the coal industry. In Part 1.5, we provide a baseline description of other economic indicators, such as population growth and participation in various transfer programs to show how changes in the coal mining industry may affect coal-producing counties in other ways beyond just output, employment, and income. In Part 1.6, we define the regional groupings of coal-producing counties which is utilized in the analysis.

Part 1.1: Revalidation of List of Major Appalachian Coal-Producing Counties

The first task of the study was to identify the coal-producing counties of the Appalachian region. These counties were identified in part using production data available from the Energy Information Administration (EIA) of the U.S. Department of Energy. This data was then supplemented with additional data sources such as coal industry employment information, and direct contact with state coal industry associations or appropriate state government agencies.

The starting point was an initial list of 120 coal-producing counties provided by the Appalachian Regional Commission. This list was composed of Appalachian counties that had coal production in 1997 according to the EIA publication *Coal Program, 1997, Annual Report*. This initial list was then revalidated using data and information from a variety of sources. To begin with, mine and production data from a longer time period, from 1991 through 1997, was assembled from data available in the EIA's *Coal Industry Annual* publications.[1] 1997 was the last year for which data was available at the time of the study. The first step was to identify whether the 120 coal-producing counties had experienced continuous production during the 1991 through 1997 period. Most of the 120 counties on the list exhibited substantial production in each of the seven years, illustrating a pattern of sustained production. This pattern of sustained production in the recent past was taken as an indication of counties that were likely to remain major Appalachian coal-producing counties both now and in the near future.

There was a further examination of counties where there were breaks in production from 1991 to 1997. In particular, we focused on those counties that had very low production (less than 10,000 tons) in 1997 as well as no production in one or more years during the 1991 to 1997 period.[2] Such counties (Jackson County, KY, Morgan County, KY, Lawrence County, OH, and Snyder County PA) were considered as candidates to be dropped from the list. To make this decision, we gathered additional information about coal mining activity or the lack thereof, in these counties since 1997. For counties in Kentucky and Virginia, we utilized employment data from 1998 and the first quarter of 1999 to examine the scope of mining activity in these counties after 1997. For these two states, the Center for Business and Economic Research (CBER) has detailed county quarterly employment data from the ES202.[3] There was no employment recorded for these counties during 1998 or 1999, and these counties were dropped from the list of major Appalachian coal-producing counties. For counties in other states, we made telephone calls to state coal organizations or agencies in those states to gather additional information about mining activity in those counties. We also decided to drop these counties from the list of coal-producing counties. Thus, 4 counties were dropped from the list of major Appalachian coal-producing counties.

Several counties also were added to the list of coal-producing counties despite having no production in 1997. This is because it is possible that counties that normally have production may fail to produce in a year, such as 1997, due to reporting errors or temporary closures. To identify counties that should be added to the list, we examined

[1] These data are available at the website http://www.eia.doe.gov/cneaf/coal/page/database.html

[2] There also was one county that had continuous production from 1991 through 1997, but never had more than 2,500 tons of production in any given year (and only 97 tons of production in 1997).

[3] The ES-202 data come from a Federal-State program run jointly by the Bureau of Labor Statistics and State Employment Security Agencies. Under this program, states are required to report employment and wage and compensation data. The data is required of all employers subject to state employment laws as well as workers covered by unemployment compensation for federal employees.

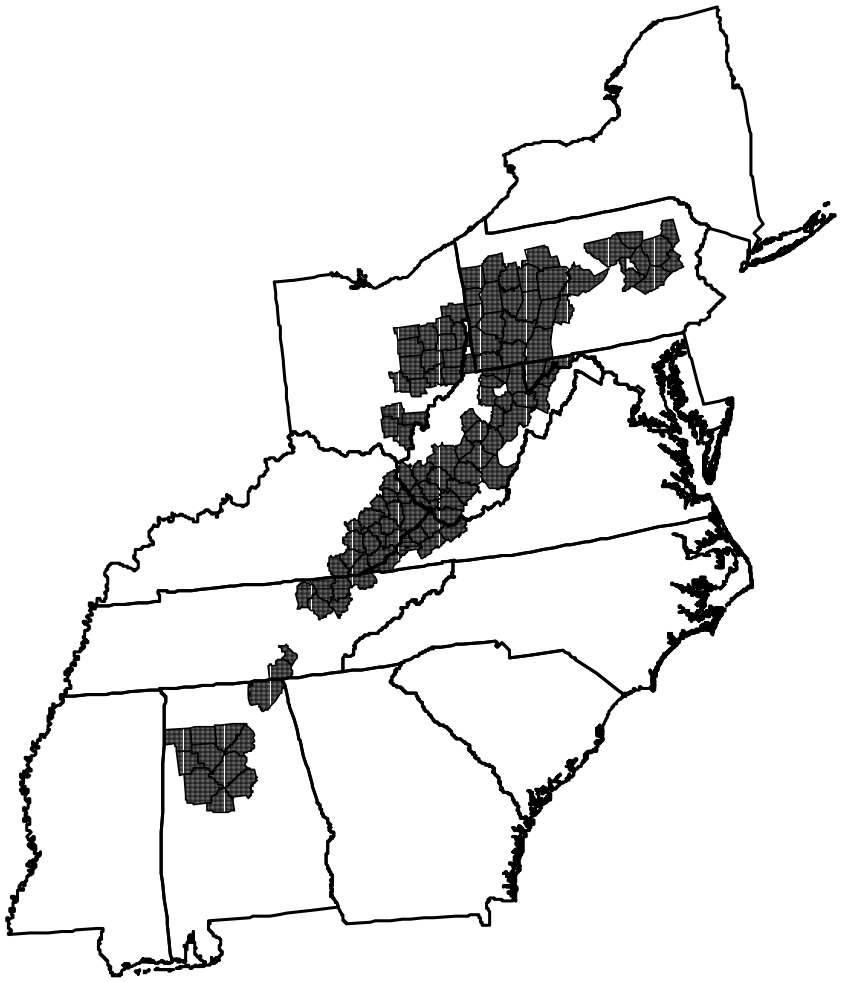
annual production data during the entire 1991 to 1997 period. We identified a list of about 30 counties where there had been coal production in some years between 1991 and 1997. We then focused on a handful of counties that had production during 1995 (and in most case, 1996), and significant production (over 20,000 tons) from 1991 through 1995. For those counties located in Kentucky or Virginia, we again used the ES202 source to check whether there was employment in the coal mining industry in these counties during 1998 and the first quarter of 1999. For counties of interest in other states, we utilized telephone calls to local and state officials to inquire whether production continued in these counties. After these efforts, we added two counties to the list that did not have production in 1997. These were Morgan County, Ohio and Carbon County, Pennsylvania.

We also conducted a general survey of state agencies and organizations, independent of production data, to try to identify counties to be added or dropped from the list. We asked these agencies and organizations to send us any lists they had of coal-producing counties. We also asked a series of questions regarding whether there were areas of the state were mines had been closed, or opened since the beginning of 1998.[4] Information from this part of the analysis did not yield any further counties to add or drop from the list, but it did help in deciding to add Morgan County, OH to the list.

Our examination of the list of 120 coal-producing counties provided by the EIA yielded only minor revisions to the list. Out of 120 counties, 116 were maintained on the list, while four were dropped. Another two counties not on the original list were added to the revalidated list. Thus, the revalidated list utilized in the remainder of this study had 118 counties, many of which were in Kentucky, Ohio, Pennsylvania, and West Virginia. These major coal-producing counties are illustrated in Figure 1.1.1. A list of the counties is provided in Appendix A.

[4] We asked four basic questions: 1) Do you know of any areas of your state where coal production has ceased since the beginning of 1998?; 2) Do you know of any areas of your state where coal production has been severely curtailed since the beginning of 1998?; 3) Do you know of any areas of your state where coal production has been initiated since the beginning of 1998?; and 4) Do you know of any areas of your state where coal production has substantially expanded since the beginning of 1998?

Figure 1.1.1: 118 Major Coal-Producing Counties in the ARC Region



Part 1.2: Detailed Economic Profile of the Coal Industry's Share of Total Employment, Output, and Income in the Appalachian Region

Introduction

For many counties in the Appalachian region, coal mining still occupies a significant position in their economies. Although the importance of coal mining to the region as a whole may be smaller than that of other industries, in some counties, the coal mining industry occupies as much or greater than 50 percent of their respective economies. Workers in the coal mining industry typically earn relatively high wages, and these high wages are important to some counties without substantial employment in other industries.

This section provides a comprehensive economic profile of the coal mining industry in the Appalachian coal-producing counties. This profile is presented by using four main measures: 1) coal production, 2) coal mining output, 3) coal mining employment, and 4) coal mining earnings. Appendix E provides these and other baseline data for the 118 major ARC coal-producing counties. It is important to look at a variety of measures to obtain a true understanding of the industry's significance to the region. For example, only looking at employment in coal mining would overlook the relatively high wages paid to workers in the industry.

Economic Profile for the Entire Region

In 1997, the coal mining industry in the Appalachian coal-producing region employed slightly more than 60,000 people.[5] As Table 1.2.1 shows, however, this large number of employees only represents about two percent of the entire workforce in these counties. Likewise, earnings from the coal mining industry totaled $4.03 billion in 1997 but represented only about 3.3 percent of total earnings across all industries.[6] These figures illustrate that coal mining jobs have higher wages than the typical job in the economy.

As measured by output, the coal mining industry is also an important part of the region's economy. Output is defined as the "value" of the mined coal, which can be calculated using data on coal production and the minemouth price of coal for each county. Table 1.2.1 shows that in 1997, total coal production in the Appalachian coal-producing region was about 467 million tons. Of this figure, about 308 million tons, or

[5] When referring to the "coal mining industry" here and throughout the report, we are using the Coal Mining Standard Industrial Classification (SIC) code and definition. This definition includes all establishments primarily engaged in producing bituminous coal, anthracite, and lignite. Included are mining operations and preparation plants (also known as cleaning plants and washeries), whether or not such plants are operated in conjunction with mine sites.

[6] Earnings include the following components: wage and salary disbursements, other labor income (primarily employee benefits), and proprietors' income.

approximately two-thirds of total production, was underground coal production while the remaining one-third, or about 159 million tons, was coal from surface production. In addition, the average minemouth price of coal for the entire region was approximately $26.50 per ton. This translates into a total output value from coal of about $12.4 billion for the entire Appalachian coal-producing region.

TABLE 1.2.1: Descriptive Statistics about the Coal Mining Industry in the Entire ARC Region, 1997

Total Coal Production (tons)	467.2 million
Underground Coal Production	308.4 million
Surface Coal Production	158.9 million
Coal Mining Employment	60,099
Coal Mining/Total Employment	1.96 %
Coal Mining Earnings	$4,028.3 million
Coal Mining/Total Earnings	3.29 %
Total Coal Output	$12,374.5 million

Source: Energy Information Administration, *Coal Industry Annual and authors' calculations*

Economic Profile for Individual States

The relative significance of the coal mining industry varies widely across the Appalachian coal-producing region. Some states with large coal reserves have higher coal production and consequently, higher output, employment, and earnings from the coal mining industry. But as shown below, the coal mining industry in some states and counties with substantial coal production occupies a smaller portion of the entire economy because of the presence of other industries. Examining the coal mining industry through the ratios of coal employment and earnings to total employment and earnings, therefore, provides a more accurate description of the relative importance of the industry to these regions.

Table 1.2.2 shows the levels and ratios for coal mining employment, earnings, production, and output for 1997 for the eight coal-producing states in the Appalachian region: Alabama, Kentucky, Maryland, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.[7] As presented in the table, there is considerable variation among the eight states in terms of the size of the coal mining industry. Some states have relatively small coal production, employment, and earnings, such as Maryland and Tennessee; some have a moderately sized coal industry, such as Alabama, Ohio, and Virginia; and

[7] The coal-producing counties in western Kentucky are *not* included in this analysis because the Appalachian Regional Commission (ARC) geographic boundaries do not extend to that area.

some have relatively high values for coal production, employment, and earnings, such as Kentucky, Pennsylvania, and West Virginia.

Coal production figures for 1997 are shown in the first part of Table 1.2.2. These range from a low of 3.3 million tons in Tennessee to a high of almost 175 million tons in West Virginia. Kentucky, with 121 million tons, also has substantial coal production, as does Pennsylvania with 76 million tons. Alabama, Ohio, and Virginia had more moderate production of 25 million, 29 million, and 36 million tons, respectively. Finally, similar to Tennessee, Maryland had coal production of only 4.2 million tons.

For all states except Tennessee, underground coal production exceeded surface coal production. As mentioned above, about two-thirds of all coal in the region comes from underground production, but there are some differences among individual states. For example, in Alabama and Virginia, about 75 percent of total production came from underground mines and about 72 percent from underground mines in Pennsylvania. By far, West Virginia had the highest *level* of underground production at 117 million tons, with Kentucky ranking second at 70 million tons. This represents about 67 percent of all production for West Virginia and about 58 percent of all production for Kentucky.

Similarly, the value of total output from coal varied across these states. In addition to production differences, the minemouth price of coal varies by county, depending upon the type and quality of the coal. In fact, the price of coal for the entire region ranges from about $15.58 per ton to $42.03 per ton. The total value of the output ranges from a low of $104 million in Tennessee to a high of about $4.53 billion in West Virginia. Kentucky ranked second in coal output, with almost $2.98 billion in 1997, and Pennsylvania ranked third with about $2.03 billion. All other states had about $1 billion in output or less, with Virginia having slightly over $1.0 billion, Alabama having about $967 million, Ohio having $636 million, and Maryland having $114 million.

These differences among states generally hold for employment in the coal mining industry. West Virginia had almost 19,000 workers in coal mining in 1997, with Kentucky having about 13,000 and Pennsylvania having about 10,400. Virginia had about 7,150 employees in coal mining, Alabama had about 5,300 employees, and Ohio had almost 4,000 employees. Finally, Maryland and Tennessee had much smaller employment figures, with about 550 coal mining workers in Maryland and about 740 in Tennessee.

When we examine the relative importance of coal mining employment to these states, however, a somewhat different description emerges. For example, although Pennsylvania had a larger number of workers in coal mining (10,409), this represents only 0.6 percent of the total employment in those coal-producing counties, which are located in western Pennsylvania and are more populous and have more types of industries than in some other Appalachian coal-producing counties. In contrast,

Virginia's coal-producing counties had about 7,150 total workers in the industry, but this represent 16.4 percent of total employment. These counties are not as populous as those in Pennsylvania and do not support a wide array of industries with substantial employment. Similarly, Kentucky had 13,081 workers in the coal mining industry in 1997, which represented 13.7 percent of total employment in those counties. The coal-producing counties in West Virginia, with the highest coal mining employment at almost 19,000 workers, saw about 6.1 percent of its workforce represented by the coal mining industry. This figure is still considerably higher than that of other states. In Ohio's coal-producing counties, about 1.8 percent of total employment was in coal mining. Likewise, in Maryland, 1.7 percent was in coal mining; in Tennessee, 1.1 percent; and in Alabama, only 0.95 percent of total employment was in coal mining.

In contrast to only looking at employment figures, examining the worker earnings from coal mining can give a more comprehensive description of the industry since these figures account for the higher wages seen in coal mining and for differences in wages across states. Again, West Virginia has the highest earnings from the coal mining industry at $1.25 billion in 1997, followed by Pennsylvania at $1.03 billion, and Kentucky at $720 million. These figures show that although Pennsylvania has lower production and employment than Kentucky, its workers earn higher wages. Alabama had about $397 million in coal mining earnings in 1997, and Virginia had about $360 million. Both Maryland and Tennessee had much smaller figures, with Maryland at $26 million and Tennessee at $34 million.

The differences highlighted in the relative coal mining employment above for Virginia and Kentucky are even more striking when we examine relative earnings in the coal industry. In 1997, the Appalachian coal-producing counties in both Kentucky and Virginia had almost 20 percent of total earnings come from the coal mining industry, with Kentucky at 19.1 percent and Virginia at 19.7 percent. No other state had over 10 percent of total earnings come from the coal mining industry in coal-producing counties. West Virginia had about 9.8 percent of total earnings in coal mining, but all other states had much lower percentages: Ohio, 2.8 percent; Maryland, 2.1 percent; Alabama, 1.8 percent; Pennsylvania, 1.5 percent; and Tennessee, 1.3 percent.

TABLE 1.2.2: Descriptive Statistics about the Coal Mining Industry in the Entire ARC Region by State, 1997

	Alabama	Kentucky	Maryland	Ohio	Pennsylvania	Tennessee	Virginia	West Virginia	Region
Total Coal Production (tons)	24.5 million	120.9 million	4.2 million	28.6 million	76.2 million	3.3 million	35.8 million	173.7 million	467.2 million
Underground Coal Production	18.5 million	69.9 million	3.3 million	16.9 million	54.8 million	1.4 million	26.9 million	116.5 million	308.2 million
Surface Coal Production	6.0 million	60.0 million	0.9 million	11.7 million	21.4 million	1.9 million	8.9 million	57.2 million	168.0 million
Coal Mining Employment	5,297	13,061	549	3,958	10,409	739	7,149	18,937	60,009
Coal Mining/Total Employment	0.95%	13.7%	1.7%	1.8%	0.6%	1.1%	16.4%	6.1%	
Coal Mining Earnings	$396.9 million	$719.6 million	$26.4 million	$218.4 million	$1,025.7 million	$34.1 million	$360 million	$1,246.7 million	$4,027.8 million
Coal Mining/Total Earnings	1.8%	19.1%	2.1%	2.8%	1.5%	1.3%	19.7%	9.8%	
Total Coal Output	$966.9 million	$2,979.5 million	$113.7 million	$635.6 million	$2,033.1 million	$103.5 million	$1,012.3 million	$4,530.0 million	$12,373.6 million

Source: Energy Information Administration, *Coal Industry Annual*

Economic Profile at the County Level

Perhaps the best way in which to present the economic profile of the Appalachian coal-producing region is by looking at individual counties. Because counties can differ widely in their size and in their coal production, there can be wide variation in the relative significance of the coal mining industry to these counties. This section will look at the various measures for the coal mining industry at the county level and, where appropriate, examine values for specific counties. Much of the profile will be presented using a series of maps that shows these values for coal production, output, employment, and earnings at the county level.

Coal Production

Coal production varies widely across the Appalachian region. In general, there are three major sub-regions of coal production, as can be seen in Figure 1.2.1. One sub-region occurs in central Alabama with additional light production in Tennessee. The largest concentration of coal production occurs at the intersection of Kentucky, Virginia, and West Virginia, along with southern Ohio, an area which has the greatest concentration of counties with the highest coal production amounts for 1997. Finally, the third sub-region consists of Maryland, eastern Ohio, Pennsylvania, and northern West Virginia.

The counties in these sub-regions and their associated production values are shown in Figures 1.2.2 through 1.2.4. Figure 1.2.2 shows the Alabama/Tennessee region, Figure 1.2.3 shows the Maryland, eastern Ohio, Pennsylvania, and northern West Virginia, and Figure 1.2.4 shows the Kentucky, southern Ohio, Virginia, and southern West Virginia region. As is evident from these maps, the central Appalachian region has the greatest concentration of coal production, with 11 of the 14 counties that had over 10 million tons of total coal production in 1997. Figure 1.2.5 gives the 15 counties in the Appalachian coal region with the highest total coal production for 1997. Although Greene County, Pennsylvania, had the greatest overall coal production of 35.4 million tons in 1997, Pike County, Kentucky, was very close with 35.0 million tons. In addition to Green County, Pennsylvania, only Jefferson County, Alabama, and Marshall County, West Virginia were high production counties not located at or near the intersection of Kentucky, Virginia, and West Virginia. Other counties with very high production figures include Boone, Mingo, and Logan Counties in West Virginia, with 30.6 million, 22.4 million, and 20.5 million tons of total coal production in 1997.

FIGURE 1.2.1: Total Coal Production by County in the ARC Region, 1997

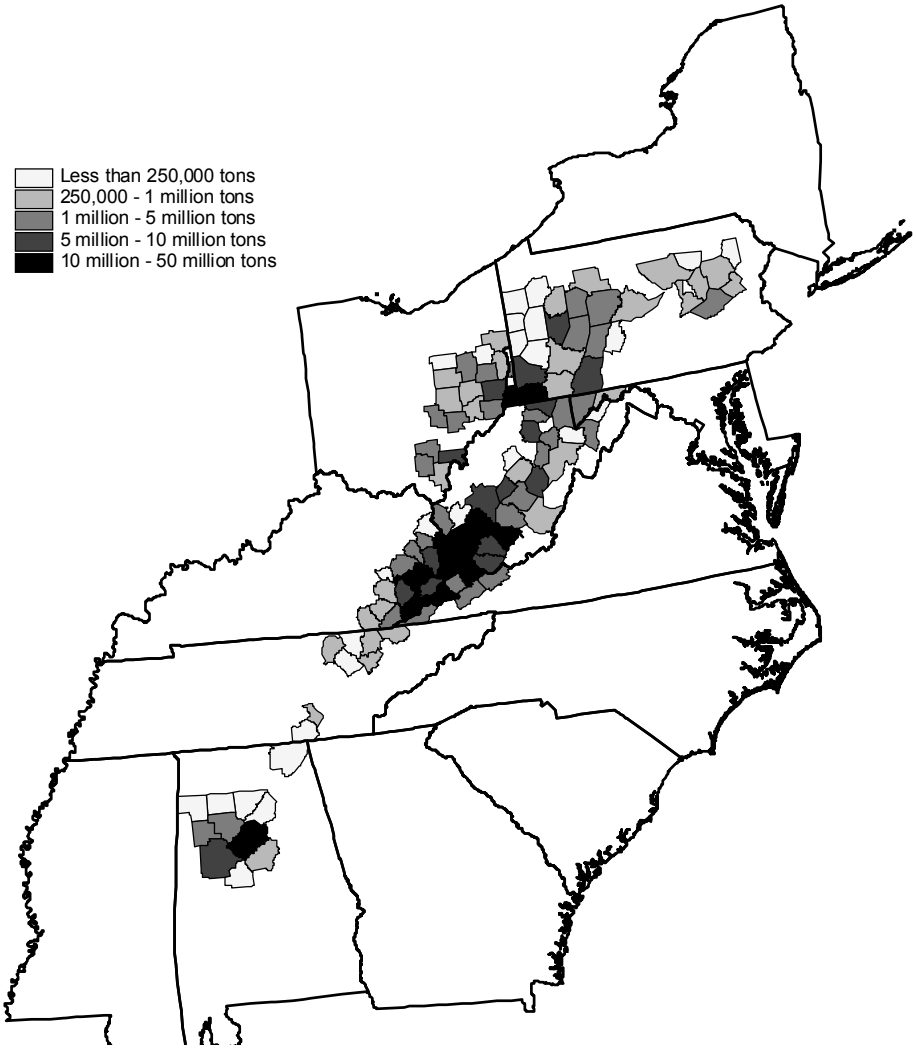


FIGURE 1.2.2: Total Coal Production by County in the Southern ARC Region, 1997

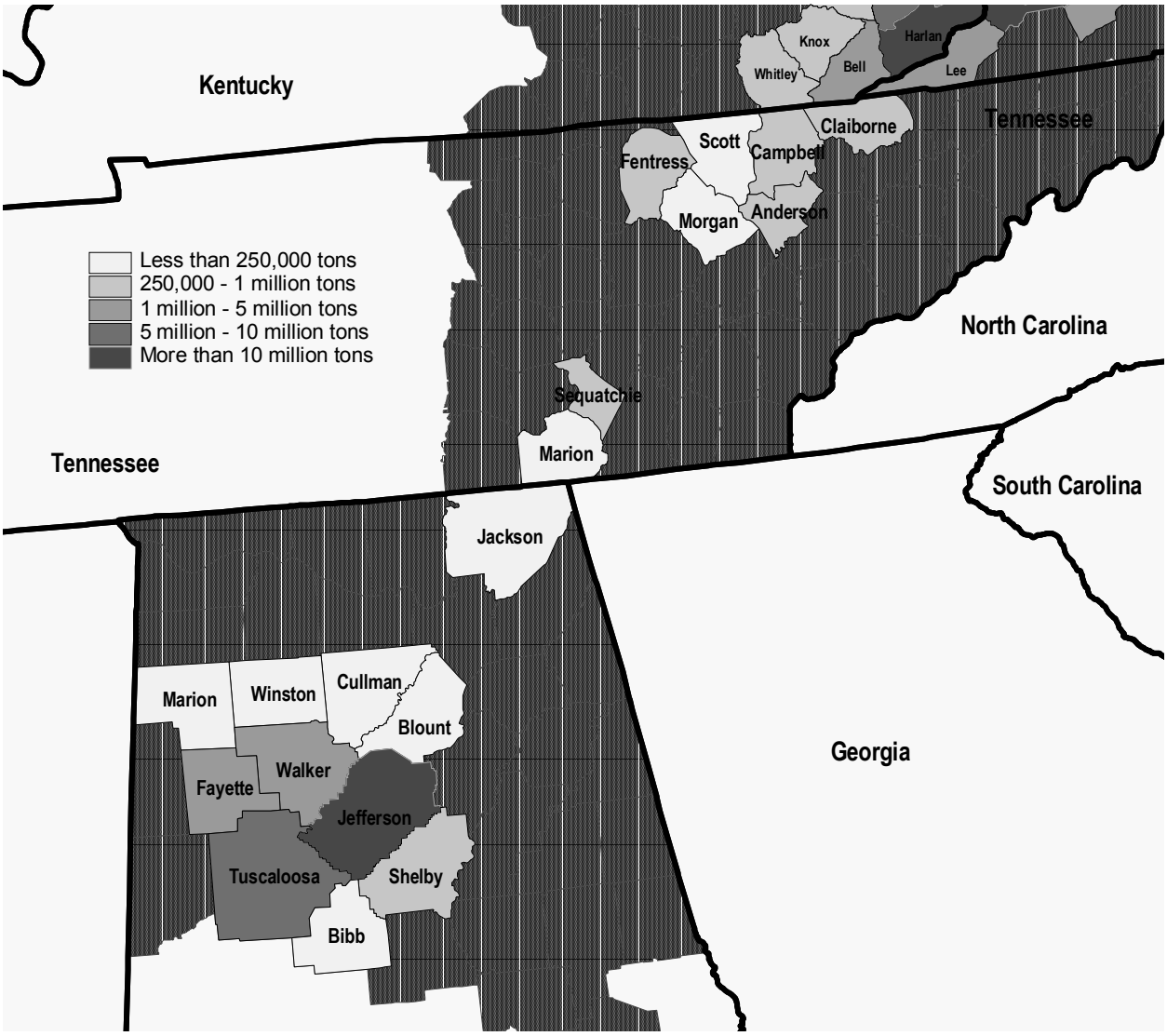


FIGURE 1.2.3: Total Coal Production by County in the Northern ARC Region, 1997

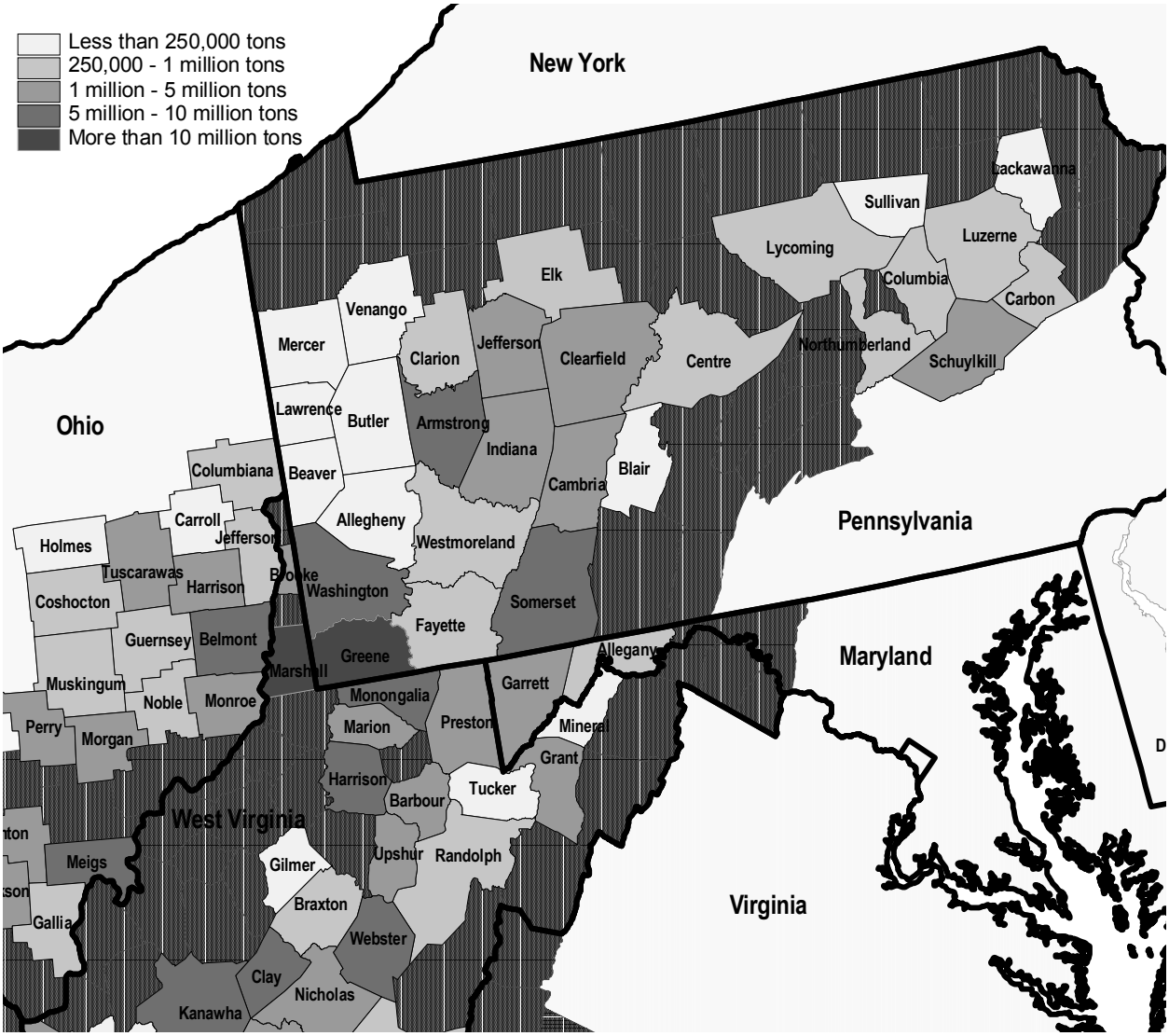


FIGURE 1.2.4: Total Coal Production by County in the Central ARC Region, 1997

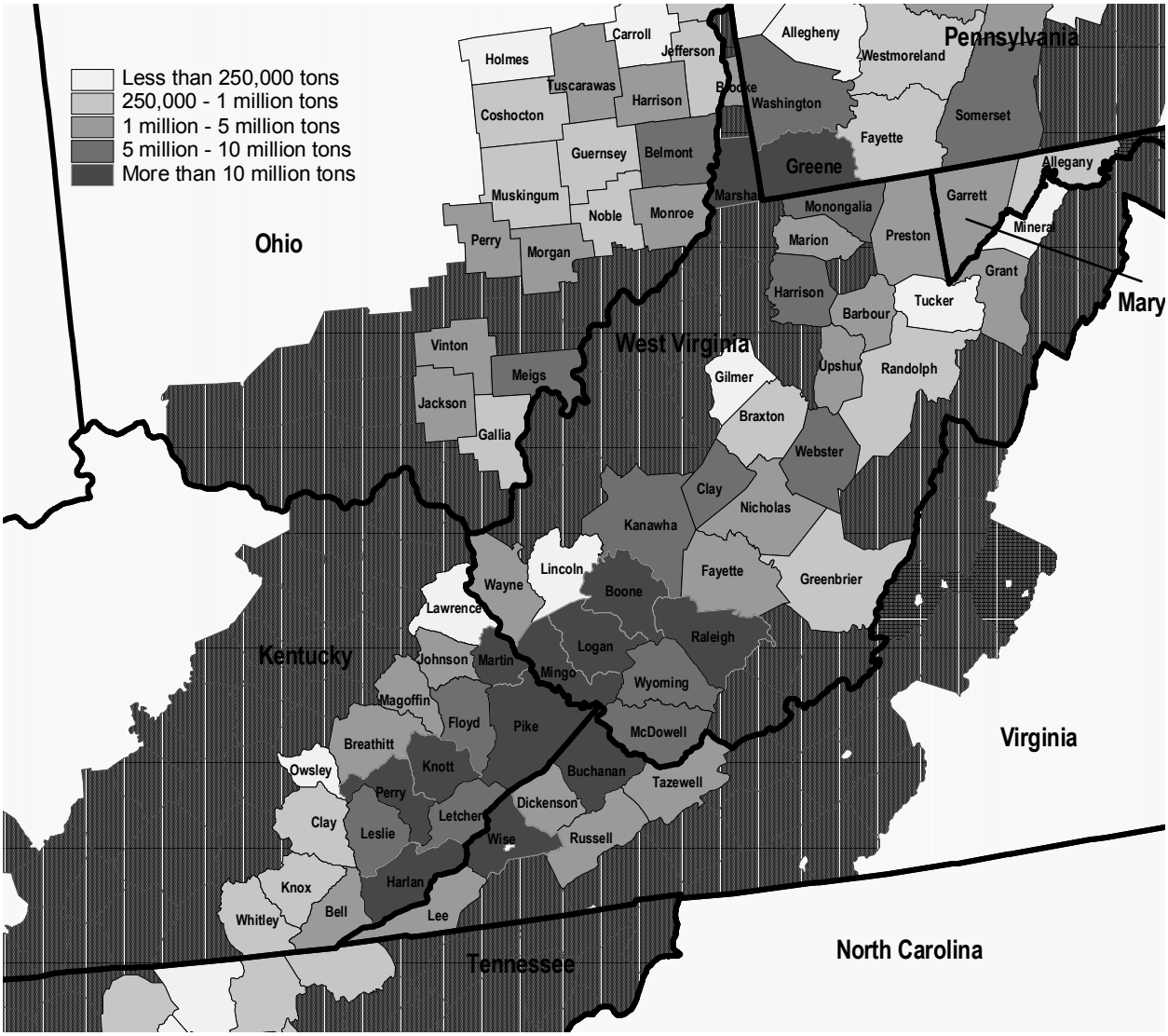
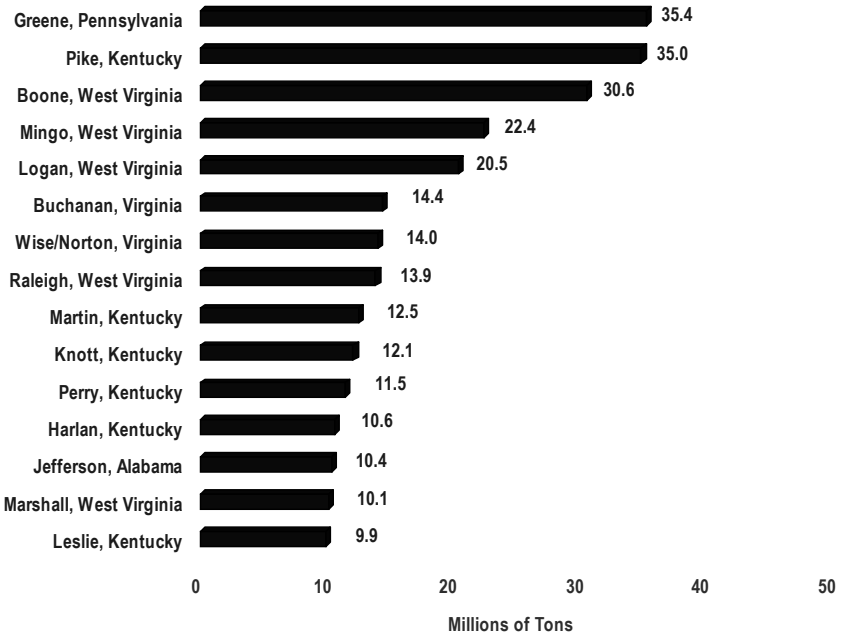


FIGURE 1.2.5: 15 Counties in the ARC Coal Region with the Highest Total Coal Production, 1997



Although most of the analysis here focuses on total coal production, it is possible to distinguish between underground and surface coal production. Underground and surface coal will likely have different production methods, which could affect the economic impacts on their respective counties. For example, underground coal mining would likely require more labor than surface coal mining, where excavation equipment can extract large amounts of the coal.

As shown in Table 1.2.1, underground coal production totaled about 308 million tons in 1997, or about two-thirds of all coal production. Surface coal production totaled about 159 million tons, or about one-third of all coal production. Figure 1.2.6 shows counties in the Appalachian region that had underground coal production in 1997 while Figure 1.2.7 shows the same information for surface coal production. Overall, surface production is more common in the region, with 103 of the 118 total coal counties having surface production while only 74 counties had underground coal production. As seen from the maps, the region centered on the intersection of Kentucky, Virginia, and West Virginia contains the greatest concentration of both surface and underground production. This sub-region has three counties with surface production over 10 million tons in 1997 (Pike, Kentucky; Boone and Logan, West Virginia) and five counties with underground production over 10 million tons in 1997 (Pike, Kentucky; Buchanan, Virginia; Boone, Mingo, and Raleigh, West Virginia). In fact, both Pike County, Kentucky, and Boone County, West Virginia, had both surface and underground production of over 10 million tons each in 1997. Another pattern that emerges is that both Pennsylvania and Ohio are more reliant on surface production than underground

production. As seen in Figure 1.2.7, there are many more counties in both states with surface production in 1997.

FIGURE 1.2.6: Total Underground Coal Production by County in the ARC Region, 1997

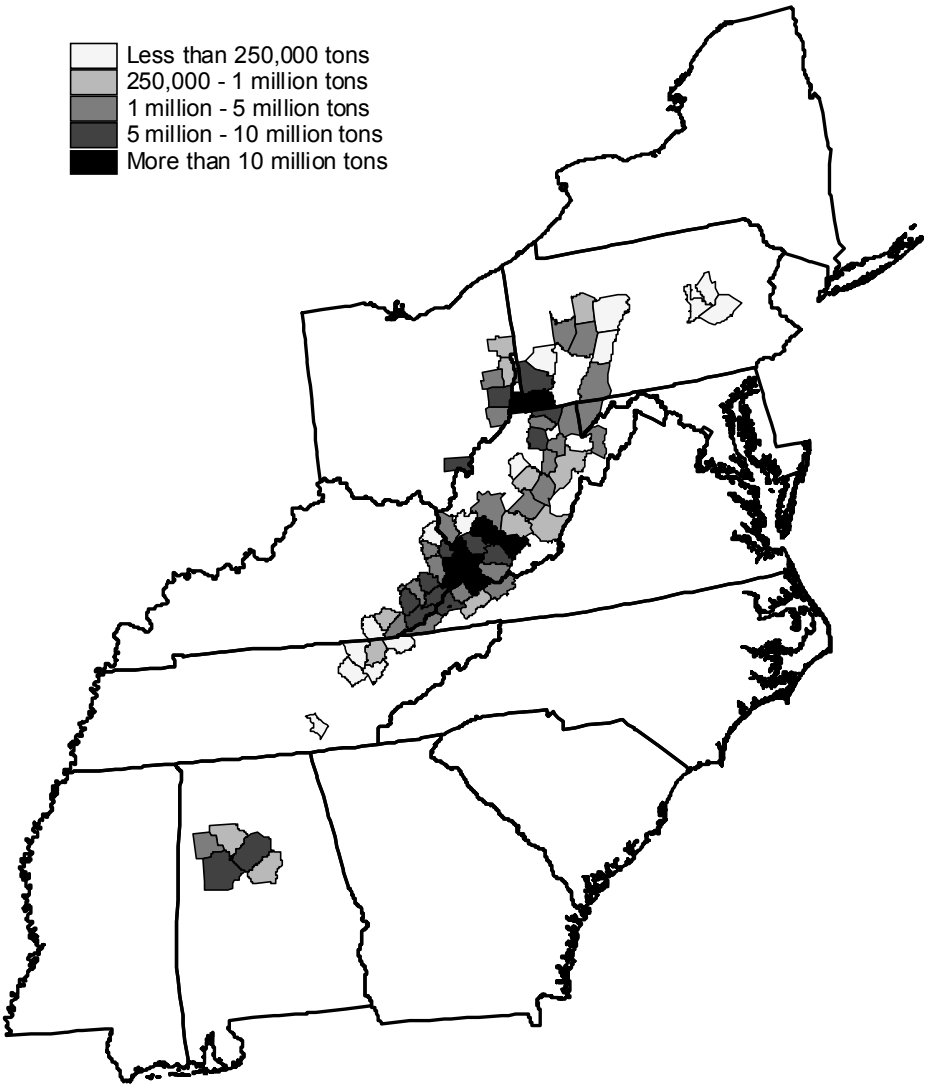
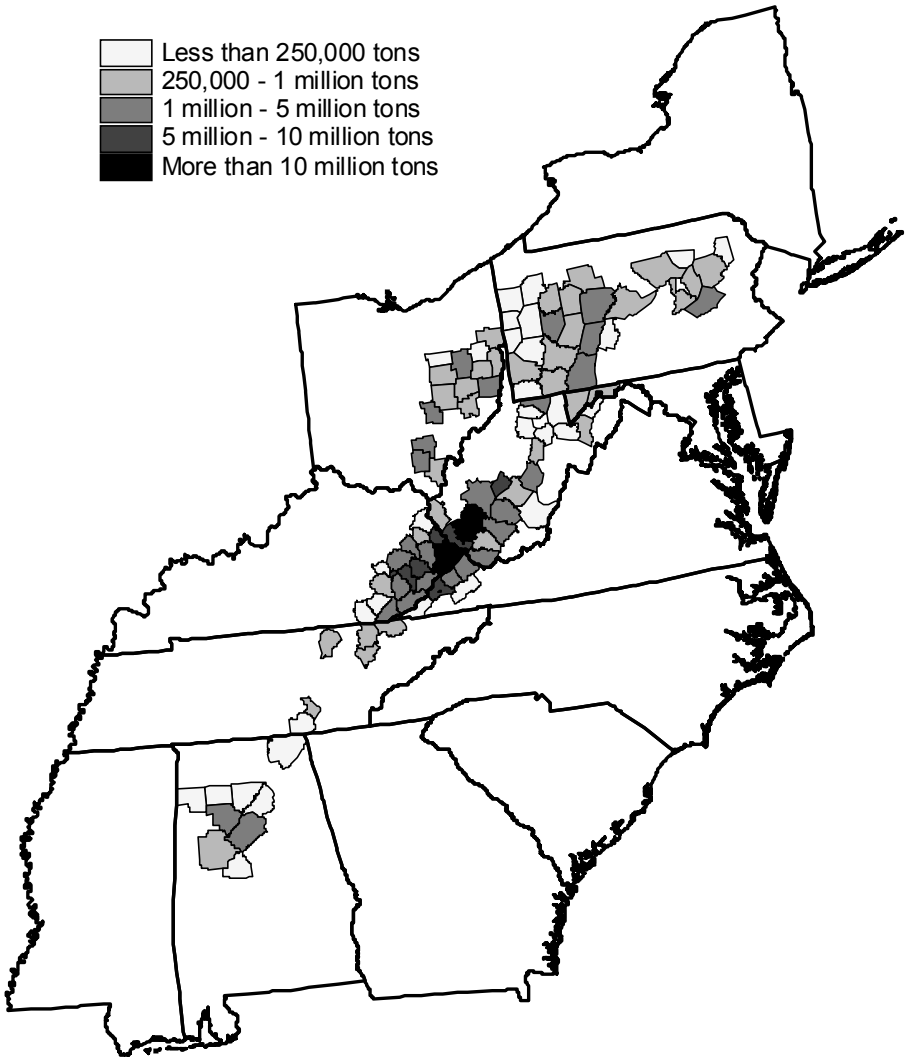


FIGURE 1.2.7: Total Surface Coal Production by County in the ARC Region, 1997

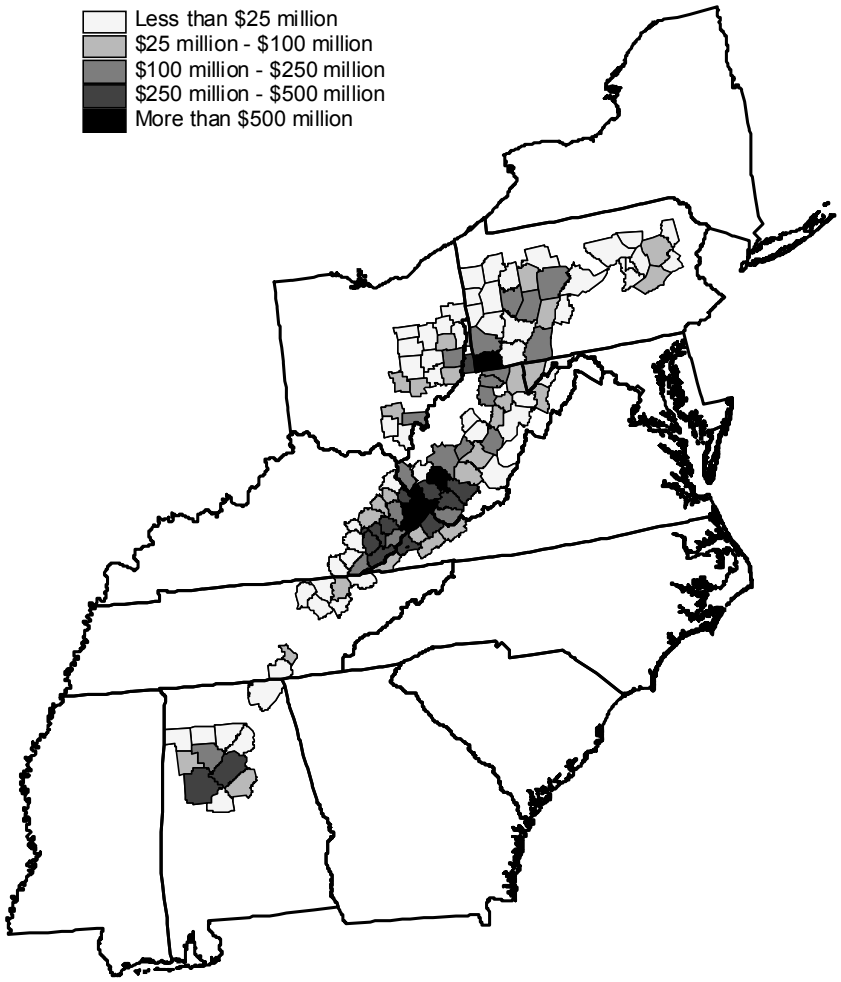


Coal Mining Output

Coal mining output is defined as the minemouth price of coal multiplied by the coal production value. Output is thus a measure of the dollar value of coal mined in a particular county. Naturally, coal mining output is concentrated in the areas where coal production is highest. However, output figures are also dependent on price, which can be a reflection of the quality of the coal being mined in the county.

Figure 1.2.8 below shows the breakdown of coal mining output by county throughout the Appalachian region using five categories of output, less than $25 million, $25 - $100 million, $100 - $250 million, $250 - $500 million, and more than $500 million. In total there were four counties with output figures greater than $500 million in 1997 including Pike County, Kentucky, Boone and Mingo County, West Virginia, and Greene County, Pennsylvania. The area of greatest concentration of high coal mining output is centered on the intersection of the Kentucky, Virginia, and West Virginia borders.

Figure 1.2.8: Coal Mining Output by County in the ARC Region, 1997



Coal Mining Employment

Employment in the coal mining industry is perhaps one of the simplest methods by which to examine the extent of coal mining in individual or groups of counties. Overall, employment is concentrated in those counties with the highest coal production, with the greatest concentration of employment again in the Kentucky-Virginia-West Virginia intersection. In addition, several counties in Pennsylvania have large numbers of workers in the coal mining industry, and there is a small pocket of concentrated employment in coal mining in Alabama as well.

Figure 1.2.9 shows the breakdown of employment in the coal mining industry throughout the Appalachian region using five categories of employment: 0 - 100 employees, 101 - 250, 251 - 500, 501 - 1,000, and more than 1,000 employees. The data are also displayed by county in Table 1.2.3. Examining the area of greatest employment, Kentucky has four counties with employment of greater than 1,000 workers, namely, Floyd, Harlan, Perry, and Pike. Virginia has two counties, Buchanan and Wise/Norton, with greater than 1,000 workers in coal mining. And West Virginia has the greatest number of counties with more than 1,000 workers in coal mining, including Boone,

FIGURE 1.2.9: Coal Mining Employment by County in the ARC Region, 1997

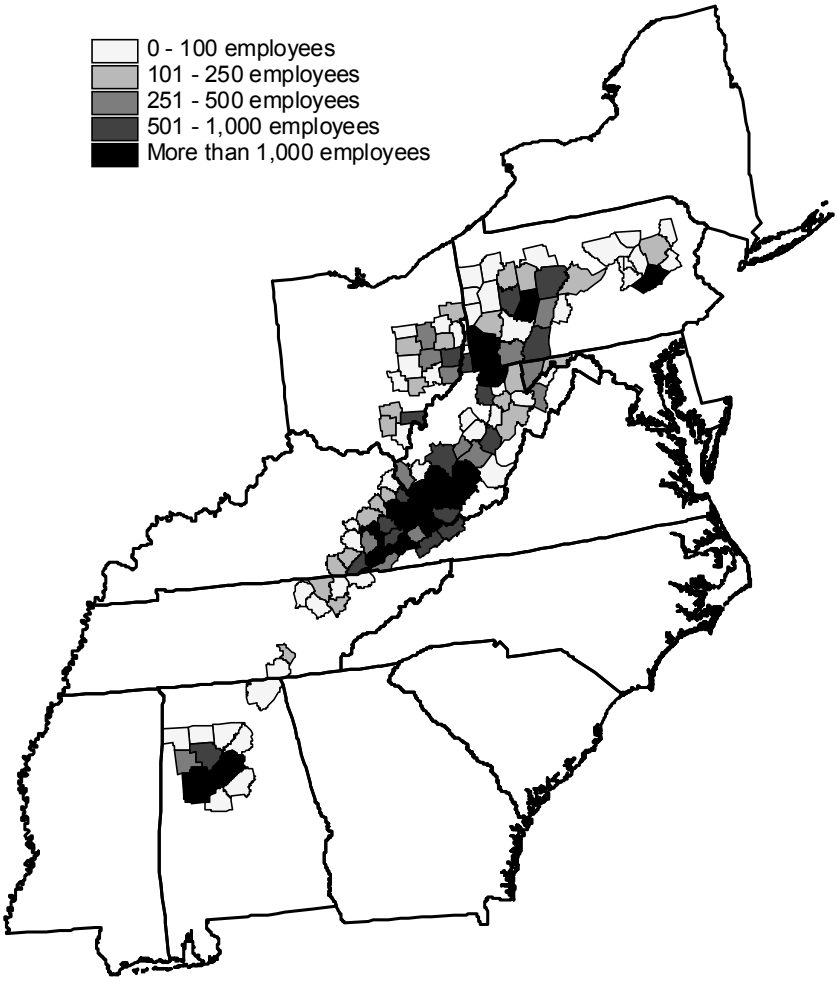


Table 1.2.3: Coal Mining Employment by County in the ARC Region, 1997

State	County	Coal Employment	State	County	Coal Employment	State	County	Coal Employment	State	County	Coal Employment
AL	Bibb	49	OH	Coshocton	240	PA	Lawrence	60	WV	Greenbrier	80
AL	Blount	49	OH	Gallia	60	PA	Luzerne	154	WV	Harrison	707
AL	Cullman	38	OH	Guernsey	347	PA	Lycoming	60	WV	Kanawha	591
AL	Fayette	375	OH	Harrison	175	PA	Mercer	4	WV	Lincoln	8
AL	Jackson	53	OH	Holmes	60	PA	Northumberland	52	WV	Logan	1341
AL	Jefferson	2052	OH	Jackson	146	PA	Schuylkill	1024	WV	McDowell	750
AL	Marion	43	OH	Jefferson	63	PA	Somerset	781	WV	Marion	1516
AL	Shelby	87	OH	Meigs	750	PA	Sullivan	2	WV	Marshall	863
AL	Tuscaloosa	1750	OH	Monroe	375	PA	Venango	9	WV	Mineral	9
AL	Walker	750	OH	Morgan	203	PA	Washington	1566	WV	Mingo	1750
AL	Winston	53	OH	Muskingum	60	PA	Westmoreland	96	WV	Monongalia	1213
KY	Bell	750	OH	Noble	60	TN	Anderson	175	WV	Nicholas	473
KY	Breathitt	10	OH	Perry	49	TN	Campbell	60	WV	Preston	221
KY	Clay	10	OH	Tuscarawas	434	TN	Claiborne	100	WV	Raleigh	1238
KY	Floyd	1553	OH	Vinton	175	TN	Fentress	59	WV	Randolph	175
KY	Harlan	1086	PA	Allegheny	175	TN	Marion	28	WV	Tucker	21
KY	Johnson	162	PA	Armstrong	762	TN	Morgan	53	WV	Upshur	82
KY	Knott	976	PA	Armstrong	762	TN	Scott	148	WV	Wayne	464
KY	Knox	175	PA	Beaver	79	TN	Sequatchie	117	WV	Webster	522
KY	Lawrence	10	PA	Blair	10	VA	Buchanan	2991	WV	Wyoming	1750
KY	Leslie	255	PA	Butler	60	VA	Dickenson	360			
KY	Letcher	998	PA	Cambria	361	VA	Lee	270			
KY	Magoffin	175	PA	Carbon	53	VA	Russell	686			
KY	Martin	750	PA	Centre	159	VA	Tazewell	617			
KY	Owsley	12	PA	Clarion	158	VA	Wise & Norton	2225			
KY	Perry	1750	PA	Clearfield	750	WV	Barbour	175			
KY	Pike	4241	PA	Columbia	123	WV	Boone	2904			
KY	Whitley	152	PA	Elk	86	WV	Braxton	45			
MD	Allegany	175	PA	Fayette	299	WV	Brooke	168			
MD	Garrett	375	PA	Greene	2183	WV	Clay	375			
OH	Belmont	622	PA	Indiana	1105	WV	Fayette	1604			
OH	Carroll	10	PA	Jefferson	237	WV	Gilmer	9			
OH	Columbiana	133	PA	Lackawanna	4	WV	Grant	375			

Source: 1997 County Business Patterns

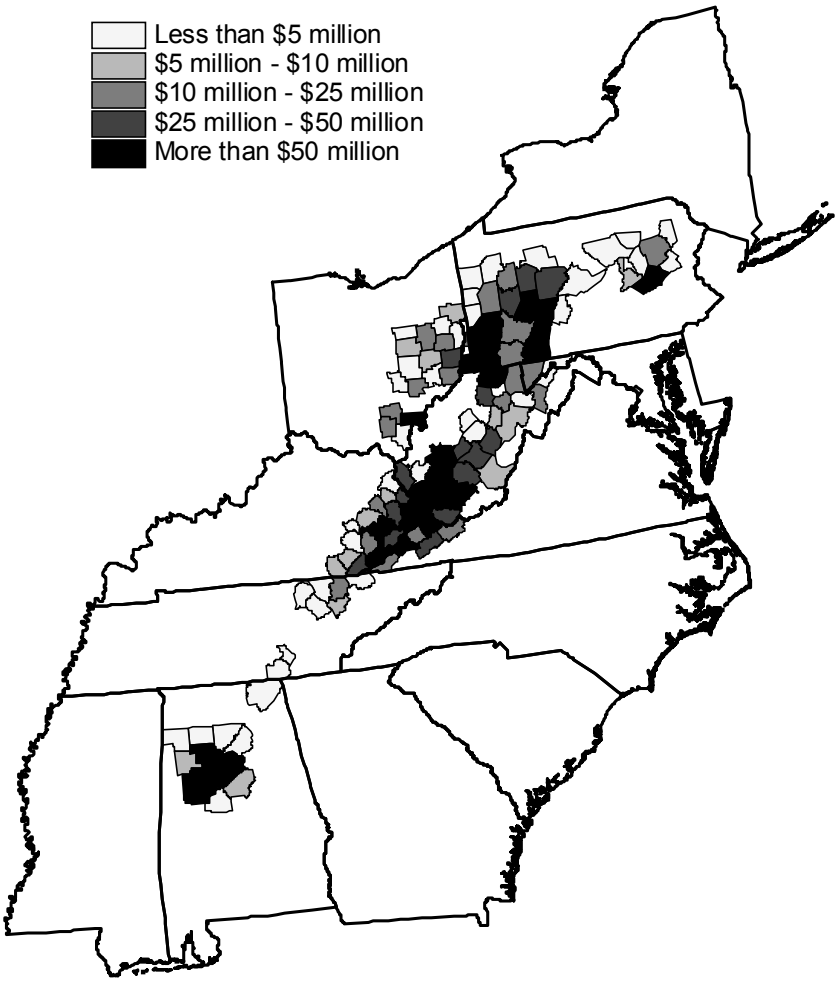
Coal Mining Earnings

Earnings from the coal mining industry will be closely related to employment in the industry. Differences in the relative magnitude of employment versus earnings will primarily reflect any differences in the wages that employees earn in one county or region versus another county or region. Although coal mining workers can expect to earn similar wages, differences in the type of coal mining (underground/surface) or local labor market conditions could raise or lower wages and change the breakdown of county-level earnings.

As with employment, earnings in the coal mining industry in 1997 is broken down into five categories, as shown in Figure 1.2.10. The five categories used are earnings of less than $5 million, $5 million - $10 million, $10 million - $25 million, $25 million - $50 million, and more than $50 million. Again, the distribution of coal mining earnings looks similar to the distribution of coal mining employment, with several exceptions. The Kentucky-Virginia-West Virginia area again has the largest concentration of counties with the highest coal mining earnings. In 1997, Kentucky had five counties with coal mining earnings of more than $50 million, including Harlan, Knott, Leslie, Perry, and Pike; Virginia had two counties, including Buchanan and Wise/Norton; and West Virginia had eight counties, including Boone, Kanawha, Logan, Mingo, Raleigh, and Wyoming in the southwestern part of the state and Marion and Marshall in the northern part of the state.

Counties in other states with high earnings from coal mining include Meigs in Ohio and Jefferson, Tuscaloosa, and Walker in Alabama. It is interesting to note that seven counties in Pennsylvania have coal mining earnings of more than $50 million. Recall that Pennsylvania only had four counties with employment in the highest category (more than 1,000 workers), so the fact that it has seven counties in the highest earnings category could reflect the fact that Pennsylvania workers in the coal mining industry receive relatively higher wages than coal mining workers in other states. These seven counties are Allegheny, Cambria, Greene, Indiana, Schulykill, Somerset, and Washington.

FIGURE 1.2.10: Coal Mining Earnings by County in the ARC Region, 1997



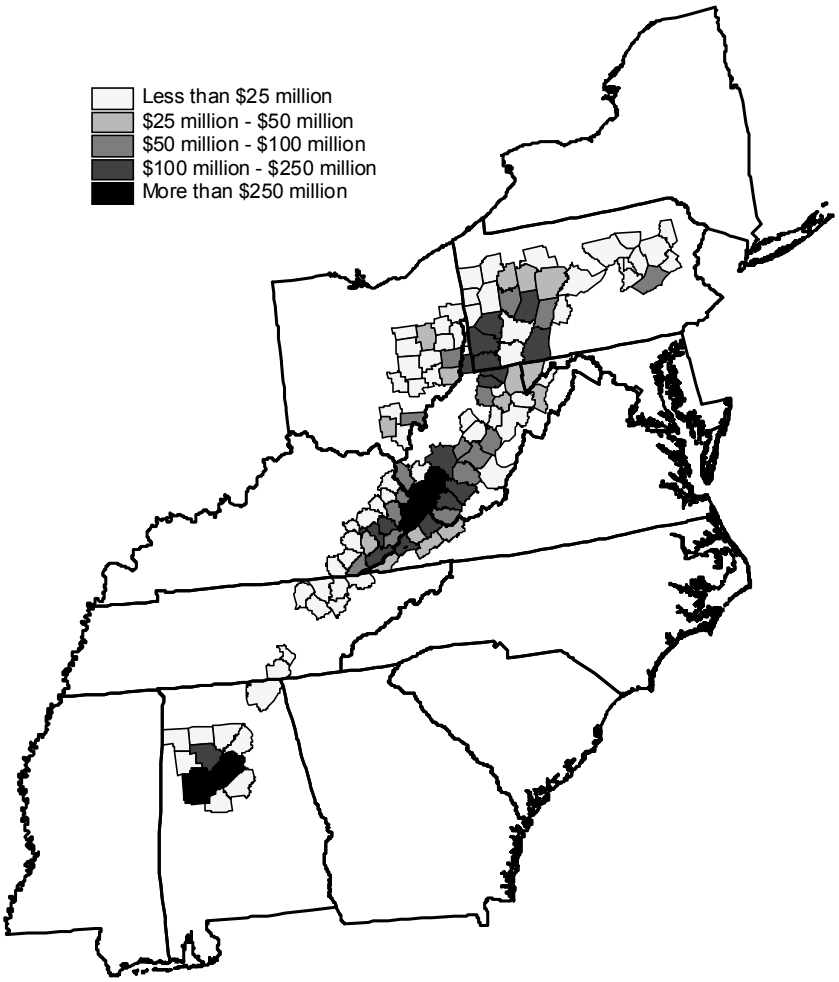
Coal Mining Gross County Product

The final criteria by which to examine coal mining by counties or groups of counties is by determining the amount of gross county product that is attributable to coal mining activities. Gross county product is the total value of goods and services produced by labor and property in the county.[8] The portion of gross county product that is attributable to coal mining is thus called coal mining gross county product.

As with employment and earnings, coal mining gross county product is broken down into five categories as shown in Figure 1.2.11. These five categories are less than $25 million, $25 million - $50 million, $50 million - $100 million, $100 million - $250 million, and greater than $250 million. As before, Figure 1.2.11 indicates that the highest levels of gross county product attributable to coal mining are generally located at the intersection of Kentucky, Virginia and West Virginia.

[8] CBER estimated gross county product data for each county. For each 1-digit SIC grouping, a statewide ratio of gross state product to earnings was developed using the Bureau of Economic Analysis publications *Gross Product by Industry for the United States and States*, and the *Regional Economic Information System 1969 to 1997 (REIS)*. County earnings data was also gathered from the REIS. Statewide ratios of gross state product to earnings were applied to county earnings data to estimate gross county product in each 1-digit SIC group in each county. Industry values were summed to estimate total gross county product for each county. The 1-digit industry groupings were farming, agricultural services, mining, construction, manufacturing, transportation, communications, and public utilities (TCPU), wholesales trade, retail trade, finance, insurance, and real estate (FIRE), services, and government.

FIGURE 1.2.11: Coal Mining Gross County Product by County in the ARC Region, 1997



Coal Mining Employment as a Percentage of Total Employment

The previous three sections discussed the levels of employment, earnings, and gross county product from the coal mining industry in the Appalachian region. While these are important measures in which to examine the overall economic activity, perhaps it is more instructive to look at these measures relative to the total levels of employment, earnings, and gross county product in all industries. Looking at these relative shares can show which county economies are most closely tied to the coal mining industry and which counties, even some with high absolute coal mining employment or earnings, are not as closely linked to the coal mining industry.

Figures 1.2.12, 1.2.15, and 1.2.18 show employment, earnings, and gross county product for coal mining as a percentage of total employment, earnings, and gross county product in each county in the Appalachian region. These figures show that some counties are much more dependent upon the coal mining industry than other counties, even for some counties that have relatively high employment, earnings, or gross county product from coal mining.

Looking first at employment in Figure 1.2.12, it is evident that several pockets of high relative employment from coal mining are present throughout the region. Alabama, Pennsylvania, and Tennessee each has only one county where the relative percentage of coal mining employment exceeds 5%, indicating that while the coal mining industry is important in many areas, there are many other types of industries that employ a greater share of each county's workforce.

But the most concentrated area of coal mining employment occurs in the Kentucky-Virginia-West Virginia intersection, with some concentration evident in southern and eastern Ohio. Figure 1.2.13 shows a magnified map of this area and highlights those counties with employment from coal mining totaling 10% or more of total employment. Figure 1.2.14 lists the 15 counties in the entire Appalachian region with the highest ratio of coal mining employment to total employment. As can be seen from these two figures, the overwhelming majority of counties with high relative employment are located in eastern Kentucky, western Virginia, and southwestern West Virginia. Boone County, West Virginia, has the highest ratio, with 48.1% of all employment in the county coming from the coal mining industry. Knott County, Kentucky, is next with 41.1% of all employment in coal mining, following by Wyoming County, West Virginia, at 39.3%; Buchanan County, Virginia, at 38.7%; and Martin County, Kentucky, at 31.4%.

FIGURE 1.2.12: Ratio of Coal Mining Employment to Total Employment by County in the ARC Region, 1997

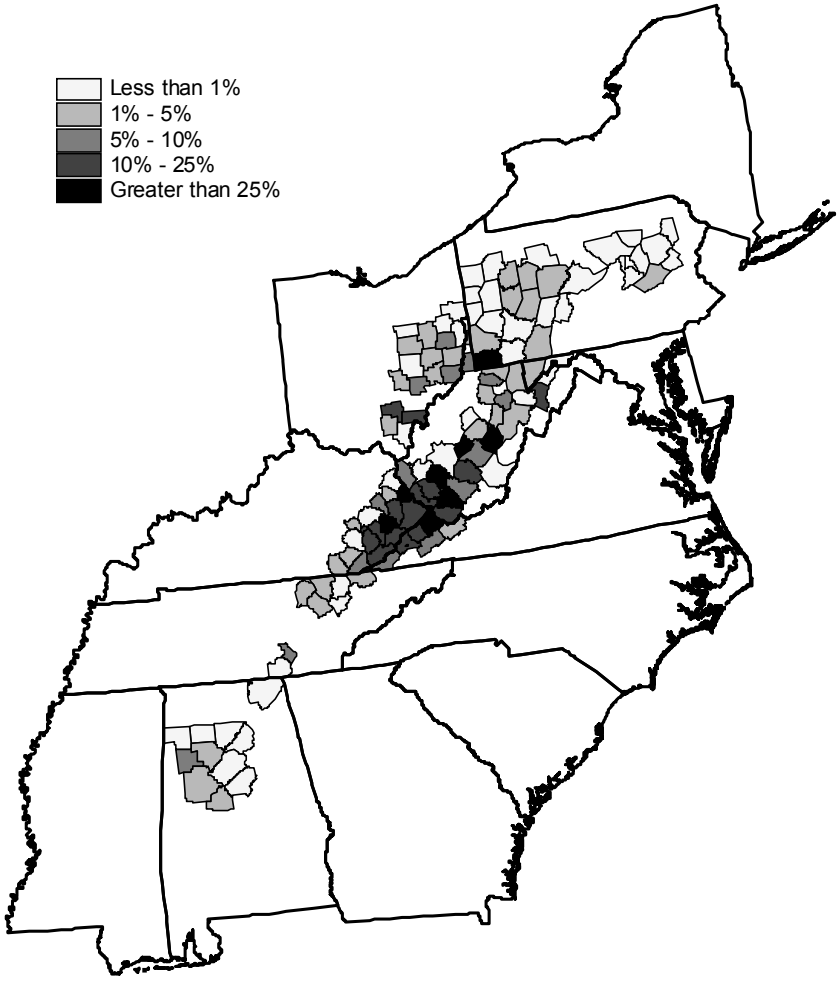


FIGURE 1.2.13: Ratio of Coal Mining Employment to Total Employment by County in the ARC Region (Enhanced), 1997

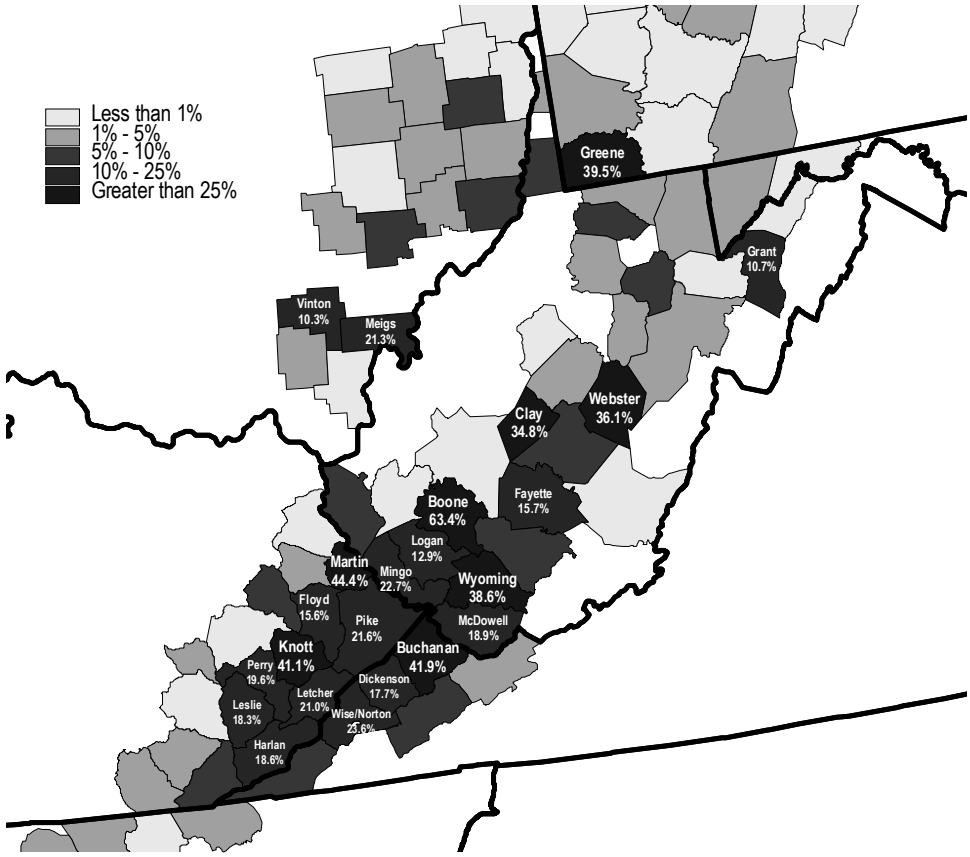
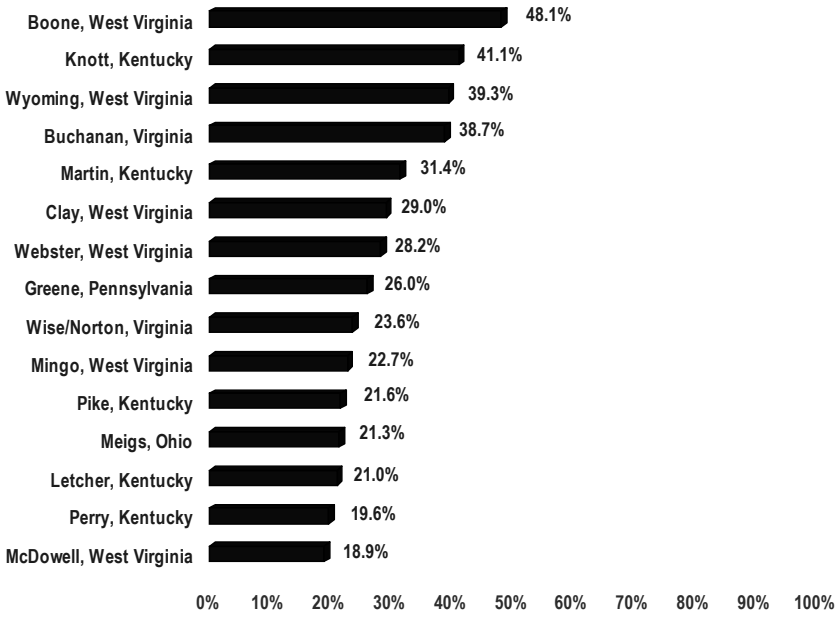


FIGURE 1.2.14: 15 Counties in the ARC Coal Region with the Highest Ratio of Coal Mining Employment to Total Employment, 1997



Coal Mining Earnings as a Percentage of Total Earnings

This concentration is reinforced more strongly when we look at the earnings from coal mining relative to earnings from all industries in each county in the region. Because workers in the coal mining industry earn relatively higher wages and salaries than workers in many other industries, they will tend to have overall higher earnings and represent a higher share of total earnings than indicated by just employment. As a result, the percentage of total earnings from coal mining will tend to be higher than the percentage of total employment from coal mining in these counties. For example, the county with the highest ratio of coal mining to total employment was Boone County, West Virginia, where 48.1% of all employment was in the coal mining industry. In contrast, Boone County had 63.4% of total earnings come from the coal mining industry, which demonstrates the relatively high wages earned by workers in this industry.

Figure 1.2.15 shows coal mining earnings as a percentage of total earnings for each county in the Appalachian coal-producing region for 1997. The darkest of the five shades shows counties in which coal mining earnings account for more than 25 percent of that county's total earnings. As can be seen, Kentucky and West Virginia have the highest concentration of earnings from coal mining, with each state having six counties with a ratio of coal mining to total earnings of more than 25 percent. Both Pennsylvania and Virginia each have one county with this high concentration of coal mining earnings. Pockets of smaller concentration also exist in other areas in the region, including central Alabama, eastern Ohio, and western Pennsylvania.

The concentration evident in the Kentucky-Virginia-West Virginia area is better seen in Figure 1.2.16, which shows a magnified view of the counties in this area, and Figure 1.2.17, which shows the 15 counties in the Appalachian coal-producing region with the highest percentage of total earnings from the coal mining industry. As seen by these figures, some counties in the region are heavily dependent on the earnings from the coal mining industry, with two counties receiving over one-half of their total earnings from the industry. Boone County, West Virginia, has the highest concentration, with 63.4% of total earnings from coal mining, followed by Knott County, Kentucky, at 48.3% of total earnings from coal mining. Other counties with high concentrations of over 40 percent include Mingo County, West Virginia (46.5%); Martin County, Kentucky (44.4%); Buchanan County, Virginia (41.9%); and Clay County, West Virginia (40.7%).

FIGURE 1.2.15: Ratio of Coal Mining Earnings to Total Earnings by County in the ARC Region, 1997

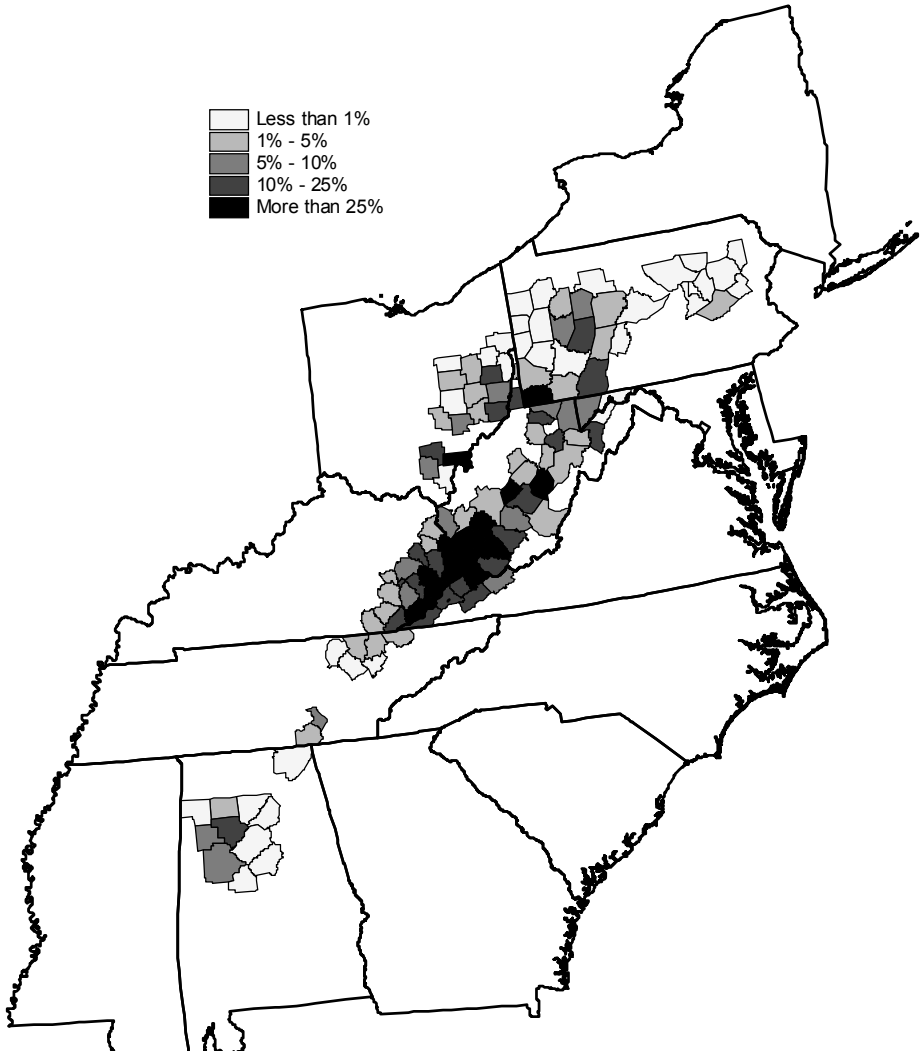


FIGURE 1.2.16: Ratio of Coal Mining Earnings to Total Earnings by County in the ARC Region (Enhanced), 1997

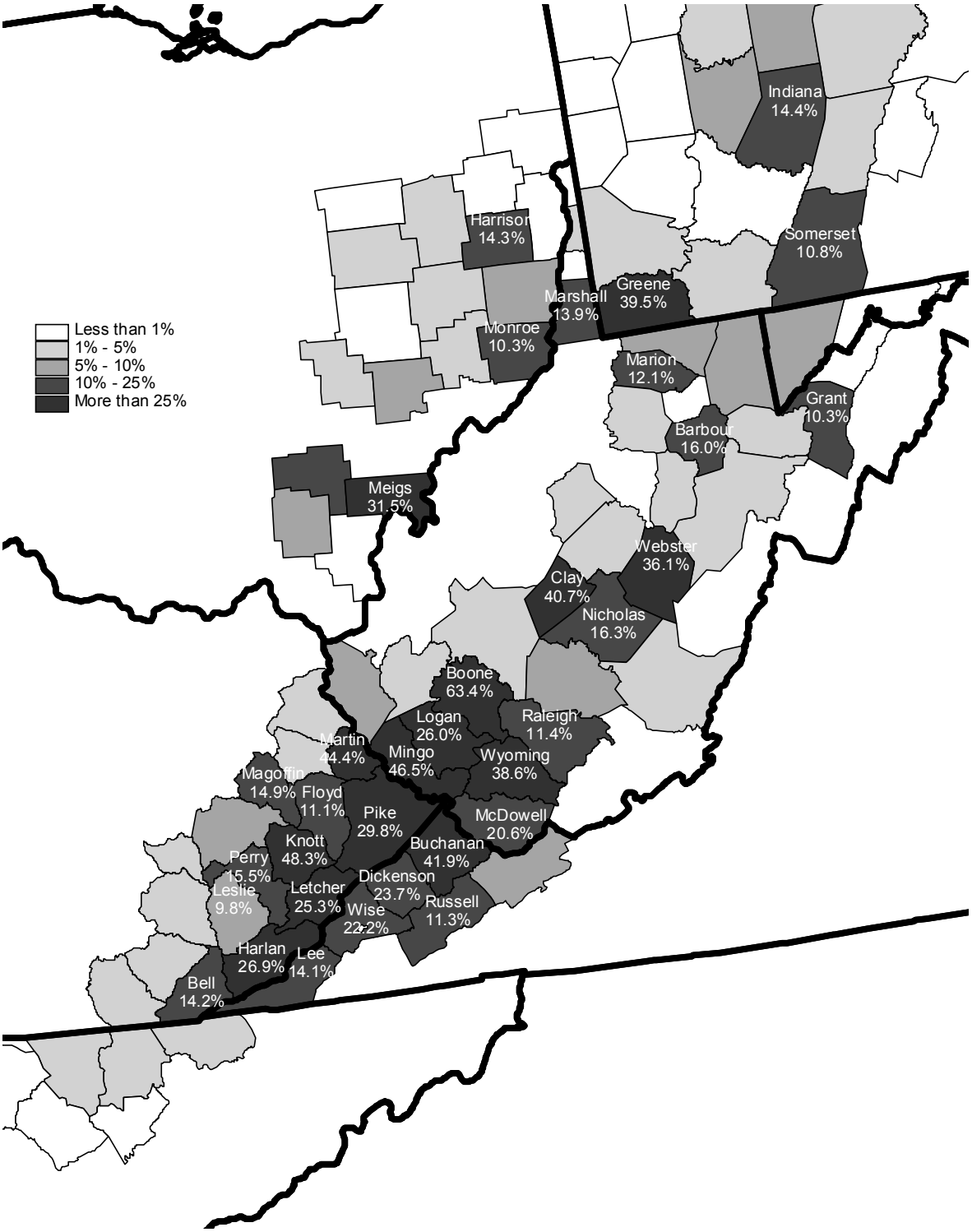
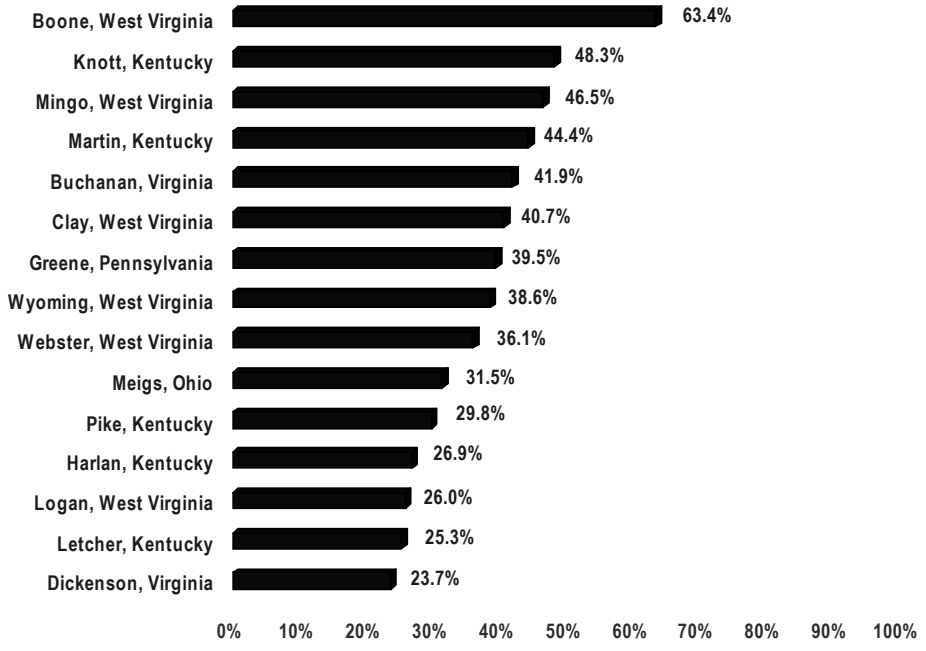


FIGURE 1.2.17: 15 Counties in the ARC Coal Region with the Highest Ratio of Coal Mining Earnings to Total Earnings, 1997



Coal Mining Gross County Product as a Percentage of Total Gross County Product

Finally, Figure 1.2.18 shows the percentage of total gross county product (GCP) that is attributable to the coal mining industry for the Appalachian coal-producing counties in 1997. This figure reinforces the results of the previous analysis of employment and earnings and shows a high concentration of GCP from coal in the Kentucky-Virginia-West Virginia region.

The concentration evident in the Kentucky-Virginia-West Virginia area is better seen in the magnified view of this area presented in Figure 1.2.19. In addition, Figure 1.2.20 presents a ranking of the top 15 counties in the Appalachian coal-producing counties with the highest ratio of coal mining gross county product to total gross county product. Boone County, West Virginia, has the highest concentration with 71.9% of gross county product from coal mining, followed by Knott County, Kentucky at 54.0% of gross count product from coal mining. Other counties with high concentrations of over 50 percent include Mingo County, West Virginia (52.0%) and Clay County, West Virginia (50.0).

These large shares for the coal mining industry reflect the significant contribution of the coal industry to incomes in the region. Gross county product, like gross domestic product (GDP), represents the returns to the various factors of production, including labor and capital, as well as other factors such as tax payments. The earnings of labor are typically the largest component of total gross county product. Therefore, it is not surprising that the coal mining industry would account for a large share of gross county product in counties where it accounted for a large share of worker earnings. The coal mining industry also would be expected to make a large contribution to the capital consumption component of gross county product since it is such a capital-intensive industry.

FIGURE 1.2.18: Coal Mining Gross County Product as a Percentage of Total Gross County Product, 1997

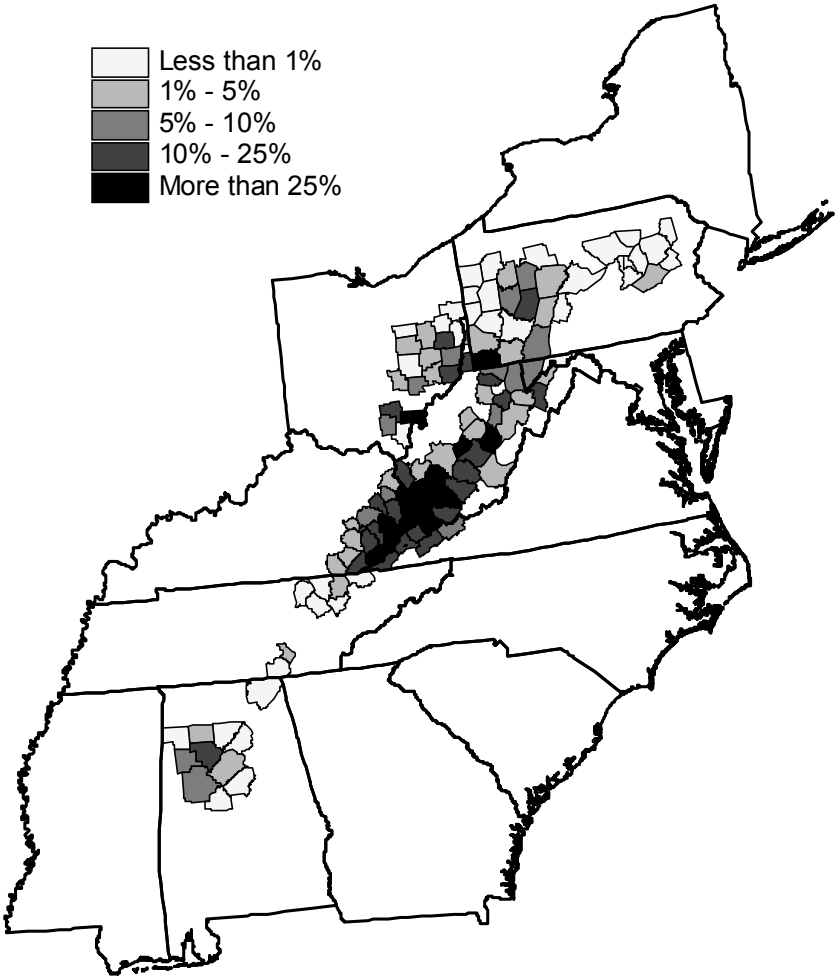


Figure 1.2.19: Ratio of Coal Mining Gross County Product to Total Gross County Product by County in the ARC Region (Enhanced), 1997

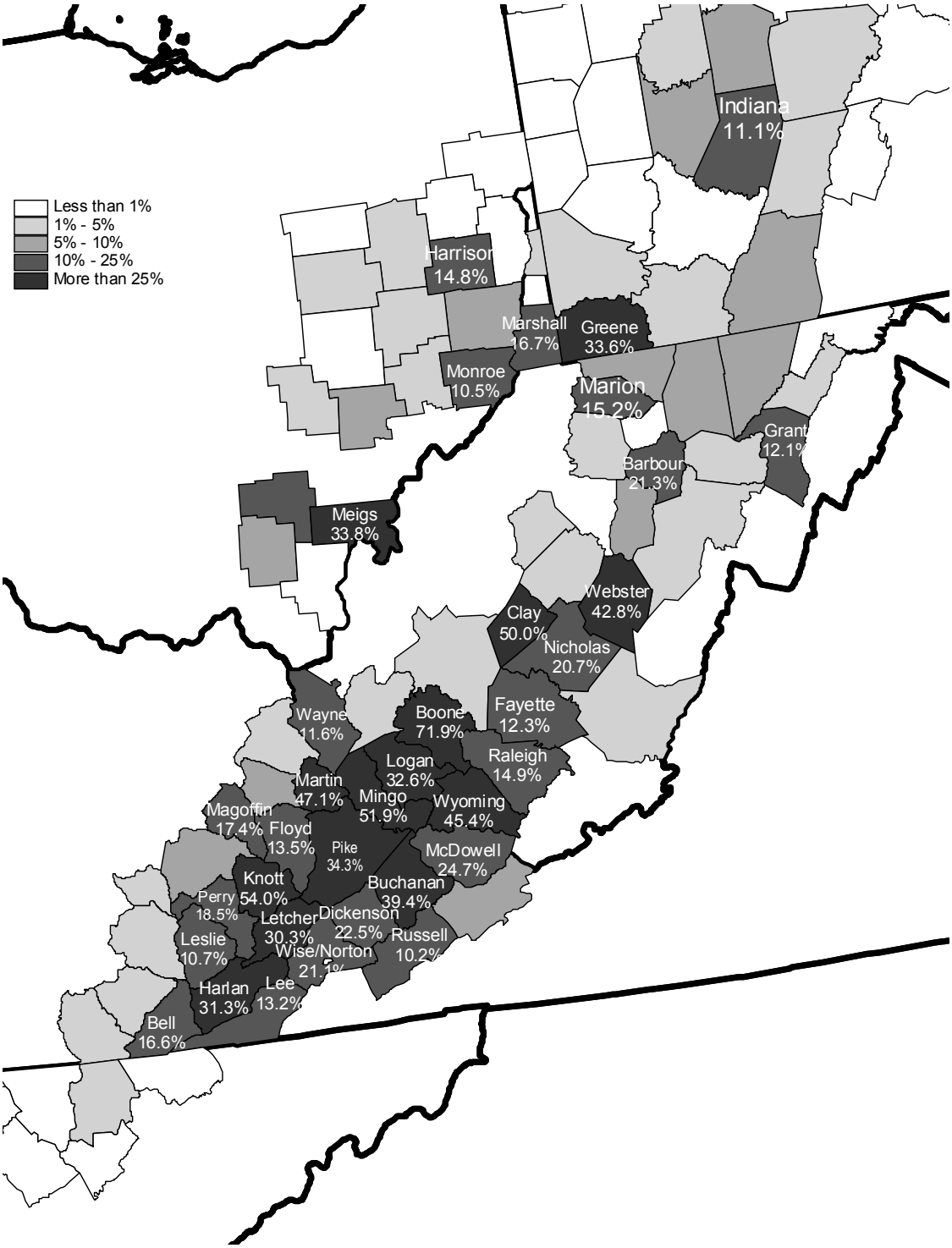
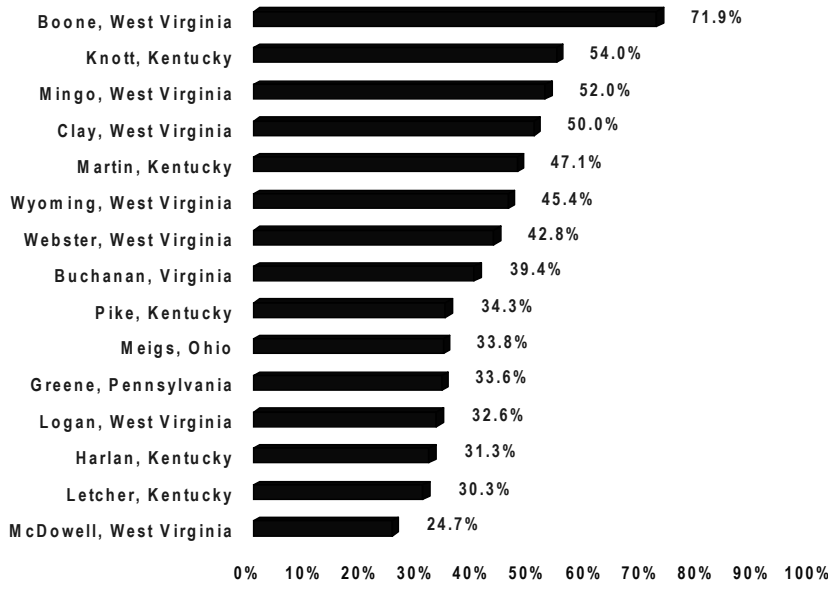


FIGURE 1.2.20: 15 Counties in the ARC Coal Region with the Highest Ratio of Coal Mining Gross County Product to Gross County Product, 1997



Part 1.3: Estimates of the Direct, Indirect, and Induced Economic Effects Attributable to the Coal Industry

Introduction

While there are a number of Appalachian coal-producing counties where coal mining accounts for only a modest share of the local economy, there also are many counties where the industry dominates the local economy, as was demonstrated in the previous section. In 37 of the 118 counties we studied, the industry accounted for more than 10% of value-added (gross county product) in the county economy, while the industry accounted for more than 5% of value-added in 52 counties. Similar percentages could be provided for other economic indicators such as employment or worker earnings.

The overall impact of the coal mining industry on these local economies actually exceeds the figures discussed in the previous section. This is because the coal mining industry supports economic activity throughout the economies of many of the major Appalachian coal-producing counties. Coal companies often support the activities of their suppliers in the manufacturing, machine shop, construction, and business services industry. The wages earned by coal miners supports their spending for a range of retail goods and services throughout the economy. These sorts of additional spending point to a larger economic impact for the coal mining industry than was discussed in the previous section.

The purpose of this section is to consider the total economic impact of the coal mining industry on the local economies of major Appalachian coal-producing counties. The section will consider the direct economic activity occurring in the coal mining industry that was discussed in the last section, but will also examine the "multiplier effect" that occurs as coal companies spend locally on supplies, and coal industry employees spend on the goods and services required by households. This total economic impact on output, employment, and worker earnings will be significantly greater than the direct impacts discussed previously.

Measuring the Multiplier Effect

The concept of economic impact encompasses the overall impact that an industry has on an economy, including both the direct activity of that industry, and the additional economic activity that it supports. The economic impact of a particular industry is typically separated into three different impacts: direct, indirect, and induced. These three impacts together form the total economic impact associated with a particular industry. The following is a description of the three different types of economic effects, with specific examples relating to the coal industry.

- **Direct Effects**

  Direct effects are those which result immediately from spending associated with a particular business or industry. For example, the direct employment effects for coal mining would be the number of coal miners and other workers directly involved in producing coal for sale to end users. A measure of the value of output produced from coal mining is needed to estimate the direct effects.

- **Indirect Effects**

  Indirect effects, along with induced effects, are commonly referred to as "multiplier" effects. These are the economic impacts that occur as the direct spending is made throughout the economy. Specifically, indirect effects represent the impact on output, employment, and income that occur as a business or industry purchases goods or supplies from other businesses that are needed for their operation. For example, a coal mining operation needs a large amount of mining equipment to operate and these purchases would represent indirect effects. Moreover, these businesses that supplied the mining equipment also need goods and services to operate and their purchases from other businesses would be indirect effects as well. These indirect effects continue from business to business until the spending "leaks" from the particular region under analysis and no longer has any additional economic impacts on the region. The "leaks" occur when money leaks out of the region through purchases made from producers out of the region or locality.

- **Induced Effects**

  Induced effects are also termed "multiplier" effects. They represent the economic impacts on output, employment, and income that occur from spending by households in the region that results from additional income created by the direct and indirect effects. Workers at businesses with both direct and indirect effects all earn incomes that they spend on items such as housing, food, clothing, transportation, entertainment, and many other items that are part of their daily lives. For example, a miner employed at a coal mining operation would receive income that he could then spend to pay a home mortgage or to purchase an automobile. Similarly, an employee of the mining equipment business mentioned above would also earn income and have an induced effect on the economy as she spends money on these items of daily living. These induced effects continue as this money is recirculated throughout the economy many times until it eventually "leaks" outside the region under analysis and no longer has any additional economic impacts on that region.

The preceding section dealt extensively with the direct impact of the coal mining industry on county employment, earnings, or value-added. The current section will examine the additional indirect and induced impacts of the coal mining industry, and sum the direct, indirect, and induced impacts to estimate the total economic impact of the coal mining industry.

Economic multipliers will be used to estimate the indirect and induced impacts of the coal mining industry in the counties. These multipliers indicate the amount of indirect or induced economic activity in terms of employment, wages, value-added, or output that are generated for each unit of direct activity. These multipliers can be calculated for each county in the United States, or for county groups, using the Micro IMPLAN model. This is possible because the Micro IMPLAN model can take a national model of spending linkages between industries and consumer spending patterns (the national input-output model) and customize to a particular county or county grouping using information about the employment structure, income pattern, and other information about this local area.

Calculations of the indirect, induced, and total impact of the coal mining industry are based on the direct impacts calculated in the last section, particularly the direct output of the industry. Recall that this output was calculated for each county by multiplying total 1997 county coal production in tons by the average price per ton. Thus, this output figure needed to be estimated in some cases because average price data for 1997 was suppressed in some counties in the Federal data, due to the privacy concerns of specific mines. The method for estimating price data in cases where it was not reported, and the characteristics of those counties where it was not reported, are discussed in the following section. Afterwards, findings are presented for the indirect, induced, and total economic impact of the coal mining industry in major Appalachian coal-producing counties.

Price Data

The average price of coal in each Appalachian coal county is an important variable in the analysis. In particular, it is a key component for calculating coal output in counties, given that coal mining industry output is the product of county production and average price. Due to the importance of the average price variable, average minemouth price data were gathered or, where necessary, estimated for each of the 118 Appalachian coal counties consider in our analysis.

County average minemouth price data were available from the Energy Information Administration of the U.S. Department of Energy. However, for a number of counties, average prices were suppressed in order to protect the confidentiality of particular mining companies. When data were suppressed in this way in a county, average price was estimated. Average price was estimated using data on average price

from a previous year in which price was not suppressed, or using price data from surrounding counties, which often operate on similar coal seams, and thus, presumably have similar production costs and coal quality. Sometimes a combination of both types of data was used. Finally, when no average price data were available from a previous year, or from surrounding counties, than the state average price was used.

Of the 118 major Appalachian coal-producing counties, 1997 average price data was reported in 58 of these counties, but was suppressed in the remaining 60 counties. The 58 counties were the average price was reported were typically among the larger coal-producing counties. This outcome is logical since it is easier to report data in a large coal-producing county with many mines without revealing any confidential information about any particular mine. In particular, the 58 counties were average price was reported accounted for 80.9% of 1997 production in the major Appalachian coal-producing counties. Therefore, output estimates are based on actual, rather than estimated prices, for the vast majority of coal mining production. The need to estimate average prices should not substantially effect aggregate output estimates, or output estimates for the largest counties, even if average prices are estimated for roughly half of the counties. The remaining 19.1% of 1997 production occurred in counties where average price information was suppressed.[9] About two-thirds of this remaining production (12.8%) was in counties where the average price was estimated based on county price data from a previous year, 1997 price data from a surrounding county, or both. One-third of remaining production (6.4%) was in counties where the state average price needed to be used as the estimate for the county average price.

[9] For 22 of 60 counties where price was not reported, price data was available from both a previous year, and for surrounding counties (in the current year). These 22 counties accounted for 9.8% of 1997 production in the major Appalachian coal-producing counties. In these counties, both the data on average price in a previous year and average price in surrounding counties was used to estimate the average county price in 1997. The county average price was estimated using a weighted average of the county price from a previous year, or the average price in surrounding counties. The weights were chosen based on a regression using data from counties where average prices were reported. These regressions predicted average price in these counties based on prices from a previous year and the 1997 price in surrounding counties (there was no intercept term in the regression). Regression results indicated the weight to place on the county price from a previous year and the 1997 price in surrounding counties. The regression was re-run for each previous year (i.e., one regression based on 1996 county price and 1997 surrounding county data, another based on 1995 county price and 1997 surrounding county data, etc. back to 1990 price data). The weight assigned to the 1997 price in surrounding counties varied from near 0% when paired with the 1996 county price, to 45% when paired with a county price from an earlier year. In 8 of 60 counties where price was suppressed, average price was available for the county in a previous year, but there was no information on 1997 average prices in surrounding counties. These 8 counties accounted for 2.0% of 1997 production in the major Appalachian coal-producing counties. In 13 of 60 counties, there was information on 1997 prices in surrounding counties, but no price information from the county itself in a previous year. These 13 counties accounted for 1.0% of 1997 production in the major Appalachian coal-producing counties. For 17 of the 60 counties, there was no price data from a previous year or a surrounding county, so the state average price was utilized as the price estimate. These 17 counties accounted for 6.4% of 1997 production.

Findings

The total economic impact of the coal mining industry on coal-producing counties in Appalachia is substantially larger than the direct impact of the coal mining industry itself. The additional impact due to the induced and indirect effects varies by state or groups of counties, but generally speaking is roughly 50% to 150% as large as the direct effect of the coal industry. The additional impact is typically 50% to 75% larger for value-added and income, but from 100% to 150% larger for employment. This difference again arises from the relatively high wages paid in the coal mining industry.

Given these additional impacts, the total impact of the coal mining industry on regional economies is substantially larger than what was reported in the last section, particularly for employment. This can be seen in Table 1.3.1. The direct output value of coal production was $12.4 billion in the 118 major Appalachian coal-producing counties, but the total impact throughout the economy was $18.5 billion, or about 50% larger. Direct earnings by workers in the coal mining industry was $4.0 billion in 1997, but the total impact on earnings was $6.5 billion, or about 60% larger. Direct industry employment in major Appalachian coal-producing counties was around 60,000, but the total employment impact was 143,000, or about 140% larger.

TABLE 1.3.1: Direct and Total Economic Impact of the Coal Mining Industry in the Appalachian Coal-Producing Counties, 1997

	Direct Impact ($1997)	Indirect and Induced Impacts ($1997)	Total Impact ($1997)
Output	$12.4 billion	$6.1 billion	$18.5 billion
Worker Earnings	$4.0 billion	$2.5 billion	$6.5 billion
Employment	60,000 jobs	73,000 jobs	143,000 jobs

Sources: Energy Information Administration and authors' calculations

The impact of the industry on major coal-producing counties in Appalachia is larger once these indirect economic impacts are considered. The coal mining industry's total impact on earnings of $6.5 billion accounts for 5.3% of total earnings in Appalachian coal-producing counties. The industry's total impact on employment accounts for 4.7% of all employment in these counties. These percentages are much larger in some county groupings in the major Appalachian coal-producing region, as is discussed below.

Economic Impact for Entire States

Coal mining's share of the economy in major Appalachian coal-producing counties varies throughout the region, and varies substantially among states. This is true of the total economic impact of the coal mining industry as well as the direct impact of the industry. The impact on individual states is summarized in Table 1.3.2.

TABLE 1.3.2: Direct and Total Economic Impact of the Coal Mining Industry in Major Appalachian Coal-Producing Counties by State, 1997

	Alabama	Kentucky	Maryland	Ohio	Pennsylvania	Tennessee	Virginia	West Virginia
Total Coal Production (tons)	24.5 million	120.5 million	4.2 million	28.6 million	76.2 million	3.3 million	35.8 million	173.7 million
Total Employment Impact (jobs)	13,200	30,300	1,300	9,200	27,100	1,700	17,000	43,600
Share of Total Employment	2.4%	31.9%	3.9%	4.2%	1.6%	2.4%	39.1%	14.6%
Total Earnings Impact	$645.7 million	$1,280.3 million	$43.6 million	$318.5 million	$1,625.7 million	$49.0 million	$587.6 million	$1,935.7 million
Share of Total Earnings	2.9%	34.0%	3.5%	4.2%	2.3%	1.9%	32.1%	15.2%
Total Output Impact	$1.5 billion	$4.4 billion	$0.1 billion	$1.0 billion	$2.9 billion	$0.1 billion	$1.5 billion	$6.9 billion

Sources: Energy Information Administration and authors' calculations

The total impact followed the same pattern as the direct impact, as pictured in Table 1.2.2. The largest total impact in terms of output, earnings and jobs occurred in West Virginia, Kentucky, and Pennsylvania. The smallest impacts occurred in Maryland and Tennessee.

Table 1.3.2 also lists the relative size of the economic impact of the coal mining industry among major Appalachian coal-producing counties in each state. These percentages show the importance of the coal mining industry, and its total economic impact to the relevant local economies in these states. These results show the total economic impact of coal mining is most important in Kentucky and Virginia. The total economic impact of coal mining accounts for nearly 40% of jobs and 32% of worker earnings in major coal-producing counties in Virginia, and for 32% of jobs and 34% of earnings in coal-producing counties in Appalachian Kentucky. In other words, the coal mining industry accounts for roughly a third of the economic activity in these counties.

The total economic impact from coal mining also accounts for a substantial share of employment and earnings in West Virginia (approximately 15%) coal-producing counties. The share of the economy is less than 5% in the other Appalachian states of Alabama, Maryland, Ohio, Pennsylvania, and Tennessee. Coal-producing counties in these states overall tended to have more diversified economies less dependent on coal mining, at least on average. This was true even of Pennsylvania which had the 3rd highest level of coal production within Appalachia of the 8 states listed in Table 1.3.2.

It should be remembered, however, that these aggregate figures for these states represent totals for all counties in a state. Sometimes the aggregate figures include counties with large metropolitan areas like Pittsburgh, PA or Charleston, WV. Therefore, even in states with a moderate or low overall share, there may be individual counties where the overall impact of the coal mining industry accounts for a very large share of the local economy. This is clearly the case for some counties in Pennsylvania and West Virginia, as is discussed in the next section.

Economic Impact for Counties and Multi-County Regions

The coal industry's largest economic impacts are found in a number of West Virginia, Pennsylvania and Alabama counties, as well as in counties in Virginia and Kentucky. This can be seen in Figures 1.3.1 through 1.3.3. In Pennsylvania, the total economic impact of coal mining in Greene County was $1.3 billion in output and over $270 million in earnings, and nearly 5,400 jobs. The total employment impact of the industry topped 3,000 in nearby Indiana County, 4,000 in Washington County and nearly reached 2,000 in Armstrong and Clearfield Counties. There were also two Alabama counties where the coal mining industry had a very large economic impact. In both Jefferson and Tuscaloosa Counties, the total economic impact in terms of jobs was approximately 5,000.

Figure 1.3.1: Earnings Impact as a Share of the Local Economy by County in the ARC Region

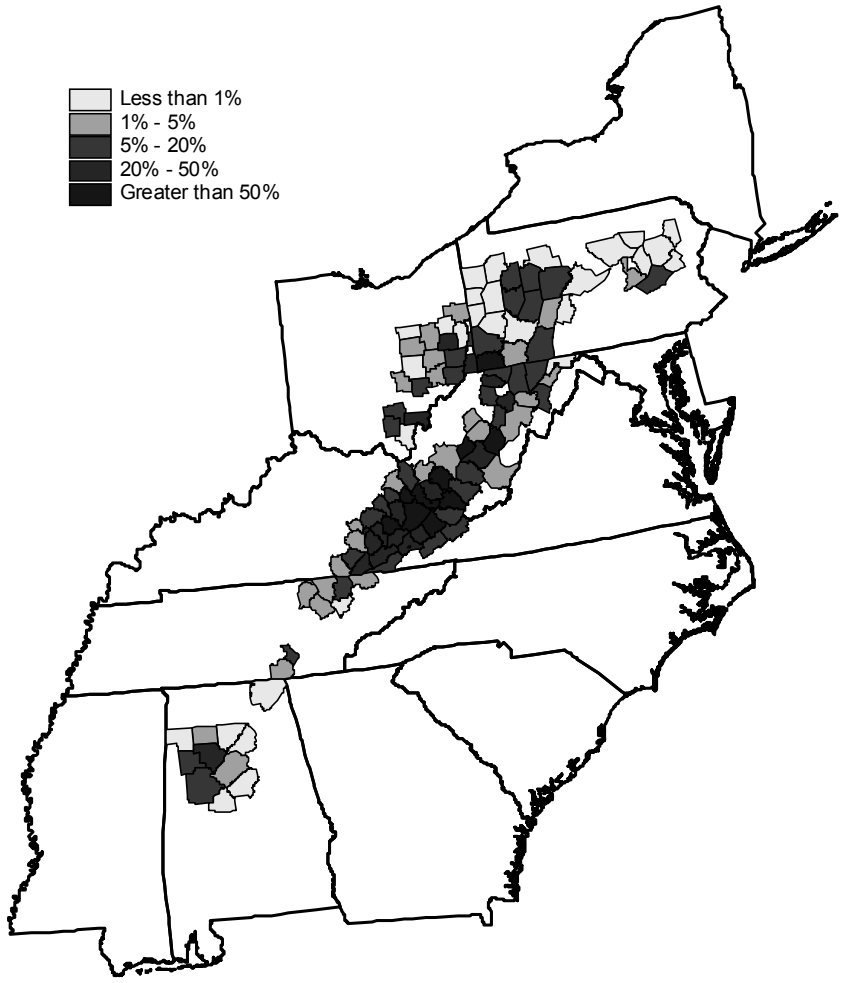


Figure 1.3.2: Employment Impact as a Share of the Local Economy by County in the ARC Region

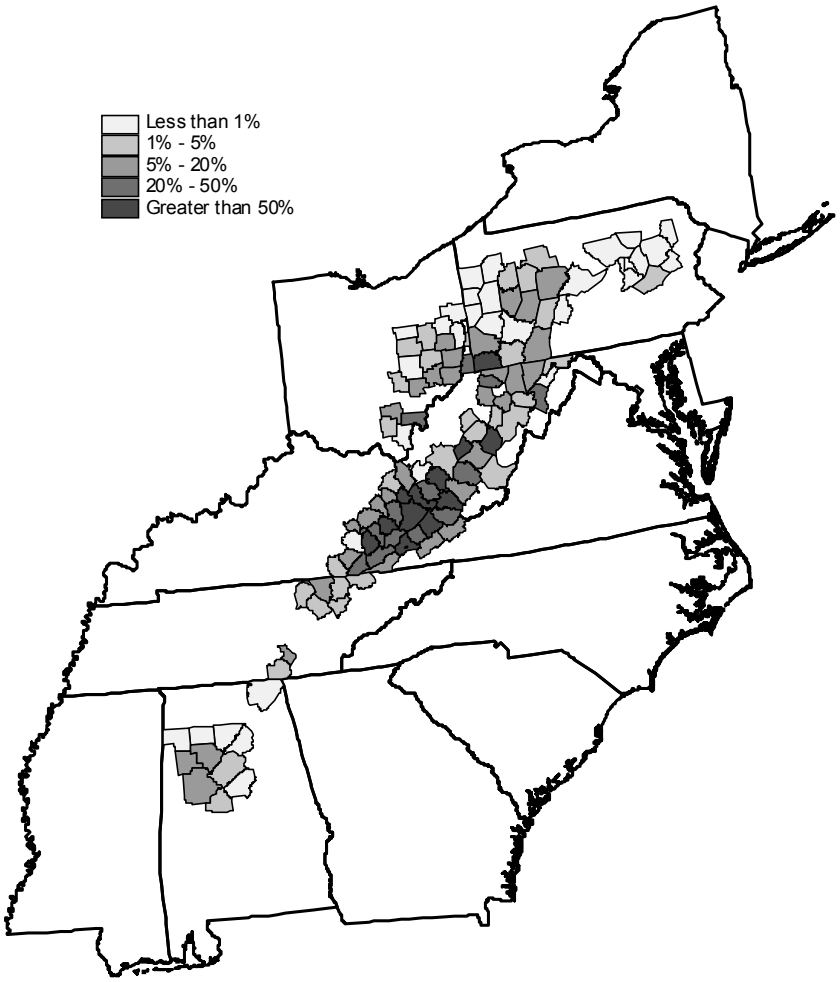
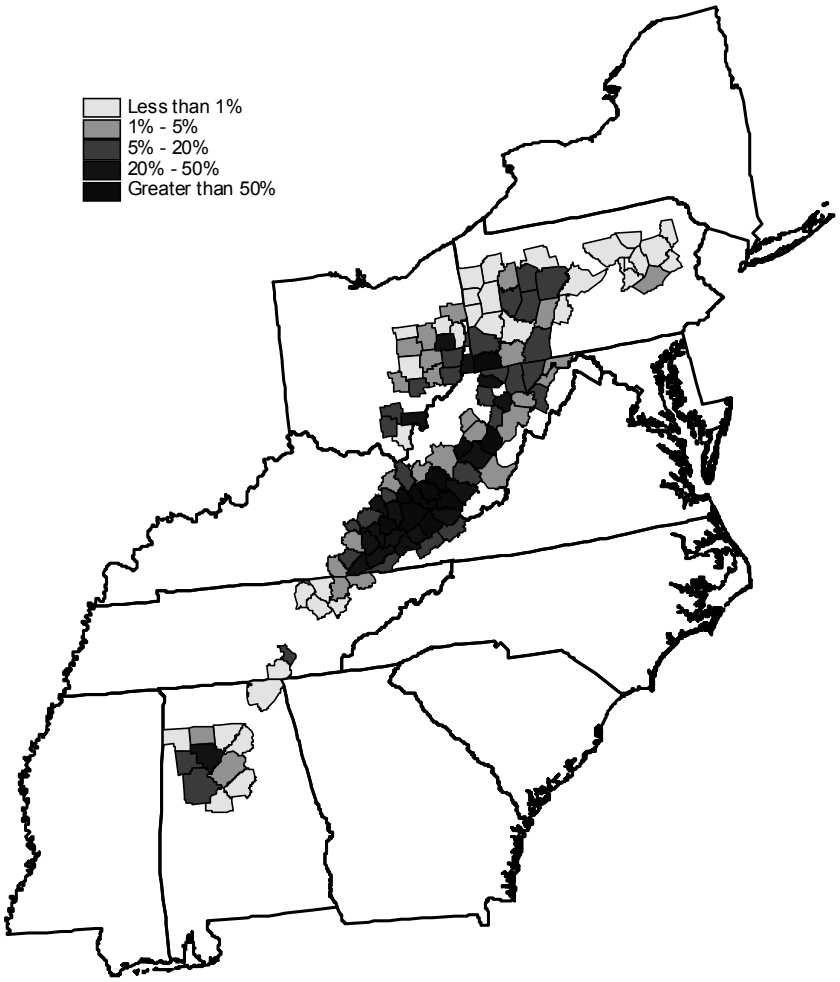


Figure 1.3.3: Value-Added Impact as a Share of the Local Economy by County in the ARC Region



As was found with the direct economic impact, the total county economic impacts are largest at the border region where Kentucky, West Virginia and Virginia intersect and are visible in Figures 1.3.4 through 1.3.6. In this region, the largest economic impact occurred in Pike County, Kentucky, where the total output impact was $1.4 billion, the total earnings impact was $420 million, and the employment impact was over 10,000 jobs. There also was a very large economic impact in adjacent Mingo County, West Virginia, where the total output impact was $0.9 billion, the earnings impact was $270 thousand, and the employment impact was 3,600 jobs. There was a similarly large total economic impact in nearby Logan, Boone, and Raleigh Counties in West Virginia. There also was a large economic impact in Virginia Counties bordering Pike County, Kentucky. The total employment impact in Buchanan County, Virginia reached nearly 7,000 jobs, while the total impact reached 5,500 jobs in Wise/Norton County, Virginia.

Figure 1.3.4: Total Earnings Impact by County in the ARC Region

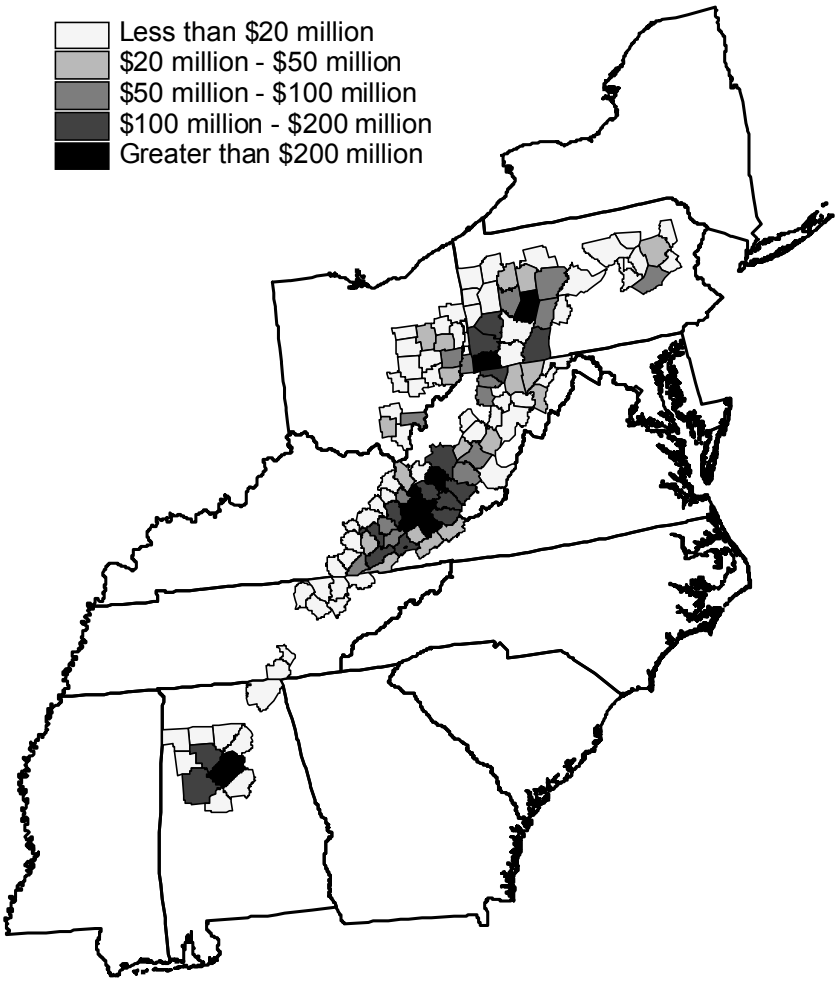


Figure 1.3.5: Total Employment Impact by County in the ARC Region

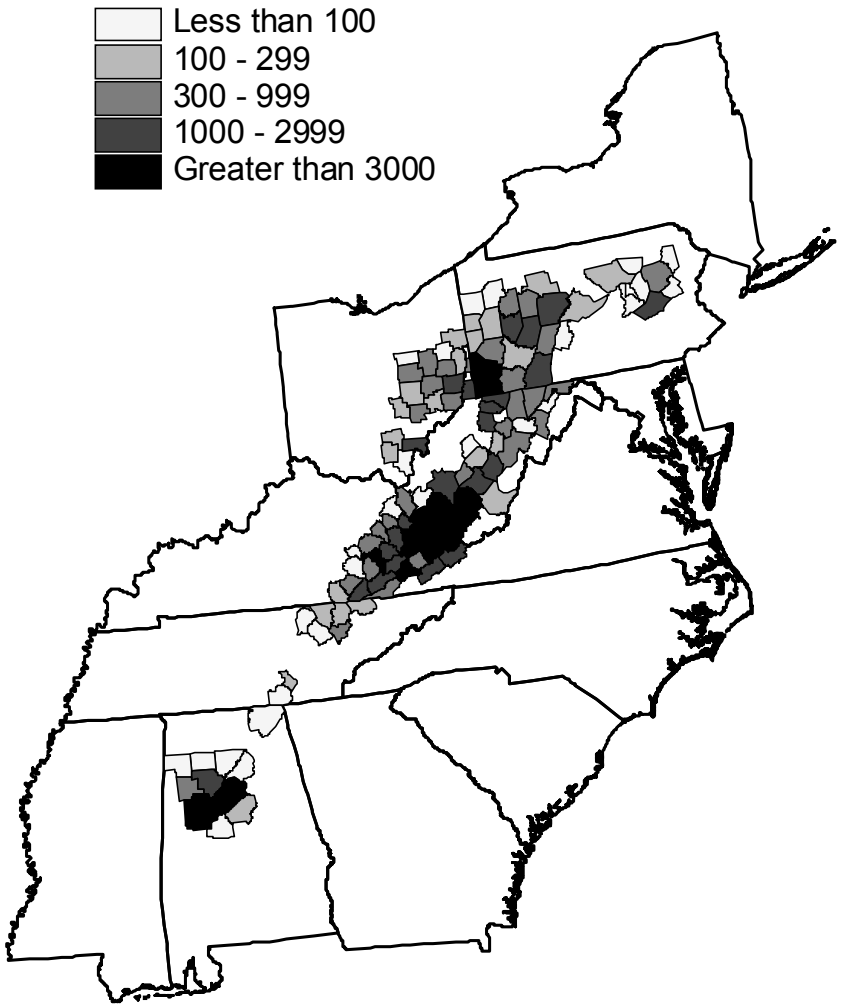
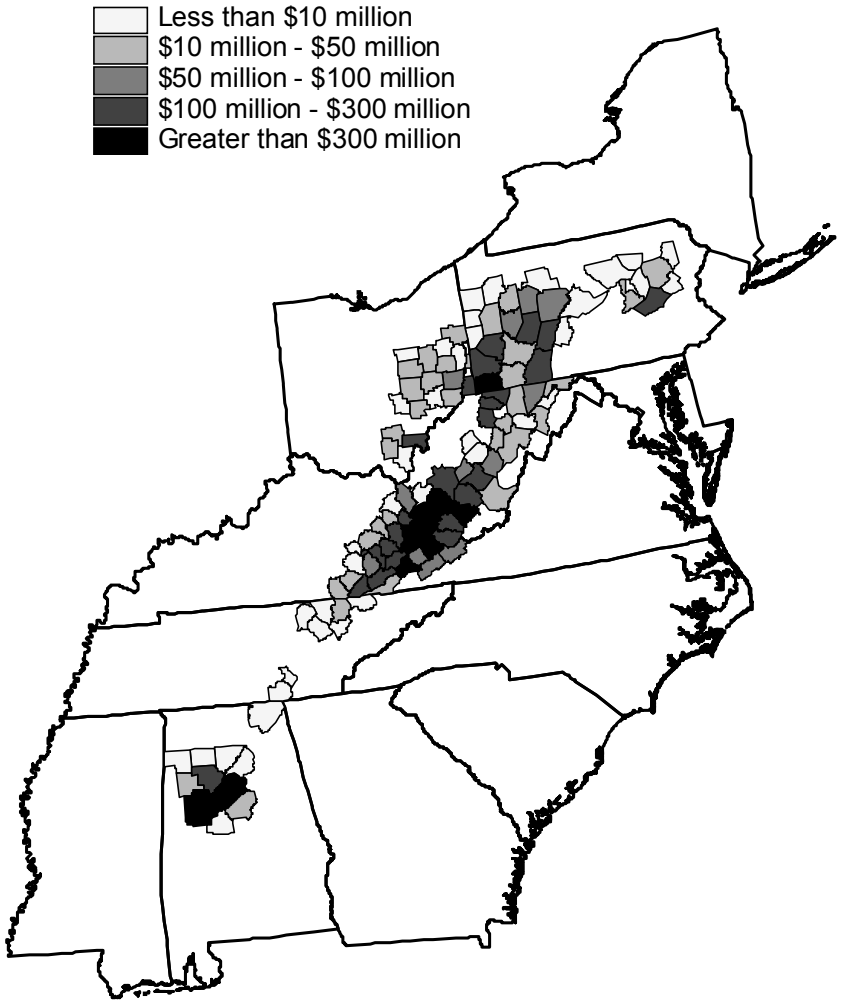


Figure 1.3.6: Total Value-Added Impact by County in the ARC Region



These large impacts from the coal mining industry often accounted for a very large portion of the economy in this mostly rural or small-city region where Kentucky, Virginia, and West Virginia intersect. The total impact of the coal mining industry accounts for roughly 50% of the employment and earnings in Pike County, Kentucky, even though this is a larger, diversified county with a population of over 70,000, and substantial health care and retail industries. The total impact of coal mining is an even larger percentage of the economy in some of the smaller, more rural counties in this region. It accounts for 70% of earnings and about 50% of employment in Mingo County, West Virginia and over 90% of employment and earnings in Boone County, West Virginia. The industry also accounts for a large share of the economy in some smaller counties where the absolute magnitude of coal mining activity was not as large as in the major production counties such as Mingo County, West Virginia. The total impact of the industry accounted for 60% of earnings and 80% of employment in Wyoming County, West Virginia, and roughly 35% of employment and earnings in McDowell County.

In Virginia, the total impact of the coal mining industry accounts for about 70% of earnings and more than 80% of employment in Buchanan County. The industry impact accounts for about 40% of earnings and 60% of employment in Wise/Norton County. The total industry impact is a large share of the economy even in counties with more modest levels of coal production than those found in Buchanan and Wise/Norton Counties. The industry accounts for 35% of employment and earnings in Dickenson County, and roughly 20% of employment and earnings in both Russell and Lee Counties.

In Kentucky, in addition to accounting for about half of the employment and earnings in Pike County, the total impact of the coal mining industry accounted for 60% of employment and earnings in Martin County, and roughly 40% of employment and earnings in both Floyd and Letcher Counties. The total impact of the coal mining industry accounts for 70% of employment and earnings in Knott County, Kentucky, 45% of employment and earnings in Harlan, and large shares in Perry and Leslie Counties. These individual county shares go to demonstrate the central role of the coal mining industry within the local economies of the Kentucky, Virginia, and West Virginia border region.

The importance of the industry is more modest in some of the other large production counties identified earlier. For example, in Alabama, there were large production levels in Jefferson and Tuscaloosa counties. However, the total impact of the coal mining industry accounted for only about 1.5% of earnings and employment in Jefferson County, Alabama, and just less than 10% of employment and earnings in Tuscaloosa County. The smaller share was due to the larger, more diversified nature of the local economies where coal production was centered in the Southern Appalachian coal producing regions of Alabama. However, it should be noted that the total impact

of the industry did account for 10% to 25% of employment and earnings in Fayette and Walker Counties in Alabama, and about 10% in Sequatchie County, Tennessee.

More modest shares also were found in the northern Appalachian production region, although the shares were larger than in the Southern Appalachian region. Typically, the total impact of the coal mining industry accounted for about 20% or less of employment and earnings, even in counties with high levels of production. Among the highest production counties in northern Appalachia, the total impact did account for about 60% of employment and earnings in Greene County, Pennsylvania, but only about 20% in Indiana County, just over 10% in Armstrong County, and around 7% in Clearfield and Washington Counties in Pennsylvania. The total impact of the industry accounted for around 15% to 25% of employment and earnings in Marshall County and Harrison Counties in West Virginia, and 10% or less in Monongalia and Harrison Counties. The total impact of the industry was about 10% of earnings and employment in Garrett County, Maryland. In Ohio, the total impact of the industry is between 10% to 20% of employment and earnings in Monroe, Belmont and Harrison Counties

The results for the total impact of the coal mining industry in individual counties suggests that there are counties throughout Appalachia where that impact accounts for a substantial share of local economic activity. As noted previously, these more coal-dependent counties tended to be relatively concentrated in Central Appalachia, particularly along the Kentucky, Virginia, and West Virginia border area. This suggests that it would be of interest to examine the total economic impact of the coal mining industry on a regional level, as was done in the previous section for the direct economic impact of the industry.

Such an economic impact would be based on regional economic multipliers for the coal mining industry, rather than the county economic multipliers used in the previous analysis. Regional multipliers are most appropriate for analyzing the impact in this larger geographic region. In particular, regional multipliers would more fully capture the supply linkages for coal mines throughout their region, rather than just within the same county.[10] As a result, the regional multipliers tend to be larger than local multipliers.

Table 1.3.3 shows the total economic impact of the coal mining industry as a percentage of the overall economy of Northern, Central, and Southern Appalachia. The results show that the total impact of the coal mining industry is significant in Northern and Southern Appalachia, but is enormous in Central Appalachia. The total economic impact of the coal mining industry accounts for nearly 30% of employment, earnings and value-added in the Central Appalachia region. These high percentages reflect the central role that coal mining plays in the economy of many counties within this region.

[10] Regional multipliers also would better capture the regional shopping behavior of coal mine employees, rather than only reflecting local shopping patterns.

There are also counties in other parts of Appalachia where the coal mining industry is just as central a part of the economy. However, for Northern and Southern Appalachia overall, the total economic impact of the coal mining industry accounts for roughly 3% of employment, earnings, and value-added. While estimates of gross county product are more a measure of output (production times price) in the region, the total economic impact accounts for the effect of the coal industry on earnings, as well as employment and value-added.

Table 1.3.3: The Total Economic Impact of the Coal Mining Industry as a Share of Regional Economic Activity

	Share of Economic Activity		
Region	**Employment**	**Earnings**	**Value-Added**
Northern Appalachia	3.1%	3.4%	2.7%
Central Appalachia	29.9%	27.6%	29.8%
Southern Appalachia	2.7%	3.0%	3.2%

Sources: Authors' calculations

Linkages

The multiplier effects examined in this section in part are the result of industrial linkages between coal mines and their suppliers. In particular, the indirect effect reflects how the spending of coal mine businesses on supplies sets off a chain of demand for the goods and services of local businesses. To begin with, these indirect effects reflect the purchase of supplies by coal mines from local business such as machine shops or construction firms, but also include the local supply purchases of these machine shops and construction firms themselves. Thus, the indirect multipliers reflect both the supply linkages between coal mines and their local suppliers, and other supply linkages in the economy. But, the local supply linkages of coal mines are the first and primary component of an indirect multiplier.

This section will examine the strength of local supply linkages for the coal mining industry throughout the Appalachian coal-producing region. The analysis examines in which parts of the region these local supply linkages are strongest. The areas will be the places that may benefit the most from current coal production in Appalachia, but may be most effected if coal activity is reduced in the future.

The first approach to identify areas with the strongest local linkages will be to examine the indirect output multipliers for each of the 118 counties and in the three regions of Northern, Central, and Southern Appalachia. In addition to examining these multipliers, analysis will focus more directly on the key suppliers for the coal mining industry, by examining the extent to which each of the 118 coal-producing counties contain key supply businesses. Four industries will be examined: explosives; screw machine products and bolts; mining machinery except oil field; and conveyors and

conveying equipment. These industries were identified using the IMPLAN model for Kentucky as the industries with the greatest linkages in terms of dollars of product purchased to the coal mining industry. Several other industries which had large sales to coal mines were not consider since these industries sell to many industries, so there presence in a county would not necessarily mean a linkage to coal mining. Trucking, wood products and logging, railroads, and water transportation are examples of these industries.

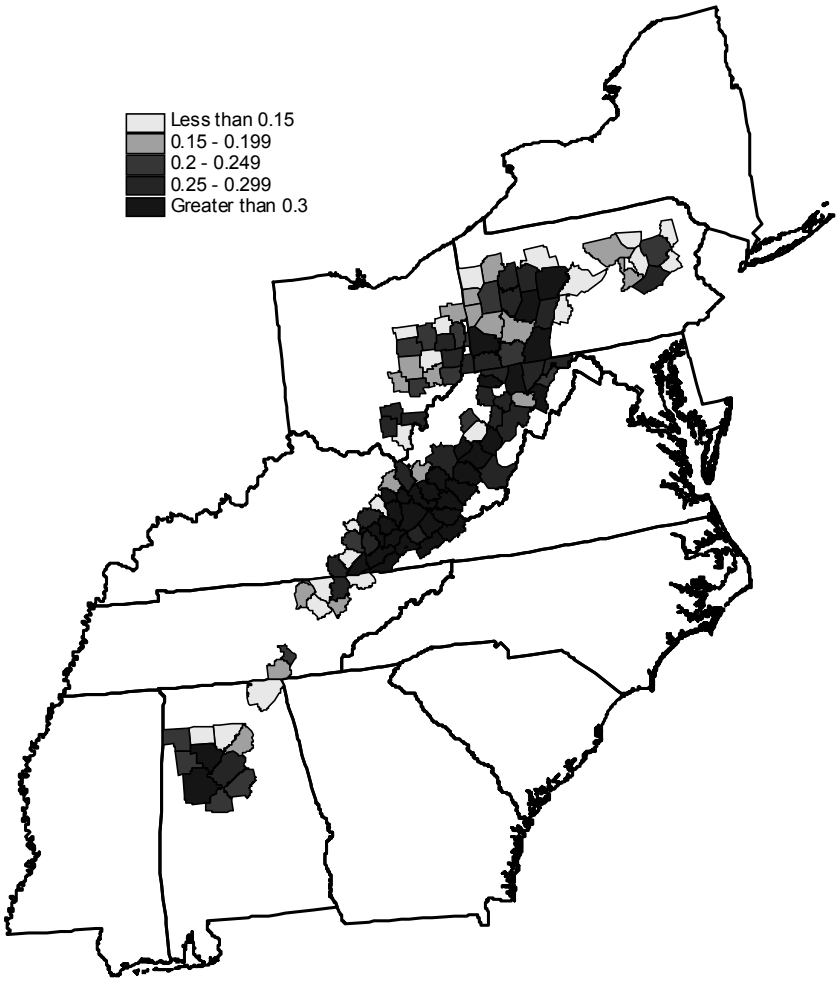
Figure 1.3.7 shows the indirect output multipliers for each of the 118 major coal-producing counties. The indirect multiplier simply shows the output in other county businesses per dollar of output in coal mining businesses that goes to meet the demand of business customers (i.e., not purchases by individuals). Results in the map show that there are both high and low county multiplier values spread throughout the Appalachian region. However, the high multiplier values tend to be concentrated in the Central Appalachian region, and to a lesser extent, in a portion of Northern Appalachia where Pennsylvania borders West Virginia. The results suggest that these are regions where the linkages between coal mining and local industry is greatest. The last column of Appendix E gives county level values of the indirect multipliers.

Turning to the linked industries, we examine the number of businesses in the four industries of explosives; screw machine products and bolts; mining machinery; and conveyors.[11] Looking at Southern Appalachia, there were 22 businesses in the four industries examined in the coal-producing counties of Alabama and Tennessee. In Central Appalachian states, there were 57 businesses in these industries in Kentucky, Virginia, and Southern West Virginia. In Northern Appalachia, there were 98 businesses from these linked industries in Pennsylvania, Ohio, Maryland, and Northern West Virginia, including 70 in Pennsylvania alone. These data show that the direct linkages, like the multipliers, tend to be greatest in Central Appalachia, and in the Pennsylvania portion of Northern Appalachia.

Both types of multiplier analysis indicate that inter-industry linkages to the coal mining industry are greatest in the very counties or regions where the industry is concentrated. This further suggests that the fortunes of the economy in these areas will be closely tied to the fortunes of the coal mining industry.

[11] Businesses in three major cities in the Appalachian coal-producing region are excluded in this analysis since it is much more likely that businesses in these cities would not primarily serve the coal mining industry. These cities are Pittsburgh, PA, Charleston, WV, and Birmingham, AL. This is done since it is more difficult to assume that businesses from these industries that are located in larger, more diversified economies would necessarily be suppliers to the coal mining industry.

Figure 1.3.7: Individual Output Multipliers for 118 Appalachian Coal Producing Counties



Part 1.4: Estimates of Potential Tax Revenue Impacts Related to Coal Production and Exports

Introduction

Coal production generates substantial revenues for state and local governments through coal severance taxes. Such coal tax revenues are the most obvious types of tax revenue generated by the coal mining industry. But, the tax revenues generated due to the industry are not limited to coal severance taxes. The aggregate economic impact of the coal industry generates many types of tax revenues. For example, the increase in worker earnings leads to additional income and payroll tax revenues, while the "multiplier" effect leading to sales at local retail outlets can yield sales tax revenues.

These tax revenue impacts are an important part of the overall impact of the coal mining industry since the taxes help support local and state government services in the major Appalachian coal-producing regions. Such revenues are important for maintaining the quality of life, school funding, or funding for public infrastructure. The tax revenue also is important for meeting some of the additional public costs associated with an active local coal industry, such as additional costs for road maintenance, and perhaps, maintaining water quality or other environmental needs.

This report focuses on three main sources of tax revenue: coal severance taxes, income taxes, and sales taxes. These taxes naturally account for a substantial share of revenue in Appalachian states. There are additional revenues supported by other types of taxes and fees garnered because a local coal industry makes Appalachian coal counties larger. However, it is beyond the scope of this study to model these given separate taxes in 8 different states and over 100 counties.

Coal severance tax revenues are estimated first, based on direct coal production in counties and states. Income taxes are estimated next based on the total earnings impact of the coal mining industry within the major Appalachian coal-producing counties. Sales taxes are estimated last, while the final section aggregates coal severance, income, and sales taxes.

Severance Taxes

Severance taxes are a group of taxes that are specifically levied on natural resource extraction industries but generally are not levied on non-resource industries. Severance taxes are levied on coal and other natural resources as they are mined, or "severed", from the ground. In the case of coal, taxes typically are assigned either on a per ton basis, or on a percentage of the value of coal mined. Taxes typically are collected by state revenue agencies, with most revenue remaining in the state and a portion of the revenue returning to counties where the coal is mined.

The state and local severance taxes generated by the coal industry are directly related to the coal production in specific counties or regions in each state. These revenues therefore can be directly estimated based on the production and value of output figures from Task 2. Such estimates were prepared for each of the 118 major Appalachian coal-producing counties. For estimating severance tax revenues, the appropriate tax rate in each state or county should be applied to the production or value of output presented in Task 2.

This simple process, however, is complicated somewhat by the fact that the severance tax regime varies substantially among the 8 states where these 118 coal-producing counties are located. Some states do not have a severance tax, and the tax rate varies among those states with a tax. Each state with the tax has a different mechanism for sharing revenue with counties, and some states even allow direct county taxation. We utilized Internet web sites and direct communications with state tax revenue departments to identify the severance tax regime in each state, and then used the tax rate information to estimate severance tax revenues for each state.

Our finding was that Maryland and Pennsylvania did not have special severance taxes while Alabama, Ohio, Tennessee, Kentucky, Virginia, and West Virginia did have such a tax. The Alabama, Tennessee and Ohio taxes were assessed per ton with Alabama and Tennessee taxing at $.20 per ton and Ohio at $.09 per ton. Alabama severance taxes were returned to counties and localities. Kentucky, Virginia, and West Virginia severance tax regimes were based on the value of coal as it is mined, where value of output is simply production multiplied by the minemouth price of coal. This value of output was estimated in Task 2. A county severance tax rate of 2% is assessed in Virginia where there is no state severance tax. The base severance tax rate is 4.5% of value of production in Kentucky and 5% in West Virginia. In West Virginia, there are special lower tax rates for new mines operating in narrow coal seams so the effective tax rate is lower statewide. We calculated the statewide effective severance tax rate to be 3.86% during fiscal year 1997. This tax rate includes a 0.35% severance tax rate for West Virginia counties.

These tax rates were utilized to produce estimates of severance tax revenue in each state that are presented in Table 1.4.1 below. The table also illustrates whether severance taxes accrue to state or local governments. The total estimate of severance tax revenue across the 8 states is $339.8 million per year. State government would retain roughly three-quarters of this revenue, while the rest would go to county and local governments or programs. The greatest revenues were collected in states with the largest production including Kentucky, West Virginia, and, to a lesser extent, Virginia. These three states alone account for 98% of severance tax collection, since Pennsylvania does not have a severance tax on coal.

With no severance tax in Pennsylvania, and the highest severance tax rates in Kentucky, West Virginia, and Virginia, the result is that coal severance taxes are heavily concentrated in the central Appalachian region. As is illustrated in Figure 1.4.1 below, severance tax collection is heavily concentrated in the border region of Kentucky, Virginia, and West Virginia.

Figure 1.4.1: Severance Tax Collection by County in the ARC Region

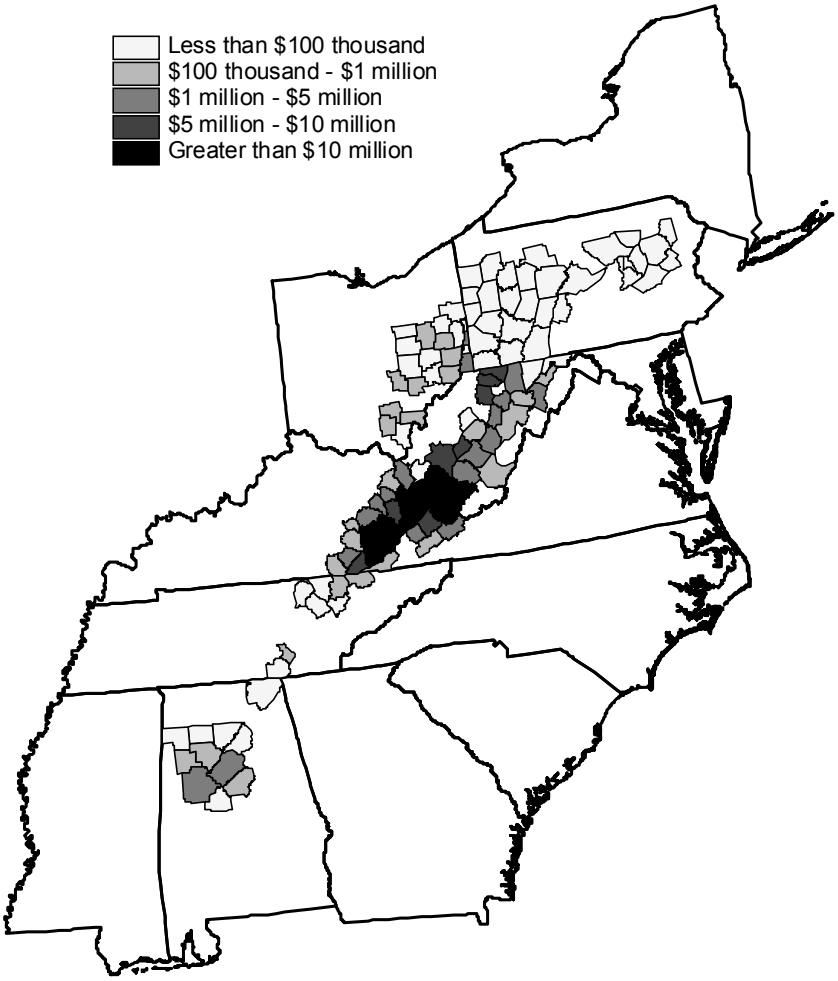


Table 1.4.1: Severance Tax Revenues by State

State	Severance Tax Revenue		
	Total	State Government	County and Local Government
Alabama	$4.9 million	$0 million	$4.9 million
Kentucky	$134.0 million	$93.8 million	$40.2 million
Maryland	$0 million	$0 million	$0 million
Ohio	$2.7 million	$2.7 million	$0 million
Pennsylvania	$0 million	$0 million	$0 million
Tennessee	$0.7 million	$0.7 million	$0 million
Virginia	$20.2 million	$0 million	$20.2 million
West Virginia	$177.3 million	$161.2 million	$16.1 million
Total	$339.8 million	$258.4 million	$81.4 million

Source: Authors' calculations

Income Tax

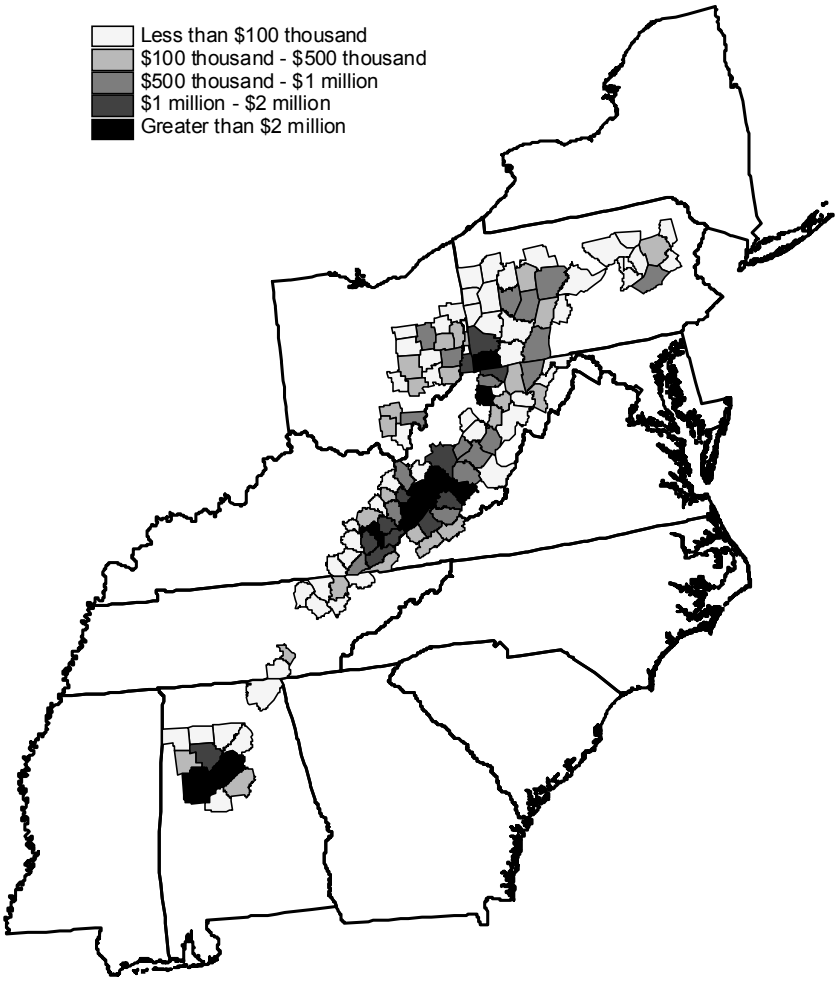
As discussed in Task 3, one aspect of the economic impact of the coal mining industry is a substantial impact on worker earnings. This earnings impact quite naturally can lead to tax revenues through the income taxes in various Appalachian states. The level of revenue depends on the income tax rates in each state, as well as the size of the economic impact.

Typically, there is no set, specific income tax rate in states. Taxpayers have minimum deductions, other personal deductions, and in many states, pay a graduated tax rate. This uncertainty about what tax rate to apply to the earnings of each particular person creates a need for a common tax rate that could be applied to all earnings, that is, an effective tax rate. This rate then could be applied to the earnings impact of the coal mining industry to estimate the resulting income tax revenue, without needing to worry about who earns that income, whether they have other income sources, the level of deductions for which they are eligible, etc.

Table 1.4.2 lists the effective state income tax rate for each of the 8 states with major Appalachian coal-producing counties. These effective tax rates were calculated by dividing the total personal income tax collected in each state from 1996 through 1998 by the total personal income earned in each state from 1996 through 1998.[12] The effective income tax rates are therefore the effective rate over three recent years, rather than the rate in any particular single year. The effective state income tax rate in most states falls within the range of 1.88% to 2.86%, with the exception of Tennessee. In Tennessee, where there is only a selective income tax, the effective rate is just 0.11%.

[12] Sources: 1996, 1997, and 1998 State Personal Income, U.S. Bureau of Census, Bureau of Economic Analysis, www.bea.doc.gov/bea/regional/spi/pi.htm and 1996, 1997, and 1998 Income Tax Paid, U.S. Bureau of Census, www.census.gov/govs/www/state.html.

Figure 1.4.2: Income Tax Collection by County in the ARC Region



These effective tax rates can be applied to the estimated total earnings impact of coal-production in order to estimate the total income tax impact of the coal mining industry. The income tax revenue impact due to coal mine production in the major Appalachian coal-producing counties is summarized for each state below in Table 1.4.2. The total income tax revenue generated due to coal mining in the major Appalachian coal-producing counties is $145.9 million annually. This is just above 40% of the revenues generated by severance taxes on coal. Since the effective tax rates are similar, with the exception of Tennessee, the distribution of tax revenues among states follows the pattern of the economic impact. Among the states, the impact is largest in West Virginia, where just over one-third of the impact tax impact is generated. Among the counties, the largest impact is in the Kentucky, Virginia, West Virginia border area, with concentrated impact in selected Pennsylvania counties, and in a portion of Alabama. This pattern is evident in Figure 1.4.2, which shows the tax revenue generated due to

the worker earnings impact of the coal industry in each of the 118 coal-producing counties.

Table 1.4.2: Income Tax Revenue Due to Coal Mining in Major Appalachian Coal-Producing Counties by State

State	Total Earnings Impact	Effective Income Tax Rate	Total Income Tax Revenue
Alabama	$595.3 million	1.91%	$11.4 million
Kentucky	$1,219.6 million	2.86%	$34.9 million
Maryland	$42.3 million	2.69%	$1.1 million
Ohio	$317.6 million	2.40%	$7.6 million
Pennsylvania	$1,488.3 million	1.88%	$27.9 million
Tennessee	$47.0 million	0.11%	$53,000
Virginia	$546.6 million	2.80%	$15.3 million
West Virginia	$1,988.4 million	2.39%	$47.6 million
Total	$6,245.0 million		$145.9 million

Source: Authors' calculations

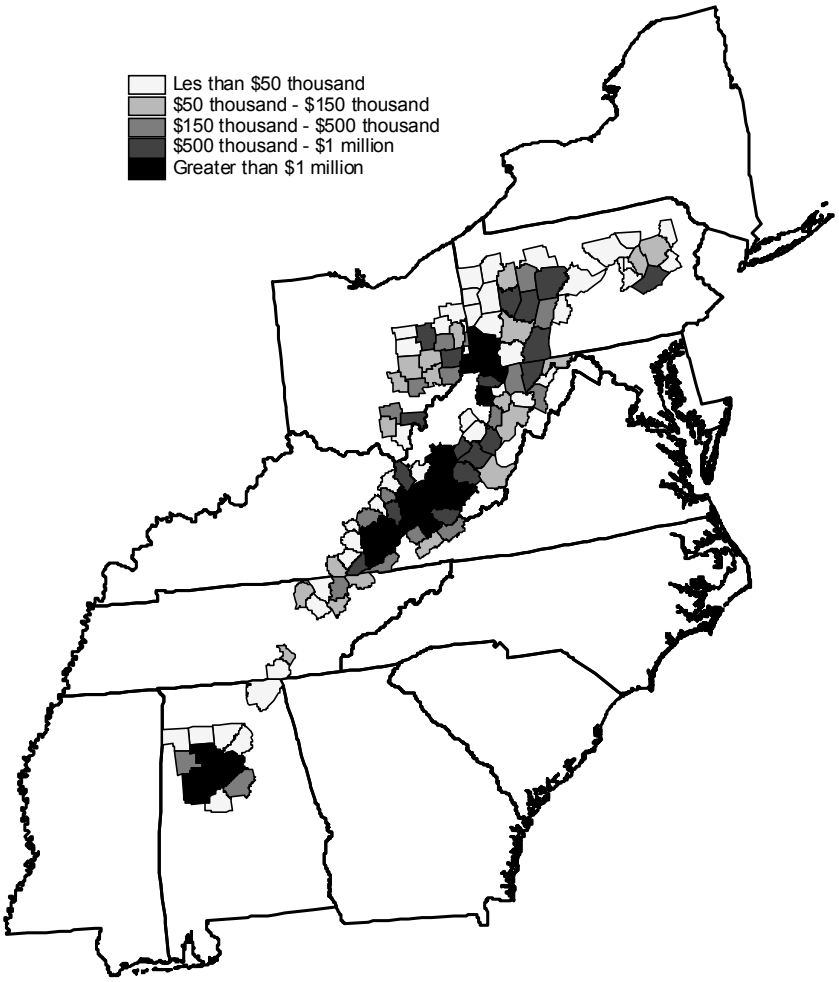
Sales Tax

The economic impact of the coal industry generates additional sales tax revenue, just as it generated income tax revenue. Sales are generated throughout the economy due to the multiplier effect, i.e., indirect and induced effect. A substantial portion of those sales occurs for products or services that are subject to state and local sales tax.

Specific sales tax laws in the eight states where the 118 major Appalachian coal-producing counties are located determine the sales tax revenue generated due to the coal mining industry. There also are local sales taxes in some of those counties. The state and local tax laws were examined in order to document the relevant tax rates and estimate the percentage of sales that are subject to sales tax in four categories of industries: restaurants, retail industries, lodging, and utilities. The result was a conservative estimate of sales tax coverage in each state, but not an exact modeling of the complex state and local tax systems.[13]

[13] Sales tax was modeled for the industries where most sales tax is collected, such as retail industries. However, there may have been additional industries, particularly service industries, that pay sales tax but were not modeled such as movie theatres. This is why the results presented are considered to be conservative.

Figure 1.4.3: Sales Tax Collection by County in the ARC Region



In order to estimate the sales tax impact, these tax rates and coverages were then applied to estimates of the indirect and induced sales impact. Due to the detail of the Micro IMPLAN multiplier model, these sales impacts were available by detailed industry.[14] The relevant sales in each industry were multiplied by the tax coverage and the tax rate in order to create the estimate.

Table 1.4.3 includes an estimate of the state and local sales taxes generated in each state due to the economic impact of the coal mining industry. Table 1.4.3 also lists the total sales tax impact, including both state and local taxes. The total sales tax collected is $73.8 million. This is about one-fifth of the tax collected due to severance taxes, but about half the revenue generated by the income tax. Most sales tax revenue is

[14] Retail margins were factored in for retail industries where industry output does not equal sales due to the wholesale cost of goods.

the result of state sales taxes rather than local taxes. About one-third of the sales tax was generated in West Virginia, but there was significant sales tax revenue in Kentucky as well. Among the counties, the largest impact is in the Kentucky, Virginia, West Virginia border area, with concentrated impact in selected Pennsylvania counties, and in a portion of Alabama. Although, the sales tax impact in Virginia is not as large due to the lower sales taxes in that state. These patterns are evident in Figure 1.4.3, which shows the sales tax revenue generated in each of the 118 coal-producing counties.

Total of Severance, Income, and Sales Taxes

Table 1.4.4 below again shows the severance, income, and sales taxes estimated to be generated in each state due to the coal mining industry, along with the sum of all three taxes. Data in Table 1.4.4 show three of the major types of taxes generated due to the economic impact of the coal mining industry. However, not all types of taxes are included. In particular, the total economic impact of the coal mining industry likely makes additional and large contributions to the local tax base through property tax impacts, and other miscellaneous local taxes. However, the level of these taxes could not be estimated due to the complexity of modeling these local tax rates and coverage in all of 118 major coal-producing counties. As a result, it should be kept in mind that the total tax impact in Table 1.4.4, while substantial, represents an underestimate of the total tax impact of the coal mining industry in Appalachia.

Table 1.4.3: State and Local Sales Tax Revenue by State

	Sales Tax Revenue		
State	**Total**	**State Government**	**Local Government**
Alabama	$8.5 million	$5.5 million	$3.0 million
Kentucky	$18.0 million	$18.0 million	$0.0 million
Maryland	$0.6 million	$0.6 million	$0.0 million
Ohio	$4.0 million	$3.8 million	$0.2 million
Pennsylvania	$10.2 million	$10.2 million	$0.0 million
Tennessee	$0.6 million	$0.5 million	$0.2 million
Virginia	$4.3 million	$3.4 million	$1.0 million
West Virginia	$27.5 million	$27.5 million	$0.0million
Total	$73.8 million	$69.5 million	$4.3 million

Source: Authors' calculations

Data in Table 1.4.4 show that the total tax impact of the coal mining industry due to severance, income, and sales taxes is quite large. The total annual impact is over $550 million per year. Several interesting patterns also are relevant in Table 1.4.4. Note that while severance taxes on coal production are an important part of the tax impact, general taxes that fall on many industries and households also account for a substantial portion of the industry's overall tax impact. Even with the omissions mentioned above,

severance taxes accounted for only about 60% of the overall tax impact across the 8 states. In states with a modest severance tax, such as Alabama or Virginia, the severance tax accounted for half or less of the total tax impact.

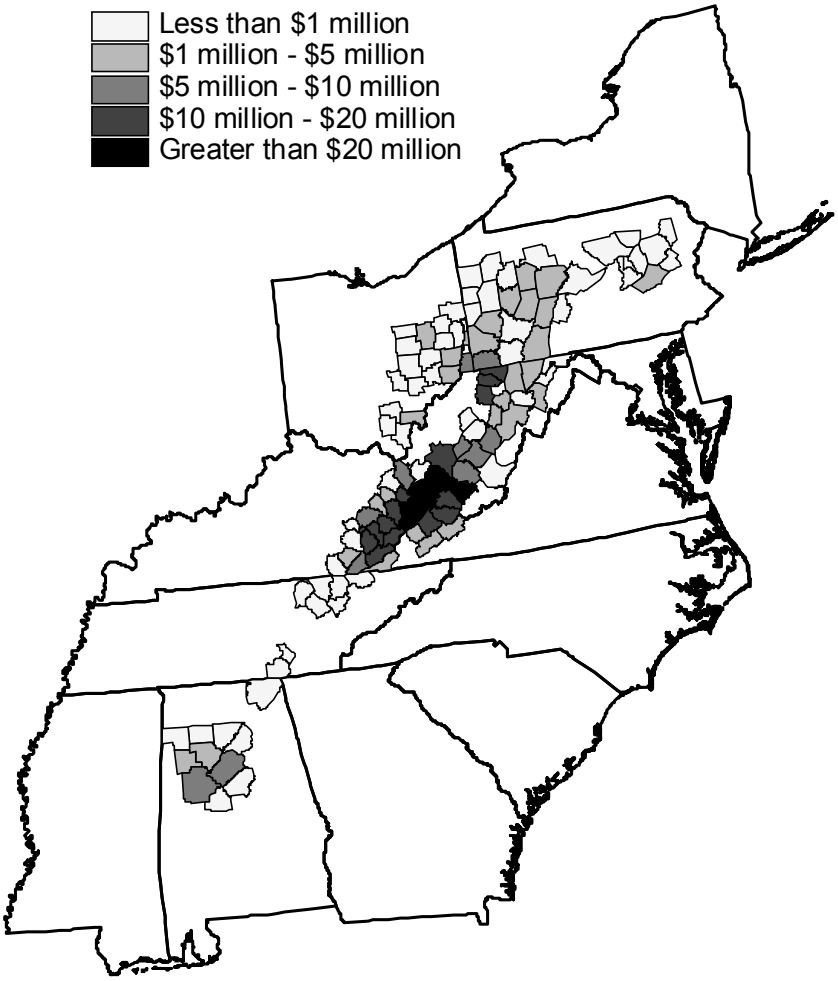
The tax impact also tended to be concentrated in certain states and industries. The largest impacts occurred in West Virginia and in Kentucky, which had substantial coal production, significant severance tax rates, and average to high sales and income tax rates. West Virginia accounted for almost 45% of total tax revenues, while Kentucky accounted for 33%. Pennsylvania and Virginia each accounted for 7%. Finally, as noted in Figures 1.4.1 through 1.4.4, the largest regional impact occurred in the Kentucky, Virginia, West Virginia border area. It is this region, and the states of West Virginia and Kentucky more generally, which gain the most from tax revenues generated due to the coal mining industry.

Table 1.4.4: Severance, Income, and Sales Tax Revenue by State

State	Total	Severance	Income	Sales
Alabama	$24.7 million	$4.9 million	$11.4 million	$8.5 million
Kentucky	$186.9 million	$134.0 million	$34.9 million	$18.0 million
Maryland	$1.7 million	$0.0 million	$1.1 million	$0.6 million
Ohio	$14.3 million	$2.7 million	$7.6 million	$4.0 million
Pennsylvania	$38.1 million	$0.0 million	$27.9 million	$10.2 million
Tennessee	$1.3 million	$0.7 million	$53,000	$0.6 million
Virginia	$39.9 million	$20.2 million	$15.3 million	$4.3 million
West Virginia	$252.4 million	$177.3 million	$47.6 million	$27.5 million
Total	$559.5 million	$339.8 million	$145.9 million	$73.8 million

Source: Authors' calculations

Figure 1.4.4: Total Tax Collections by County in the ARC Region



Part 1.5: Baseline Analysis of Demographic and Transfer Payment Impacts

Previous sections of this report have focused on the economic impact of the coal mining industry on a number of aggregate economic indicators such as total employment, income, and output, as well as tax revenue. These types of indicators are typically the focus of economic impact and fiscal impact studies, and certainly are important and appropriate measures of how a particular industry contributes to a region's economic performance. But, these are just some of the important aggregate indicators of a regions economic situtation. Other key indicators would include population change, labor force participation, unemployment, and social welfare dependency. Economic impact studies do not always discuss how the growth or decline of a particular business or industry might effect these fundamental indicators of regional economic health, in part because one sector often does not have a large enough effect on the local economy to dramatically change these indicators. However, when a particular industry represents a large share of that region's economy, factors such as the direction of population growth, or the rate of social welfare dependency can be signficiantly influenced by growth trends of that industry. This certainly may be the case for the coal mining industry in many of the major coal-producing counties in Appalachia.

The extent of the link between the performance of major local industries and changes in key local socioeconomic indicators such as population growth, labor force participation, or social welfare dependency has been a subject of recent research. Research by Dr. Dan A. Black and others has shown a direct link between the performance of the coal industry and these economic measures. These links emerge in part due to the nature of coal industry jobs and because the industry has a major impact on the overall economy. Coal industry jobs often offer relatively high pay to workers with relatively low general skill levels, although these workers clearly have developed substantial industry-specific skills for use in coal mining. Thus, losses in coal mining employment represent lost earnings opportunities that may not only lead to outmigration from the region in some cases but also to increased poverty and dependence on social welfare among workers who are unwilling to move outside the region or who face few well-paying opportunities outside of the coal mining industry. Of course, when the coal mining industry experiences growth, just the opposite occurs. More high-paying jobs in coal mining will likely be accompanied by a decline in participation in social welfare programs and less outmigration from the region and perhaps even inmigration to the Appalachian regions.

This section of the report will discuss this relevant research in more detail, and point out the link between the coal mining industry, as well as other heavy industries such as steel, and key indicators of regional socioeconomic health. This information will make it possible to predict how these socioeconomic factors may be expected to change in these counties in the future in reaction to anticipated changes in the local coal

mining industry. This section also will present information on the current socioeconomic situation in the major Appalachian coal-producing counties. As will be demonstrated, many of these counties under current conditions already perform poorly according to a number of socioeconomic measurements such as populaton growth, poverty, labor force participation, and dependence on social welfare programs.

Review of Literature

Dr. Dan Black and a number of colleagues have conducted a group of research studies examining how growth and decline in key industries can effect aggregate economic outcomes in local economies such as population change, or dependence on social programs (Black, McKinnish, and Sanders, 1999; Black, Daniel, and Sanders, 1996)[15]. Much of this research has focused on the effects of growth or decline shocks to the coal industry, but their work also has focused on the steel industry, another heavy industry where generally low-skill workers earn high wages due to strong industry-specific skills. As discussed above, the argument in this research is that some industries such as coal or steel might be expected to have an especially broad impact on the local economy when these industries are a larger part of the local economy, and they experience significant shocks, that is, substantial growth or decline. In line with this argument, Black and his co-authors did find that large and permanent changes in employment in the coal or steel industries have a major effect on aggregate socioeconomic indicators, and a larger effect than changes in total employment. Black, McKinnish, and Sanders (1999) argue that this is because changes in employment in the coal and steel industries directly affects the high wage employment opportunities of low skill workers.

Looking at some of the specific findings of this research, the authors found that a permanent (or at least long-term) 10% change in earnings in coal or steel counties was associated with a 9 to 10% change in AFDC program expenditures in that county (Black, McKinnish, and Sanders, 1999). Naturally, this relationship worked in the opposite direction, so that earnings losses lead to rising AFDC expenditures, and *vice-versa*. Another paper (Black, Daniel, and Sanders, 1996) focused exclusively on the impact of the coal boom and bust during the 1970s and 1980s, and examined its effect on a wide-variety of social-economic indicators such as poverty rates, SSI spending, Food Stamp payments, unemployment insurance payments, medical transfers (medicare and medicaid), and social security. That paper found that a 10% decrease in county

[15] The estimation method in Black *et. al.* (1996; 1999) utilized a time series, cross-sectional county database. Each outcome measure (population growth, TANF payments, etc.) is a function of county earnings. Due to the endogeneity of county earnings and the outcome measures, a two-stage least squares framework is employed. County coal price is the exogenous variable in the model. County earnings is estimated based on coal prices in the first stage, and then estimated earnings is utilized in the second stage of the regression.

earnings lead to a 2.4% increase in the number of people living in poverty, but a 2.2% decrease in population. Focusing on transfer programs, a 10% decrease in county earnings lead to a 7.9% increase in SSI benefit payments, an 18.7% increse in Food Stamp payments, a 26.0% increase in unemployment insurance payments, a 4.1% increase in medicare and medicaid payments, and a 1.5% increase in social security (OASDI) payments. Note that these are absolute increases that occurred at the same time that county population was declining. These responses, commonly called elasticities, relating the change in earnings to the change in these various socioeconomic indicators are summarized in Table 1.5.1.[16]

Table 1.5.1: Change in Economic Indicator Resulting from a 10% Decline in County Earnings (Resulting from a Loss of Steel or Coal Industry Earnings)

Economic Indicator	Percent Change Due to 10% Decline in County Earnings	Source
Population	2.2%	Black, Daniel, and Sanders (1996)
Poverty	2.4%	Black, Daniel, and Sanders (1996)
AFDC	9 - 10%	Black,McKinnish and Sanders (1999)
SSI	7.9%	Black, Daniel, and Sanders (1996)
Food Stamps	18.7%	Black, Daniel, and Sanders (1996)
Unemployment Insurance	26.0%	Black, Daniel, and Sanders (1996)
Medical Transfers (Medicare and Medicaid)	4.1%	Black, Daniel, and Sanders (1996)
Social Security (OASDI)	1.5%	Black, Daniel, and Sanders (1996)

Current Situation and Maps

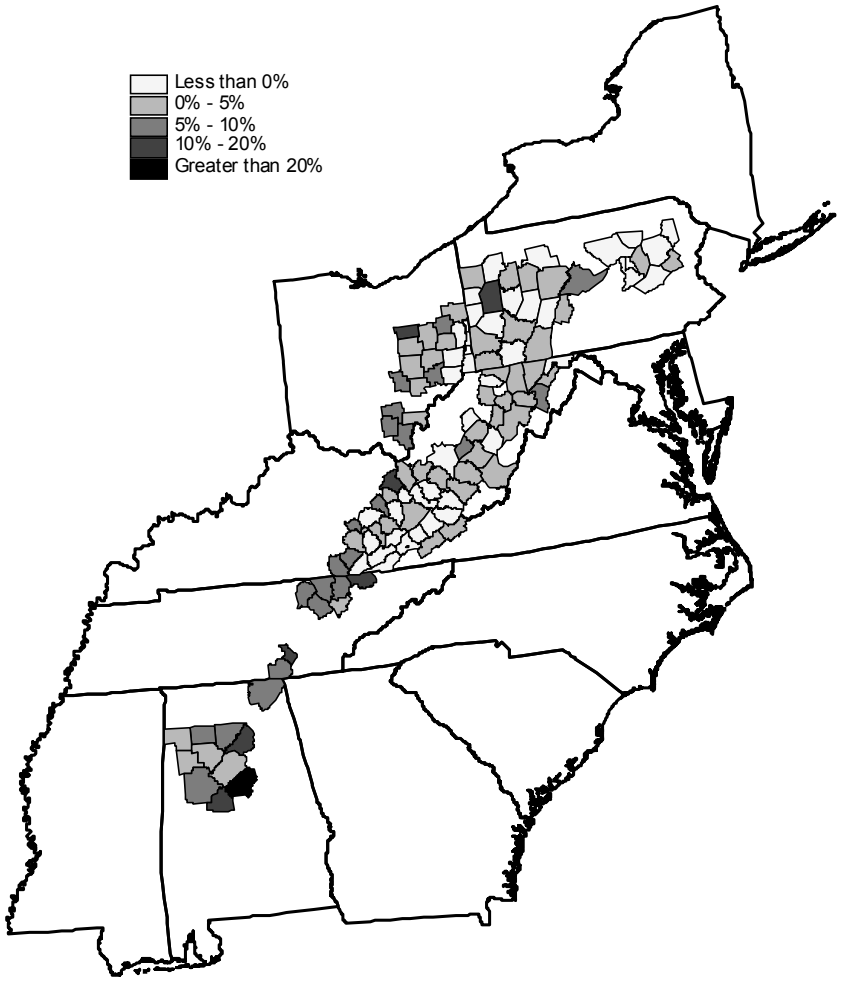
The elastic relationships in Table 1.5.1 between earnings and county socioeconomic indicators will help illustrate how these indicators may react to future changes in the coal mining industry. In particular, the data in Table 1.5.1 may indicate how population growth and transfer payments in major coal-producing counties may be affected under alternative scenarios for the macro-economy and environmental regulations under the Kyoto Protocol.

[16] The term elasticity refers to a measure of responsiveness. In this case, measuring the change of the economic indicator in response to a given change in earnings.

These reactions will be considered in Section II of this report, which discusses the future of the Appalachian coal industry under these alternative scenarios. This section will consider the current conditions in the coal-producing regions of Appalachia, identified in the baseline analysis, in terms of these major socioeconomic indicators. We will consider whether regions already exist which perform poorly according to these socioeconomic indicators, and therefore, could be a particular area of concern should socioeconomic conditions worsen.

Figure 1.5.1 shows recent population growth in the major coal-producing counties of Appalachia during the 1990 to 1997 period. Note that population growth

Figure 1.5.1: Percent Population Change, 1990 – 1997, by County in the ARC Region



rates are highly volatile among the coal-producing counties. There is both a substantial number of growing counties and a substantial number of counties where population

declined from 1990 through 1997. Most counties grew or contracted by no more than 5% to 7% over the seven years. However, changes were quite dramatic in some counties. Cumulative growth over these seven years was as high as 35.6% in Shelby County, Alabama, but population loss was as great as 12.6% in McDowell County, West Virginia. Looking at the county growth rates, it is evident that the contracting counties were most common in the Central Appalachia and Northern Appalachia regions. Population growth was more common in Southern Appalachia. These county data are consistent with regional totals for population growth, which are illustrated in Table 1.5.2. The major coal-producing counties in Northern Appalachia had a slight decline in population over the seven-year period, as did the counties in Central Appalachia. In Southern Appalachia, however, the coal-producing counties had a substantial increase in population of 6.4%, which is just less than a 1% annual increase. Due to the growth in Southern Appalachia, the 118 major Appalachian coal-producing counties overall experienced a slight increase in population.

Table 1.5.2: Regional Totals for Socioeconomic Conditions

Socioeconomic Indicator	All 118 Counties	Northern Appalachia	Central Appalachia	Southern Appalachia
Population Growth (1990 – 1997)	0.7%	-0.4%	-0.2%	6.4%
Per Capita Temporary Assistance to Needy Families (TANF/AFDC)	$51.51	$53.74	$85.37	$14.74
Per Capita Supplementary Security Income (SSI)	$143.36	$111.24	$292.86	$143.25
Per Capita Food Stamps	$86.73	$71.51	$169.15	$77.04
Per Capita Unemployment Insurance	$110.53	$135.43	$71.58	$46.62
Per Capita Medical Transfers (Including Medicare and Medicaid)	$1,785.90	$1,870.24	$1,730.64	$1,505.63
Per Capita Social Security (OASDI)	$1,739.37	$1,787.30	$1,803.39	$1,500.69

Source: *Regional Economic Information System*, 1969-1998 (REIS)

Figures 1.5.2 through 1.5.4 show per capita payments to individuals from three transfer programs focused on income maintenance. Temporary Assistance to Needy

Families (TANF/AFDC) is an income maintenance program for poor households, typically households with children. Supplementary Security Income (SSI) provides payments to workers who are certified as disabled. The Food Stamp program provides families with extra income for food purchases. Higher per capita payments from these programs likely reflect higher rates of poverty and lower rates of income within any area. In the case of TANF, however, payments may also reflect the level of financial support that each state chooses to provide. There also may be smaller state contributions in the case of the SSI and Food Stamp programs. This suggests that high payments in these programs may reflect that an area possesses a higher burden on federal and state government as well as indicating lower income and higher poverty.

Figure 1.5.2: TANF Payments per Capita by County in the ARC Region, 1997

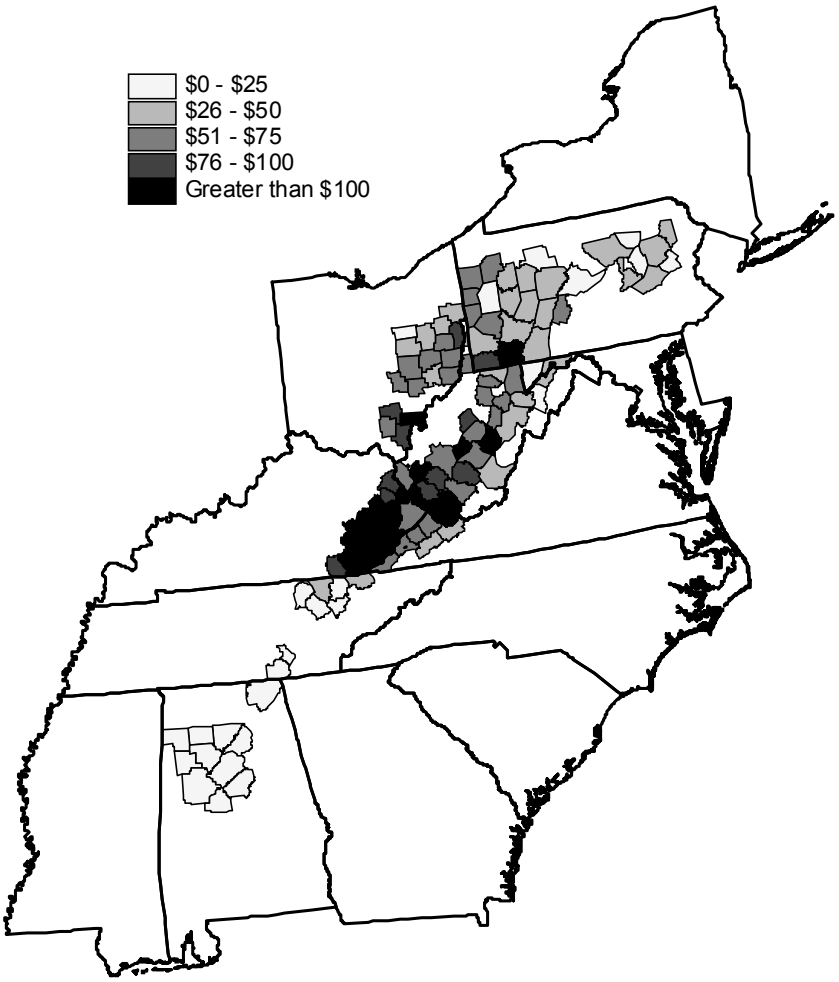


Figure 1.5.3: SSI Payments per Capita by County in the ARC Region, 1997

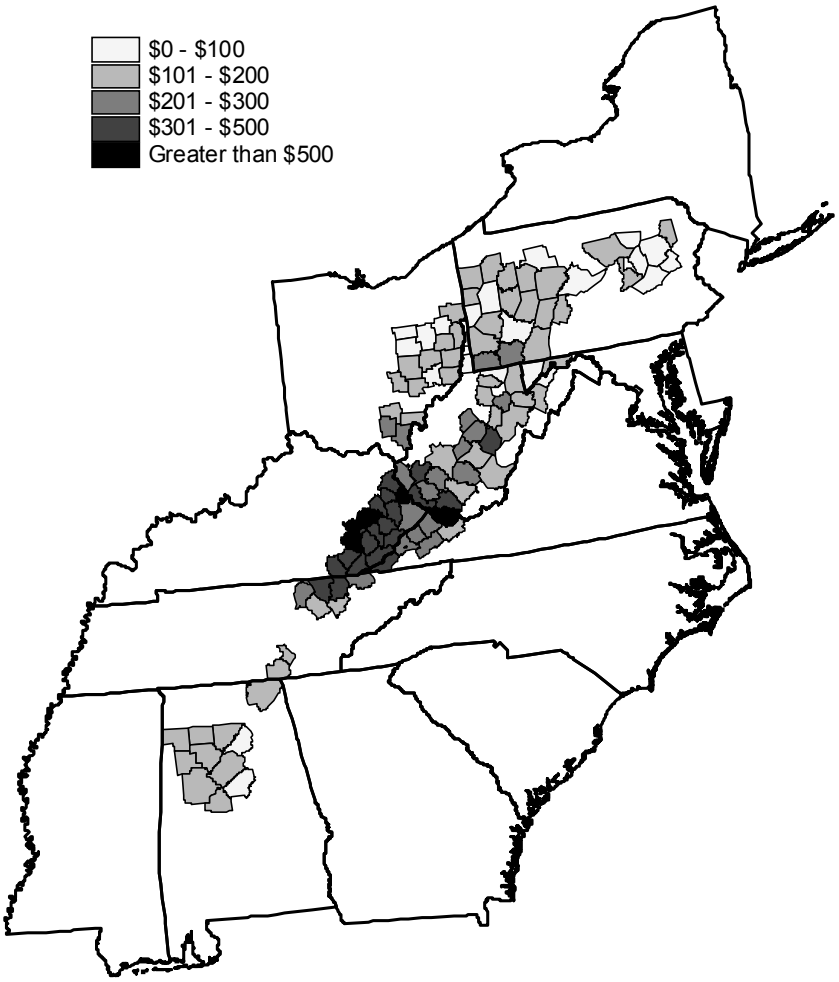
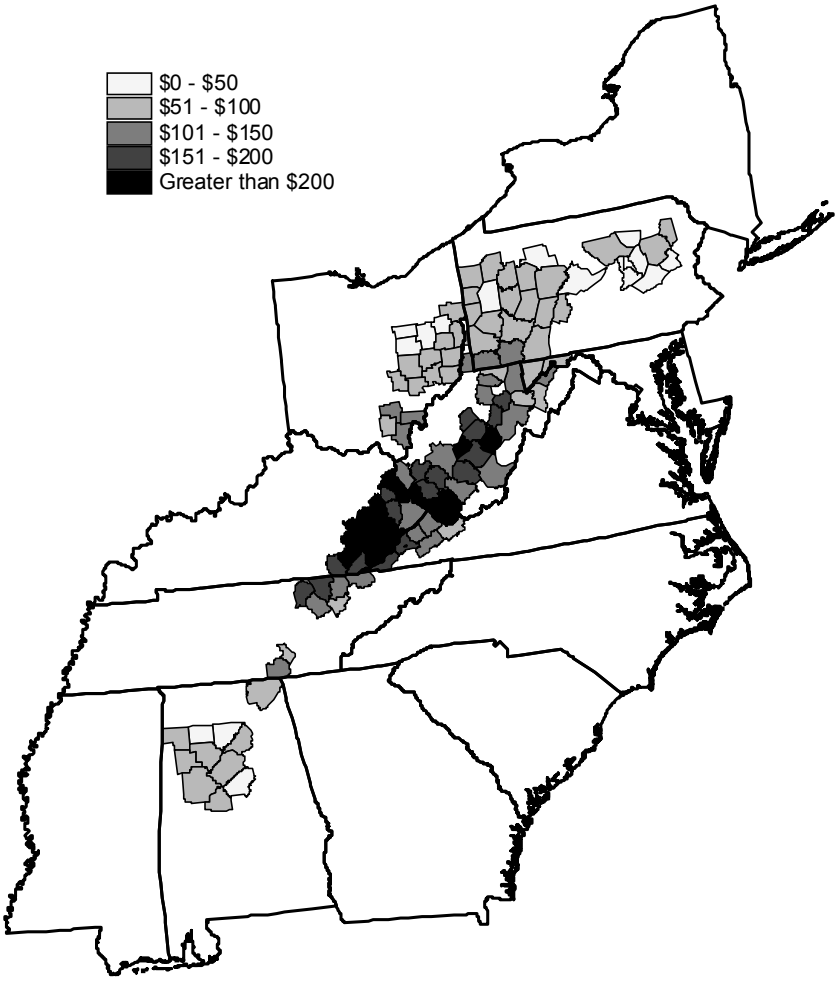


Figure 1.5.4: Food Stamp Payments per Capita by County in the ARC Region, 1997



Results in Figures 1.5.2 through 1.5.4 indicate that payments in these programs typically are higher in counties in Central Appalachia. There are counties in the higher payment classification throughout the Appalachian region, but such counties clearly are concentrated in counties in Eastern Kentucky, Southern West Virginia, and Southwest Virginia. These county results are reflected in the regional figures for these programs presented in Table 1.5.2. Per capita payments are clearly higher in Central Appalachia under all three programs. Generally speaking, the average per capita payment in Central Appalachia is roughly twice as large as in the two other regions.

Figures 1.5.5 through 1.5.7 show per capita payments to individuals from three programs oriented towards providing "social insurance." In these programs, workers directly or through their employers typically make donations to these programs and then receive payments at a later time when and if they meet the required criteria. Unemployment insurance is a program where contributions are made based on a worker's wages and then workers receive payments should they become unemployed. In the social security program (OASDI), workers and their employers make contributions based on a worker's wage rate and the worker and their family can receive benefits upon retirement, or in some cases, the worker's death. In the Medicare portion of medical payments, worker's wages are taxed in order to help fund health care upon retirement. However, other portions of medical payments such as Medicaid are more consistent with an income maintenance program in that payments are made to households with lower income, or with medical expenses that are beyond the family's financial needs.

Results in Figures 1.5.5 through 1.5.7 indicate that payments in these programs do not vary as systematically by region as the three income maintenance programs. Higher payment counties are spread throughout the 118 county region. Higher and lower payment areas are not highly concentrated on the maps, at least not as strongly as was the case with the three income maintenance programs. Looking at the regional averages in Table 1.5.2, per capita payments are somewhat higher in Northern Appalachia, and somewhat lower in Southern Appalachia, particularly in the case of unemployment insurance. In the case of unemployment insurance, this likely reflects the much larger unemployment benefits available in northern states. The smaller differences found for social security (OASDI) and medical transfer payments likely reflect that wages are higher in Northern Appalachia, and that the population is somewhat older in both Northern and Central Appalachia than in Southern Appalachia.

Figure 1.5.5: OASDI Payments per Capita by County in the ARC Region, 1997

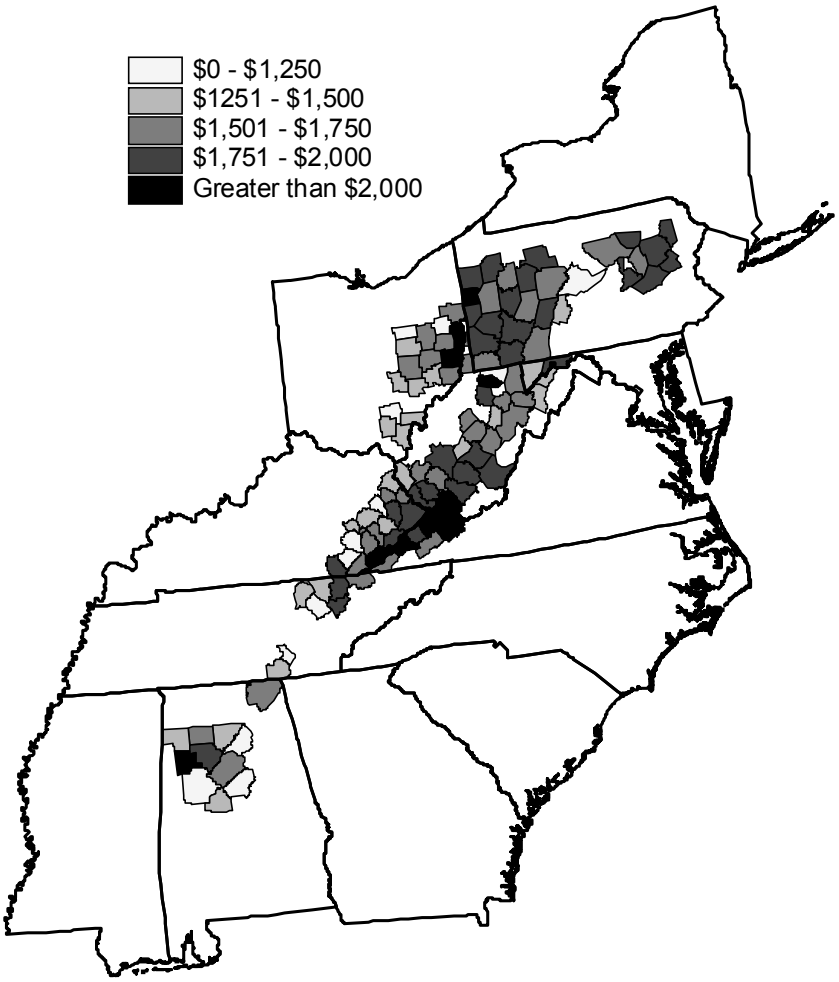


Figure 1.5.6: Medical Payments per Capita by County in the ARC Region, 1997

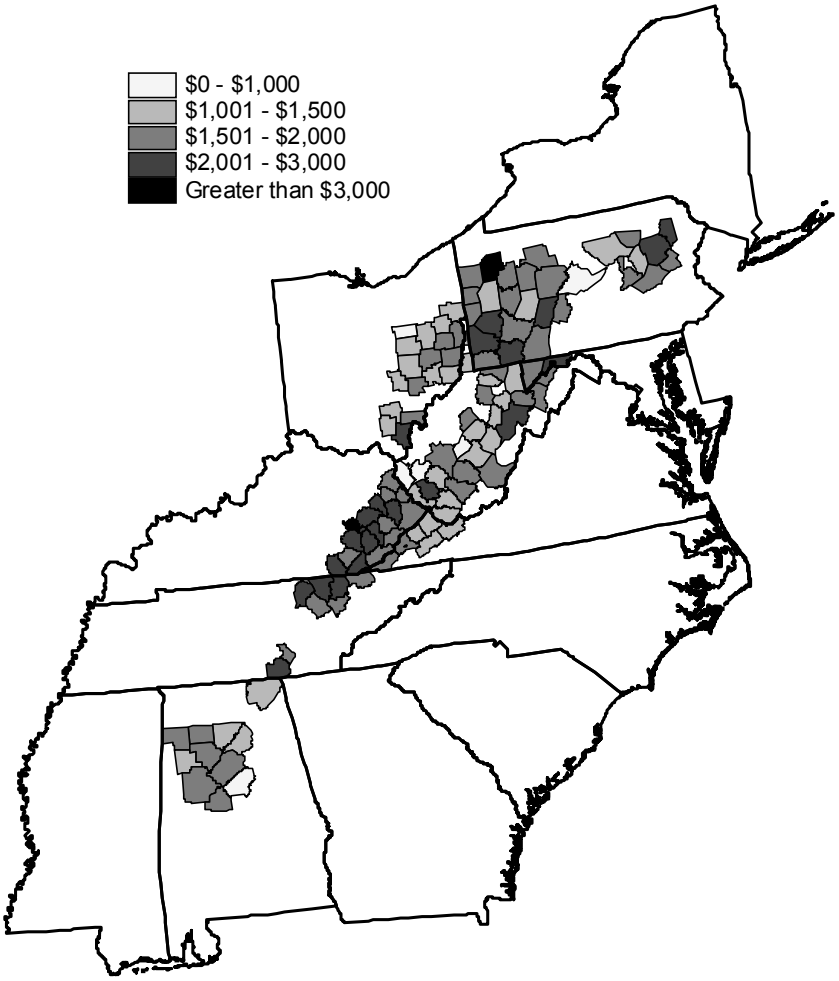
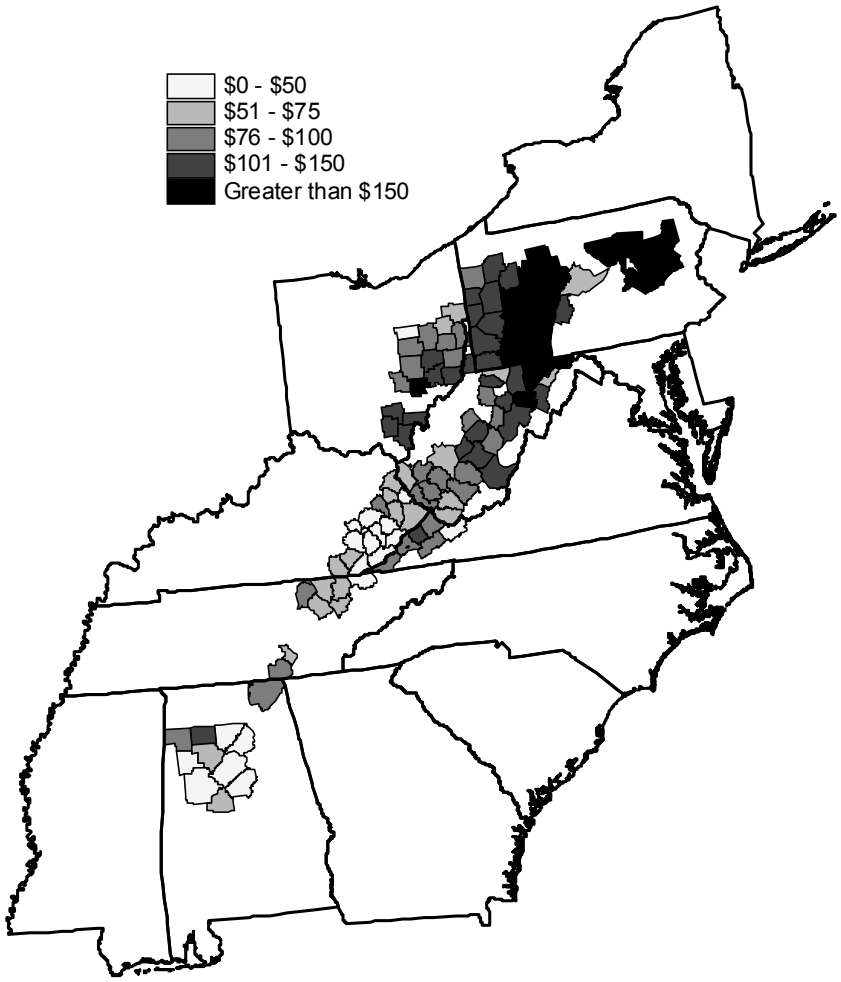


Figure 1.5.7: UI Payments per Capita by County in the ARC Region, 1997



Summary

The changing fortunes of the coal mining industry, more than many industries, has the potential to have a significant impact on the basic socioeconomic conditions of major coal-producing counties. This is the case both because the industry is often a large part of the local economy and because it is one of the few industries that offers high-wage jobs for worker's which on average have low general skills. Although, these workers certainly have built up great skill which they utilize in their work as coal miners.

Research by Dr. Dan Black and others (1996, 1999) has demonstrated the impact which fluctuations in coal mining employment and earnings has on major socioeconomic indicators such as population growth and transfer payments. The potential for future changes in coal mining earnings to affect these indicators in Appalachia will be discussed later in this report in sections that address forecasts for the coal industry. But, the possibility that changes in the industry could worsen these socioeconomic indicators is a concern, particularly given some of the current values of these indicators within the coal-producing counties of Appalachia. In particular, population is already shrinking on average in the coal-producing counties of both Northern and Central Appalachia. Meanwhile, the coal-producing counties of Central Appalachia already have high levels of income maintenance program payments. The per capita payments for three income maintenance programs- TANF, SSI, and Food Stamps- are already twice as high in Central Appalachia as in Northern and Southern Appalachia.

Part 1.6: Groupings of Appalachian Coal-Producing Counties Organized by Sectors, Sub-State Areas, and Other Appropriate Approaches

The 118 major Appalachian coal-producing counties cover a wide geographic area from Alabama to Pennsylvania, and comprise a great variety of coal and mine types. The importance of the coal industry in each county's economy also varies greatly within the group. Finally, while the productivity of these mines has risen throughout Appalachia, the rate of productivity growth has varied within the coal-producing counties.

All of these factors suggest that any analysis of Appalachian coal-producing counties should not just consider the situation for the industry in Appalachia overall, but should also examine the industry in groupings of similar counties. Such groupings would not necessarily consist of identical or even very similar counties, but would be designed to broadly capture how the situation and prospects for the coal industry differ in the coal-producing counties of Appalachia. The county groupings also could be considered to be geographic regions, if the groupings are made using contiguous counties. In fact, three broad geographic regions are currently used by the Energy Information Administration (EIA) of the U.S. Department of Energy. These regions are Northern Appalachia, Central Appalachia, and Southern Appalachia. The regions are illustrated in Figure 1.6.1. Summary data on prices and production are reported for these 3 regions in selected EIA coal reports and forecasts. The three regions comprise 3 of the 11 major coal-producing regions in the United States.

This regional distinction used by the EIA is sensible, since the three regions are quite different. The Northern Appalachia region has a significant level of production of high sulfur coal, and even some lignite coal production, but relatively little production of premium coal. The Northern Appalachian region has experienced the most rapid growth in labor productivity in recent years. The Central Appalachia region is primarily compliance and medium sulfur coal, with a significant amount of production (just less than one-quarter) devoted to premium coal. The region contains some of the most coal-dependent counties in Appalachia. The Southern region is characterized by higher coal prices, at least in the Alabama coal-producing counties, where most Southern Appalachia production takes place. Mines in Southern Appalachia overall have had the slowest labor productivity growth rates in recent year.

Finally, the three regions of Appalachia have fairly distinct forecasts for future levels of coal production and employment, as is discussed in the second part of this study. All of this suggests that these three regions should be utilized for analysis in the remainder of this report. However, the regions are rather large geographically, particularly Northern Appalachia. This raises the question of whether any or all of these three regions should be divided into sub-regions during further analysis.

This report will analyze the coal industry in these three regions, but will not consider any such sub-regions. This is done because forecasts for production, price, and employment, which are discussed in the second part of this report, do not point to any consistent basis for differentiating areas within regions. There is no consistent difference between the prospects for production growth of compliance and low sulfur coal, or even for the high sulfur coal so common in Northern Appalachia.[17] Similarly, there is no consistent difference between growth forecasts for premium coal versus bituminous coal.

There are differences between forecasts for underground versus surface mines. In particular, production is forecast to grow in underground mines across Appalachia while falling in surface mines. This forecast result, however, was primarily driven by EIA assumptions regarding future productivity growth in underground mines and surface mines. The future labor productivity growth of underground mines was assumed to be much greater in EIA forecast models, as it has been in some cases in recent years. This assumption may be a reasonable one, but the future of productivity growth is hard to predict, and past rates may not continue. For example, a rapid expansion of "mountain top removal" mining techniques could quickly raise the productivity of surface mines in Central Appalachia.

Since distinctions between the forecasts for underground and surface mines may be too sensitive to uncertain assumptions about productivity growth, sub-regions will not be defined based on whether counties primarily have surface mines versus underground mines.[18] Such a distinction could lead to erroneous expectations about the prospects for production growth within sub-regions of Northern, Central, or Southern Appalachia.

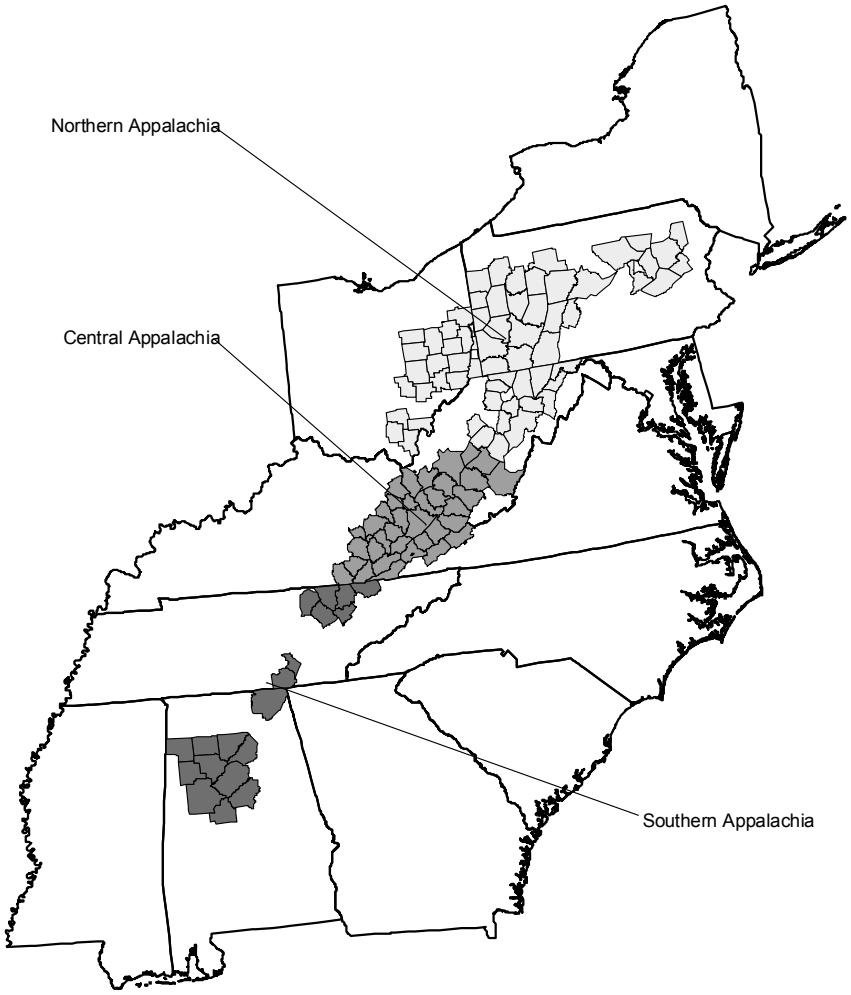
The analysis that follows, therefore, will consider the current situation and forecast future impact of the coal mining industry on the Appalachian coal-producing area overall, as well as the distinct impact in Northern Appalachia, Central Appalachia, and Southern Appalachia. The three regions are pictured in Figure 1.6.1. The Northern Appalachia region contains major coal-producing counties in Pennsylvania, Ohio, Maryland, and Northern West Virginia. The Central Appalachia region contains

[17] Conversations with personnel at EIA suggest that high sulfur coal production in the future may no longer be negatively effected by compliance with the Clean Air Act due to the installation of "scrubbers" to clean emissions at nearby power plants, and the stockpiling of emissions credits by these same power companies.

[18] The uncertainty regarding forecast for surface versus underground mines also discourages forming sub-regions of most coal-dependent, and least coal-dependent counties within Central Appalachia, as well as Northern Appalachia. The difficulty is that underground mines tend to be concentrated in the most coal-dependent counties, while surface mines are more common in the least coal-dependent counties. Thus, forming sub-regions based on coal-dependence would essentially lead to forecasts based on the surface versus underground mining, which are very sensitive to uncertain assumptions about the future growth of mine productivity.

Appalachian coal-producing counties in Virginia, Kentucky, and Southern West Virginia. The Southern Appalachia region contains coal-producing counties in Tennessee and Alabama.

Figure 1.6.1: The Northern, Central, and Southern Regions of the Appalachian Coal-Producing Area



Section 2: Economic Forecast — The Future Role and Status of the Coal Industry in the Region's Economy

The current economic impact of coal production within Appalachia could change substantially over the next decade. Continuing increases in labor productivity can be expected to reduce the total amount of work and earnings paid per ton of coal mined. At the same time, competition from mines in the western U.S. and environmental regulations, both existing and potential, will tend to limit coal production growth in Appalachia and could even cause declines in production in some cases. Thus, losses in employment and earnings in the coal mining industry may occur within Appalachia in coming years. These losses could be concentrated in certain parts of the Appalachian region, among specific groups of major coal-producing counties, while other counties continue to expand production and employment. The pattern of losses or gains will also depend on the growth rate in the economy, the price of other fuels, such as oil, and the types of environmental regulations that are enacted over the next decade.

Part 2.1: Economic Forecasts for the Appalachian Coal-producing Region Using Baseline and Alternative Scenarios

Introduction

This second portion of the study focuses on forecasting the future condition of the coal mining industry in Appalachia, specifically around the year 2010. The goal will be to forecast the level of production, price, employment, and earnings in the industry in that year, and how each of these measures will change over the 1997 to 2010 period. This section of the report also will examine how employment and earnings changes in the coal mining industry might effect the overall economy of Appalachian coal-producing regions. Analysis will be conducted for the major Appalachian coal-producing counties overall, and for the groupings of counties identified in Section 1, Task 6. The Task will examine a baseline forecast, forecasts under four alternative macroeconomic conditions, and under six alternative environmental policy scenarios related to the Kyoto environmental protocol. Forecasts may vary a great deal based on the forecast scenario, so the differences between the baseline forecast and the forecasts in other scenarios will be a major focus of the analysis below.

Given this, the next section will examine the assumptions and justifications behind each of the four macroeconomic and six Kyoto scenarios. Afterward, there will be a detailed discussion of the baseline forecast for the Appalachian coal industry for 2010. In the last section, we compare the baseline forecast versus each of the macroeconomic and Kyoto forecast scenarios.

Forecast Scenarios

This section describes the 4 alternative macroeconomic scenarios and the six alternative Kyoto environmental scenarios. The alternative macroeconomic scenarios are described first. Each of the alternative macroeconomic scenarios was estimated as part of the Annual Energy Outlook 1999 (AEO99) forecast, which was also the source for the baseline forecast. The baseline and alternative projections in AEO99 reflect ongoing changes in the financial structure of the U.S. electricity industry and cost reductions that are becoming evident with increased competition. The economic growth has a strong impact on the projections of energy and consumption and therefore carbon emissions.

The baseline case reflects considerable optimism about the potential for worldwide supply. Production from countries outside OPEC is expected to show a steady increase, reaching almost 47 million barrels per day by the year 2000 and increasing gradually thereafter to more than 55 million barrels per day by 2010. The total U.S. gross oil imports increase from 10.2 million barrels per day in 1997 to 14.1 million in 2010.

The high economic growth rate scenario includes higher growth rates for population, labor force, and labor productivity resulting in higher industrial output, lower inflation and lower interest rates. As a result, GDP increases at an average rate of 2.6 percent a year from 1997 to 2020, compared with a growth rate of 2.1 percent a year in the reference case. Total energy consumption in the high economic growth case is 129.4 quadrillion Btu in 2020, compared with 119.9 quadrillion Btu in the reference case.[19]

The low economic growth case assumes lower growth rates for population, labor force, and productivity, resulting in higher prices, higher interest rates, and lower industrial output growth. In the low growth case, economic output increases by 1.5 percent a year from 1997 through 2020, and growth in GDP per capita slows to 0.9 percent a year. With lower economic growth, energy consumption in 2020 is reduced from 119.9 quadrillion Btu to 110.5 quadrillion Btu, and carbon emissions are 1,826 million metric tons, or 8 percent, lower than in the baseline case.

The historical record shows substantial variability in world oil prices. There is considerable uncertainty about future prices. Three cases with different price paths allow an assessment of alternative views on the course of future oil prices. For the baseline case (year 1997), a prices increase of about 0.9 percent a year, reaching $21.30 in constant 1997 dollars in 2010, is used. The high price case has a price increase of about

[19] Btu or British Thermal Unit is defined as the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit and is equal to 252 calories.

2.5 percent a year, where in 2010 the oil price reaches $27.33. The price further increases in 2015 and levels off at $29.35 in 2020. The leveling off at about $29.35 in the high price case is due to the market penetration of alternative energy supplies that could become

Table 2.1.1: Macroeconomic and Kyoto Scenarios

Scenario	Source of Scenario
Macroeconomic Scenarios	
Baseline	EIA, *Annual Energy Outlook, 1999*
High Growth	EIA, *Annual Energy Outlook, 1999*
Low Growth	EIA, *Annual Energy Outlook, 1999*
High Oil Price	EIA, *Annual Energy Outlook, 1999*
Low Oil Price	EIA, *Annual Energy Outlook, 1999*
Kyoto Scenarios	
Baseline	EIA, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*
24% Above 1990 Levels	EIA, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*
14% Above 1990 Levels	EIA, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*
9% Above 1990 Levels	EIA, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*
Stabilization at 1990 Levels	EIA, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*
3% Below 1990 Levels	EIA, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*
7% Below 1990 Levels	EIA, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*

economically viable at that price. The low price case has prices rising, after the current price slump, to $14.57 by 2005 and remaining at about that level to 2010.

The alternative environmental forecasts are based on policies to reduce greenhouse gas emissions. Over the past several decades, rising concentrations of greenhouse gases have been detected in the Earth's atmosphere, and it has been suggested that this may lead to an increase in the average temperature of the Earth's surface and may consequently lead to detrimental effects. Some are emitted from natural sources; others result from anthropogenic, or human activities. The Intergovernmental Panel on Climate Change (IPCC) was established by the World Meteorological Organization and the United Nations Environment Program concluded that, "our ability to quantify the human influence on global climate is currently limited because the expected signal is still emerging from the noise of natural variability, and because there are uncertainties in key factors." Nevertheless, many believe that there is a discernible human influence on global climate.

Conventions including the Montreal Protocol and the Framework Convention on Climate Change, in Rio de Janeiro, were held in an attempt to establish an objective of stabilizing the greenhouse gas concentrations in the atmosphere at a level that would prevent anthropogenic interference with the climate system. The signatories of the Framework Convention agreed to formulate programs to mitigate climate change, and the developed countries agreed to adopt national policies to return anthropogenic emission of greenhouse gases to their 1990 levels. On December 1 through 11, 1997, representatives from more than 160 countries met in Kyoto, Japan, to negotiate binding limits for greenhouse gas emissions for developed nations. In the resulting Kyoto Protocol, emissions targets were established for the developed nations to achieve an overall reduction of about 5.2 percent. The targets range from an 8 percent reduction for the European Union to a 10 percent increase allowed for Iceland. The reduction target for the United States is 7 percent below 1990 levels. The established targets must be achieved over the period 2008 to 2012, the first commitment period. Each country should make demonstrable progress by 2005.

In order to achieve carbon emission reductions, the type of energy fuel used in the United States is projected to change because of higher relative carbon content of coal. The reduction in coal use would come at a cost. Although coal is the major carbon emitter, existing coal plants are very economical and their operating costs are falling. Under stringent emission reduction targets and rising carbon prices, the economics of coal-fired generation would change. Coal plants simply are not very economical when carbon prices are high. Higher carbon prices would result in converting existing coal-fired plants into natural gas plants and a reduction in coal exports.

The Kyoto protocol allows for some flexibility in meeting the emission targets. The emission targets can be achieved through a number of potential actions including energy efficiency improvements, research development of sequestration technology, and phasing out of fiscal incentives and subsidies that may inhibit the goal of emissions. An Emission trading program has been favored in the Kyoto protocol as a means of achieving emission reductions. The countries that reduce emissions below their allowed levels can sell excess emission permits that can be purchased by the other countries at the prevailing market price. However, no principles, rules, and guidelines have been established for trading the carbon permits.

The protocol established a Clean Development Mechanism (CDM), under which the countries can take credit for the projects that reduce emission. In addition, the countries that have ratified the treaty may create a bubble or umbrella to meet the total commitment of all the member nations. In the bubble, countries would agree to meet their total commitment by allocating a share to each member. In an umbrella arrangement, the total reduction of all member nations would be met collectively through the trading of emission rights. The United States may have an interest in entering into an umbrella trading arrangement with the countries outside the European

Union. However, industrialized nations have had difficulty writing rules for carbon trading, as was illustrated during a recent meeting in the Netherlands. The use of carbon sinks and carbon trading with less industrialized nations in particular has been questioned.

Still, the potential for flexibility in meeting the emission reduction goal for the United States suggests that actual emissions may not need to be reduced to 7 percent below the 1990 level to comply with the Kyoto Protocol. The energy information administration has developed a baseline scenario and 6 alternative scenarios. None of these scenarios, however, examine the possible offsetting impacts of any economic adjustments programs that might be established to mitigate the employment, income and transfer payment effects of these emission reductions.

The baseline scenario is 33 percent above the 1990 level and represents projections of energy markets and carbon emissions without any enforced limits and is compared with energy market impacts. The projected carbon emission is 1791 million metric tons.

The first scenario, 24 percent above the 1990 level, assumes that carbon emissions can increase to an average of 1,670 million metric tons between 2008 and 2012. Compared to the average emissions in the baseline case, carbon emissions are reduced by an average of 122 million metric tons during the commitment period.

The second scenario, 14 percent above the 1990 level, represents carbon emissions averaging 1,539 million metric tons between 2008 and 2012, approximately at the level estimated for 1998 in AEO98, 1,533 million metric tons. This results in an average annual reduction of 253 million metric tons of carbon from the baseline case.

The third scenario, 9 percent above the 1990 level, assumes that energy-related carbon emissions can increase to an average of 1,467 million metric tons between 2008 and 2012. This results in an average annual reduction of 325 million metric tons from the baseline case.

The fourth scenario assumes stabilization at 1990 levels and that carbon emissions reach an average of 1,345 million metric tons during the commitment period of 2008 through 2012, stabilizing approximately at the 1990 level. This is an average annual reduction of 447 million metric tons from the baseline case.

The fifth scenario, 3 percent below the 1990 level, assumes that energy-related carbon emissions are reduced to an average of 1,307 million metric tons between 2008 and 2012, an average annual reduction of 485 million metric tons from the baseline case projections.

Finally, the sixth scenario, 7 percent below the 1990 level, assumes energy-related carbon emissions are reduced from the 1990 level to an average of 1,250 million metric tons in the commitment period, 2008 to 2012. This is an average annual reduction of 542 million metric tons of energy-related carbon emissions during that period.

Baseline Forecast

The baseline forecast represents the expected path for the Appalachian coal mining industry through 2010 assuming moderate macroeconomic conditions, and existing environmental standards. The baseline forecast results from movements of the underlying forces affecting the Appalachian coal mining industry such as demand growth, competition from low-cost Western mines, and labor productivity growth. As the forecast will demonstrate, even under moderate, baseline conditions, these forces alone will create an interesting pattern of growth and contraction within the Appalachian coal mining industry and resulting changes in the industry's impact on the Appalachian economy.

Rates of Change

The results of the baseline forecast for coal production are summarized in Figure 2.1.1. That figure shows the forecast percent change in coal mine production in Appalachia through the year 2010, both overall and by region. The forecast calls for roughly flat production levels in the Appalachian region overall through 2010. Production is forecast to increase by only 1.0% over the entire 1997 to 2010 period. The forecast for Central Appalachia calls for a modest decline over 1997 to 2010, roughly in line with the overall forecast. Production is forecast to grow by 15.6% in Northern Appalachia, or an annual growth rate over 1%. Production in Southern Appalachia is forecast to decline 21.7% by 2010, which is a decline of nearly 1.5% per year.

These production changes are forecast to occur in an environment of falling coal prices. Figure 2.1.2 shows the baseline forecast for real (inflation adjusted) coal prices over the 1997 to 2010 period in all regions. Real prices are forecast to decline by 16.1% for Appalachia as a whole, which is an average decline of more than 1% per year. Such price declines are possible because of steady increases in mine productivity that are expected over the next decade (EIA, 1999). The steepest decline is forecast for Northern Appalachia. The smallest price decline is forecast for Southern Appalachia. Southern Appalachia is also the region where the productivity of mines in output per man hour is expected to grow the most slowly, so that there will be fewer opportunities for cost cutting.

Figure 2.1.1: Forecast Change in Coal Production Under Baseline Scenario (Millions of Tons), 1997-2010

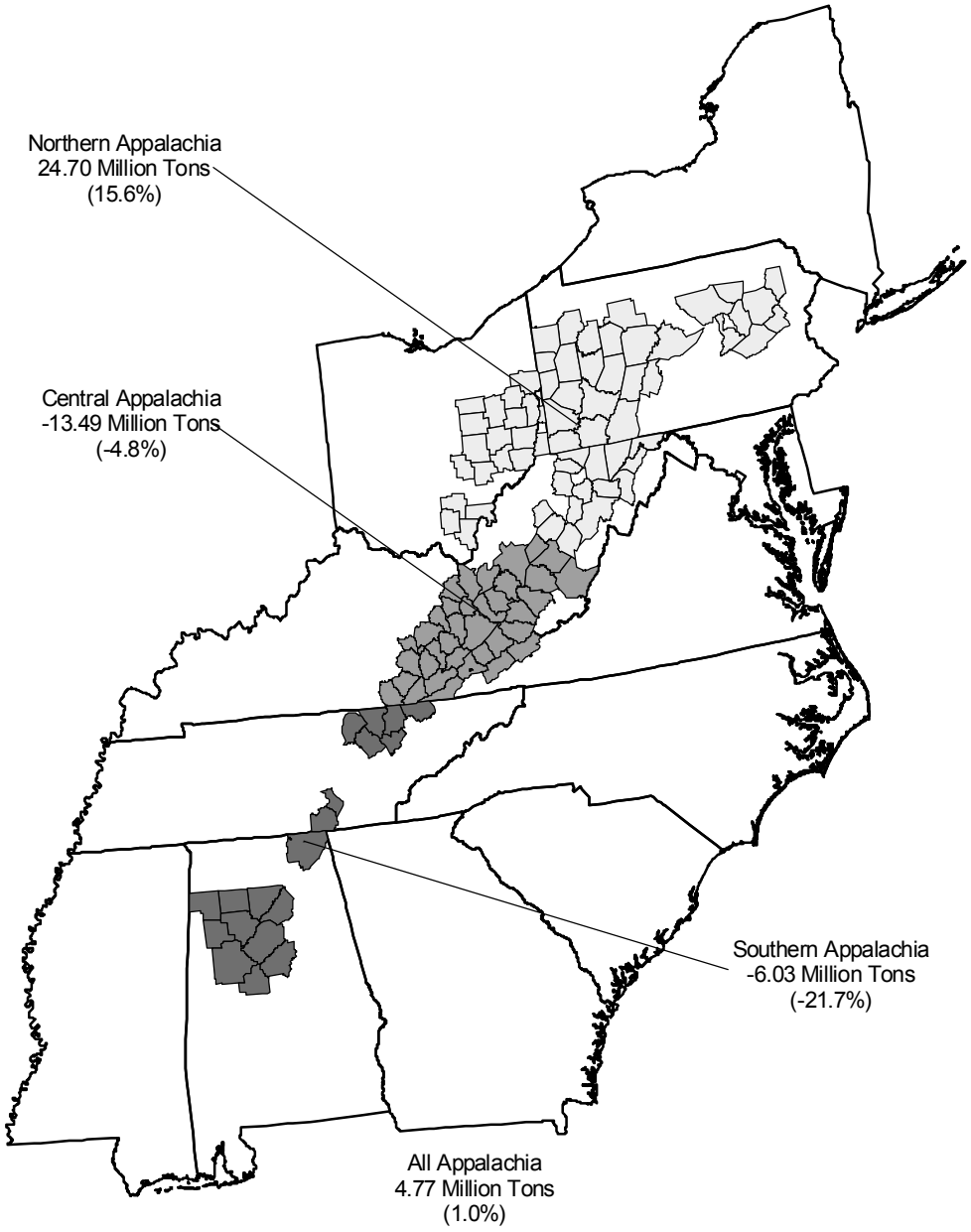
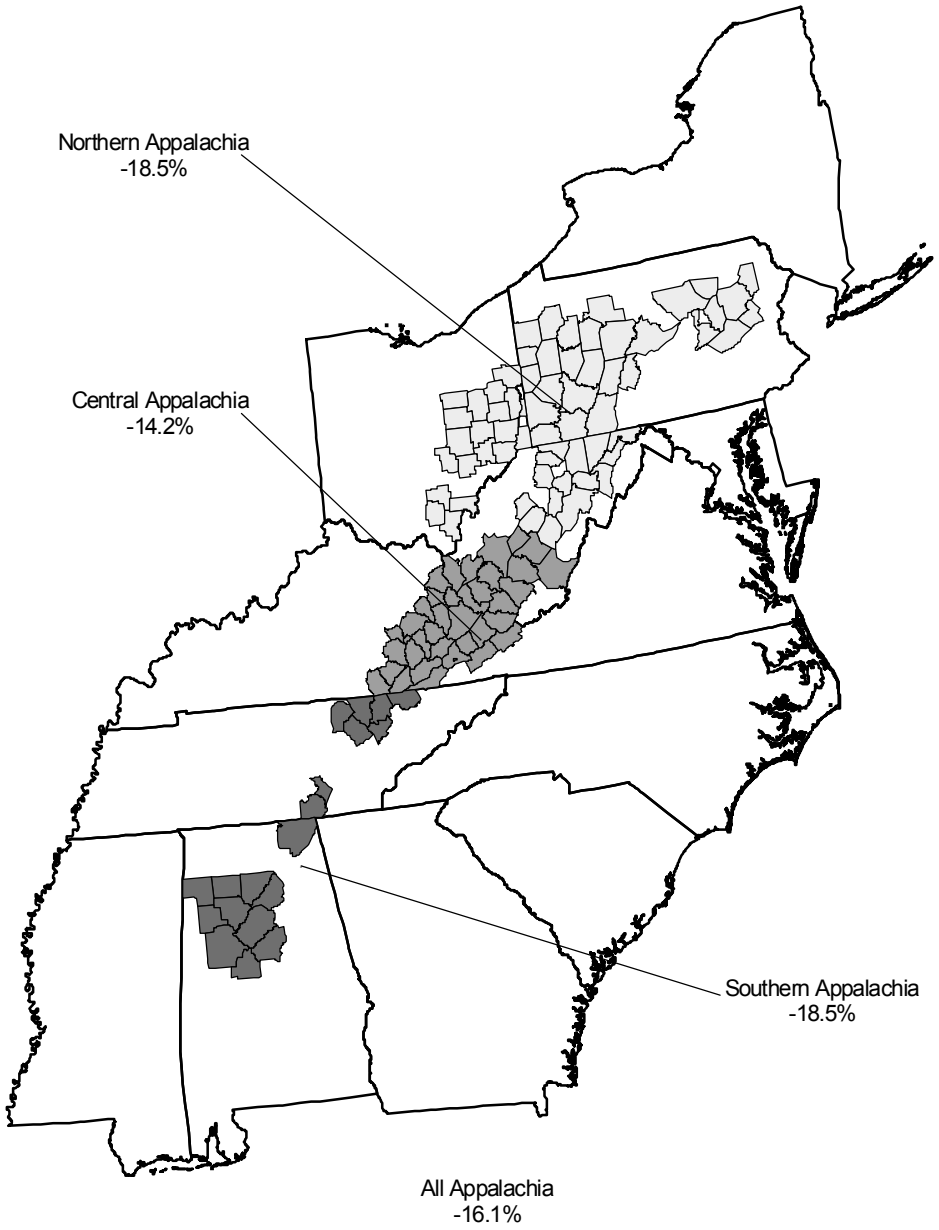


Figure 2.1.2: Forecast Change in Coal Prices (Minemouth) Under Baseline Scenario, 1997-2010



Previous figures have illustrated forecasts for coal industry production and price through the year 2010. Figure 2.1.3 shows forecasts for coal industry sales, which is simply industry production times price. Sales also can be refered to as output, which is the term used in Figure 2.1.3. The output forecasts reflect what was found in the production and price forecast information presented above. The production forecast called for total production in all of Appalachia to be roughly flat through 2010 in the baseline scenario. But, the price forecast called for real prices to fall significantly during the period. As a result, it is not surprising that total Appalachian output (i.e., sales) would therefore be forecast to fall over the 1997 to 2010 period. The same pattern is repeated in the three regions of Appalachia. Even in Northern Appalachia, where production was forecast to grow significantly, output is forecast to fall due to price declines. The decline in output naturally was more severe in Central Appalachia and in Southern Appalachia, where both falling prices and falling production are forecast.

The output declines forecast in the baseline scenario represent a significant decline for the industry, and point to a significant reduction in the economic impact of the coal industry on the Appalachian regions, particularly in Central Appalachia. The forecast total decline in industry output from 1997 to 2010 is $1.89 billion. Of this, $1.37 billion is forecast to be lost in Central Appalachia.

Forecasts for employment and earnings also point to a reduction in economic impact, with both industry employment and real (inflation adjusted) earnings forecast to decline substantially. Figure 2.1.4 illustrates the forecast employment change for the coal mining industry in Appalachia through 2010 under the baseline scenario. These employment forecasts were based on the forecasts for production presented above and expected changes in mine labor productivity. These productivity expectations were developed by EIA and utilized in coal industry forecast models. Growth in labor productivity was forecast for all regions of Appalachia. The forecasts called for a rapid growth in labor productivity in Northern Appalachia, particularly in underground mining. The forecast rate of productivity growth was more moderate in Central Appalachia, while productivity growth forecasts were slowest in Southern Appalachia. Forecast production levels were then divided by the EIA productivity estimates each year to yield estimates of labor requirements in 1997, and in 2010 under each scenario.

As seen in Figure 2.1.4, industry employment is forecast to decline by about one-quarter from 1997 to 2010, with the most rapid percentage declines forecast in Northern and Southern Appalachia, where employment is forecast to decline by roughly 30%. Note that the rapid decline in employment is forecast for Northern Appalachia even though this region is forecast to have the fastest production growth. The explanation for this is the forecast rapid rate of growth in labor productivity in mines in Northern Appalachia. The more rapid rate of decline in Southern Appalachia results primarily from forecast declines in production in that region in the baseline scenario, combined with a modest rate of labor productivity growth.

Figure 2.1.3: Forecast Change in Coal Output Under Baseline Scenario (Billions of Dollars), 1997-2010

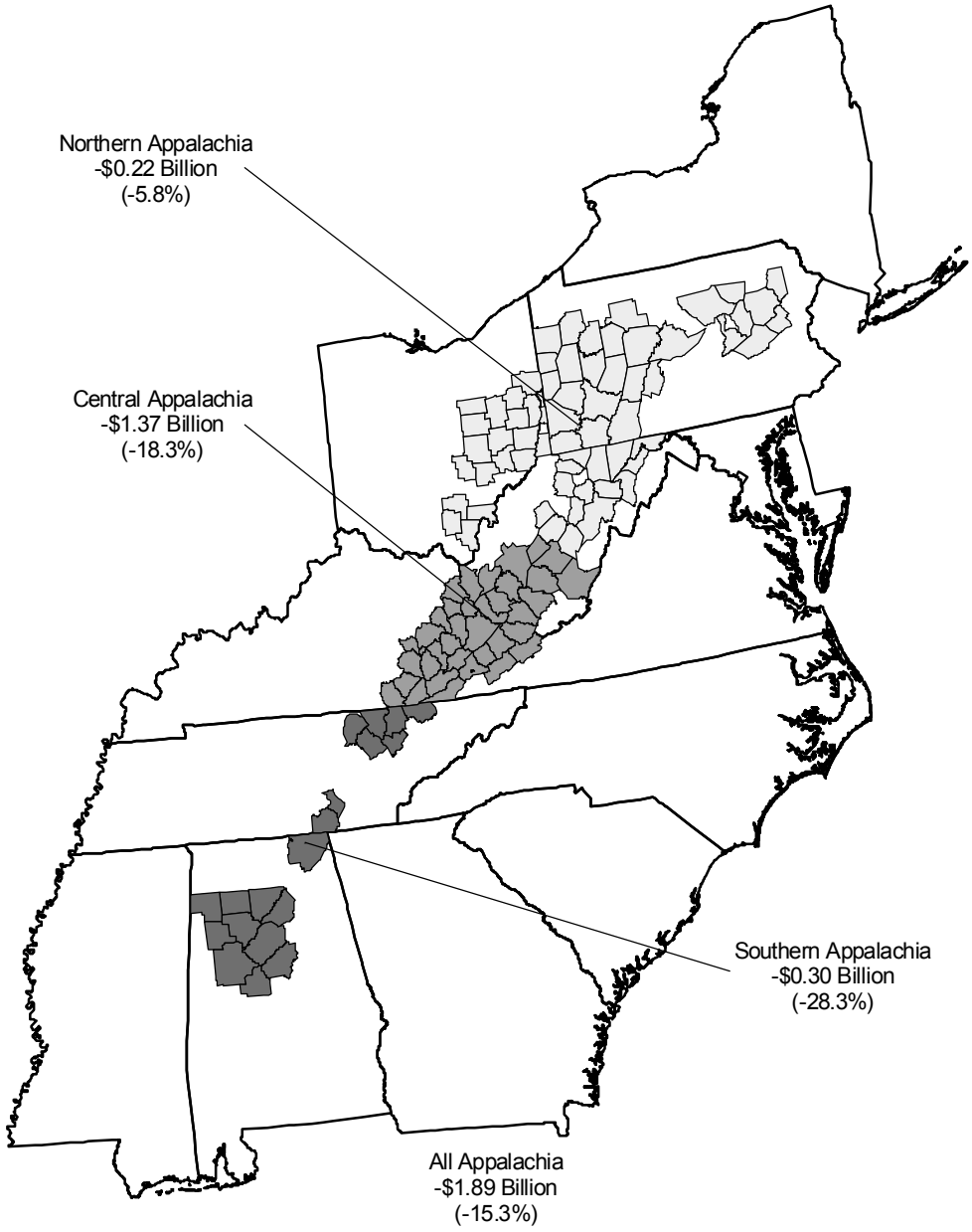
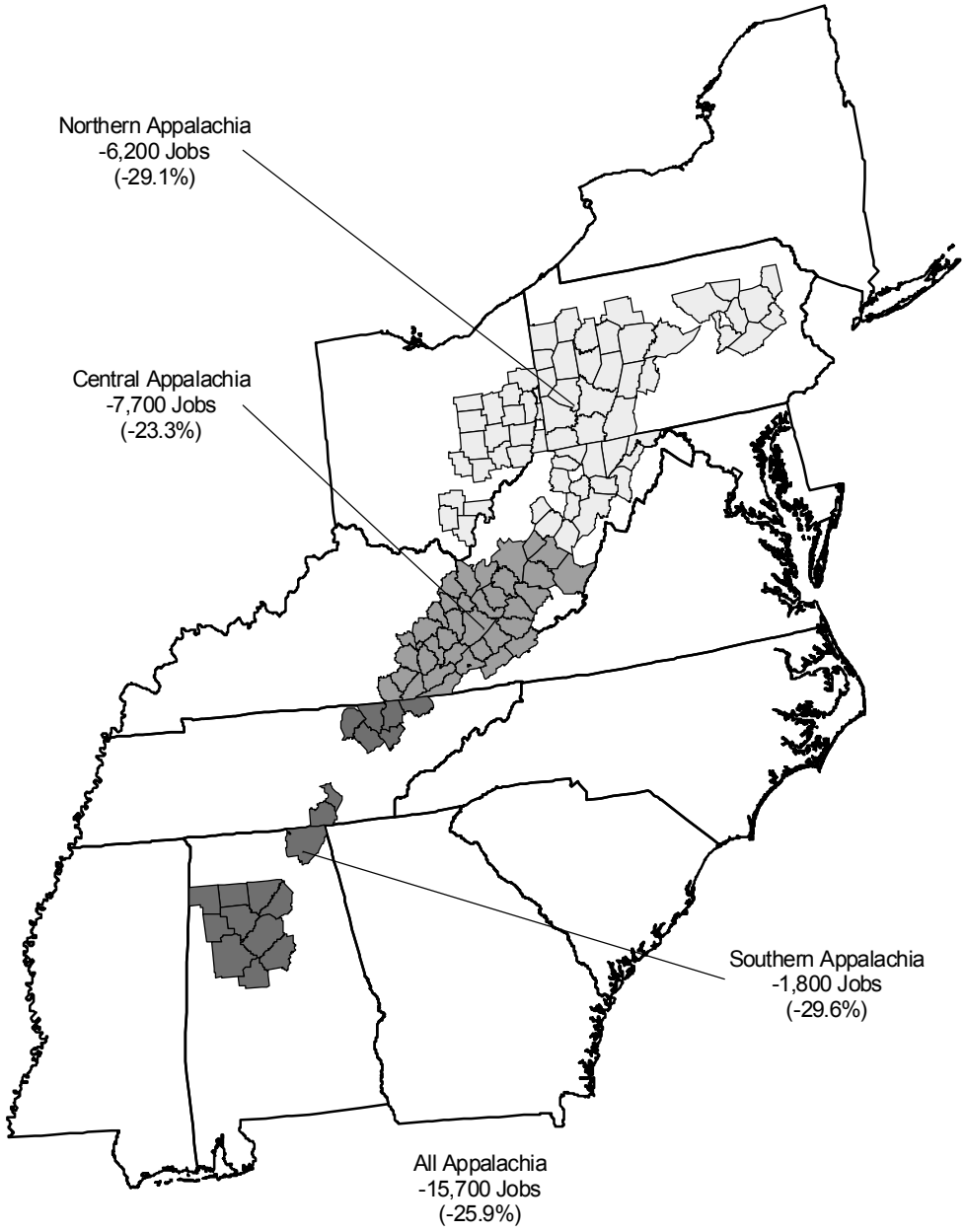


Figure 2.1.4: Forecast Change in Coal Employment Under Baseline Scenario, 1997-2010

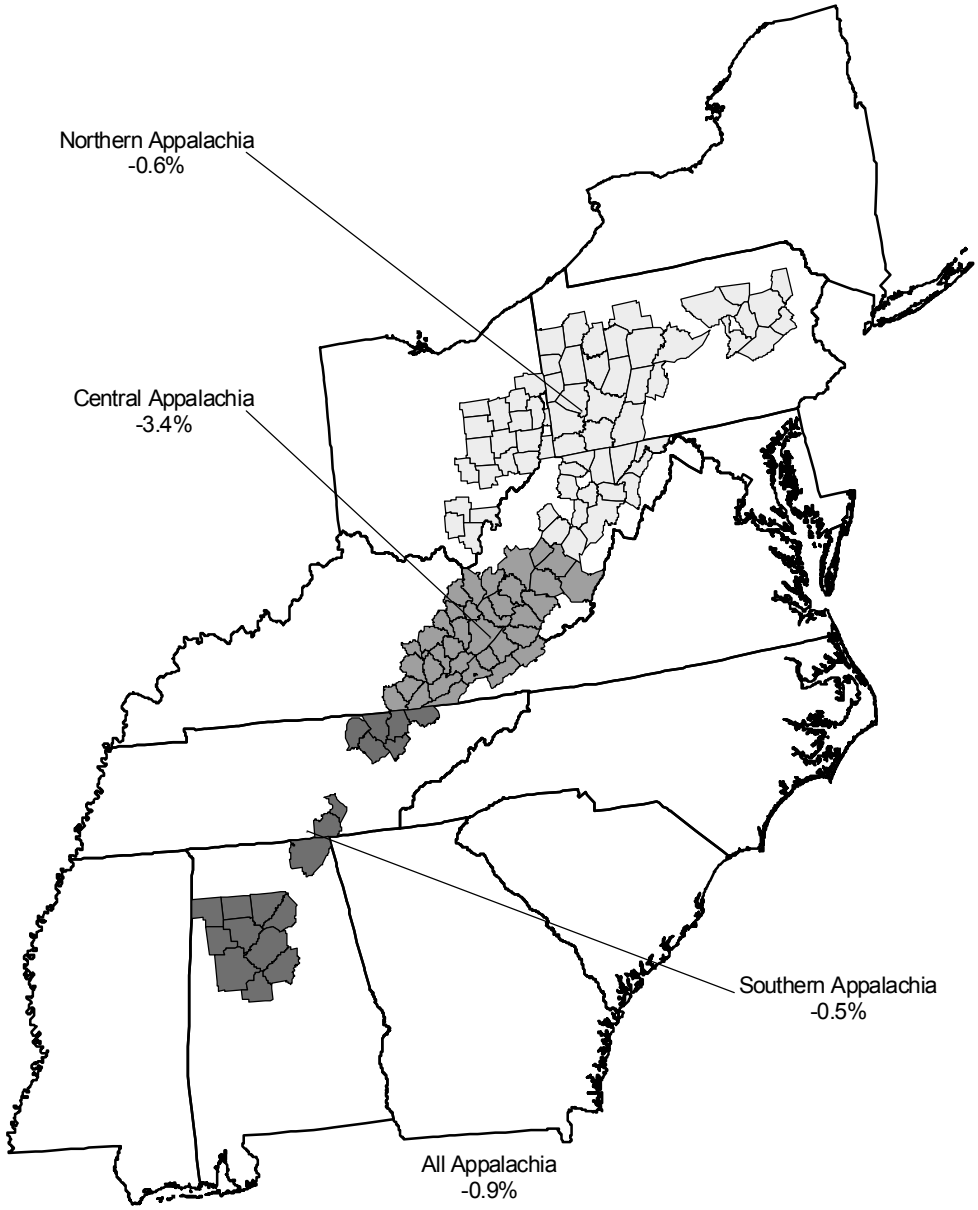


As for the level of employment loss, while the percentage rate of employment loss was lower in Central Appalachia then in other regions, the absolute decline is largest since Central Appalachia has the most employment. The forecast calls for roughly 7,700 lost jobs in Central Appalachia. The forecast employment loss in Northern Appalachia was 6,200 jobs. The baseline scenario forecasts a loss of 1,800 coal mining industry jobs in Southern Appalachia. Again, these substantial declines in industry employment even in the baseline scenario likely portend a similar reduction in the economic impact of the coal mining industry, particularly in Central Appalachia.

Figure 2.1.5 shows the forecast change in earnings for the coal mining industry in the baseline scenario. The forecast is obtained by multiplying the forecast for employment under each scenario by the forecast real wage, and then calculating the change in earnings. The percentages in Figure 2.1.5, however, mirror those for employment change on a percentage basis. This is because the when making the forecasts EIA assumed that real wages would remain constant from 1997 through 2010. Thus, the forecast percentage change in employment is also the forecast change in earnings.

These percentage losses translate into a substantial loss in coal industry earnings. The baseline forecast calls for a loss of $1.06 billion in coal industry earnings from 1997 through 2010. These losses will be concentrated in Northern Appalachia, which will account for $0.48 billion of lost annual earnings, and Central Appalachia, where $0.46 billion worth of earnings are forecast to be lost. Note that the absolute loss in earnings is larger in Northern Appalachia then in Central Appalachia. This was not the case for employment, and reflects that average earnings per job are somewhat higher in Northern Appalachia than in Southern Appalachia. Approximately $130 million in annual earnings are forecast to be lost in the coal mining industry in Southern Appalachia. As was the case with the declines in output, and employment, these declines in earnings suggest that there will be a substantial decline in the direct economic impact of the coal mining industry on the Appalachian economy. The next section considers how much of an effect these declines in the coal mining industry might have on the overall economy of each Appalachian region.

Figure 2.1.5: Forecast Change in Coal Earnings Under Baseline Scenario (Billions of Dollars), 1997-2010



The Relative Impact of Coal Industry Change

Industry output, employment, and earnings represent the direct economic impacts of the coal mining industry on the Appalachian economy. Forecast declines in each of these measures suggests that there would be a substantial drop in the economic impact of the coal mining industry in Appalachia under the baseline scenario. Results presented above suggest that the contraction of the coal mining industry output will be most severe in Central Appalachia, but that the decline in industry employment and earnings will be about as substantial in Northern Appalachia.

What effect will these large drops in output, earnings, and employment have on the economies of Northern and Central Appalachia, as well as Southern Appalachia? The answer to this question relies in part on how much the economy of each region is dependent on the coal mining industry. In other words, will the large losses of direct output, earnings, and employment represent a substantial loss for the overall economy of these regions, or a relatively small loss? This section addresses this issue by comparing the forecast losses in the coal mining industry with the size of the overall regional economy. Note that this section only compares the direct economic impact of the coal mining industry with the size of the overall economy, the indirect or "multiplier" effect is not included. Changes in the total impact of the industry will be discussed in the next section of this report.

As illustrated in Figures 2.1.6 and 2.1.7 below, forecast losses in the coal mining industry are likely to have the largest effect on the economy of Central Appalachia, the region where coal mining is the largest part of the economy. In this region, the significant declines in coal industry output, employment, and earnings forecast in the baseline scenario would represent a large share of the regional economy. The direct losses in the industry would account for 2.4% of regional employment and 3.4% of regional earnings. Outside of this Central Appalachian region, the relative size of coal industry losses are small compared to the overall economy. The large reductions in coal industry employment and earnings examined in the baseline scenario would account for about 0.5% of earnings in both Northern and Southern Appalachia. For the Appalachian coal-producing region overall, losses in the coal mining industry would account for 1% or less of total employment and earnings.

Figure 2.1.6: Lost Coal Earnings as a Share of All Earnings Under Baseline Scenario

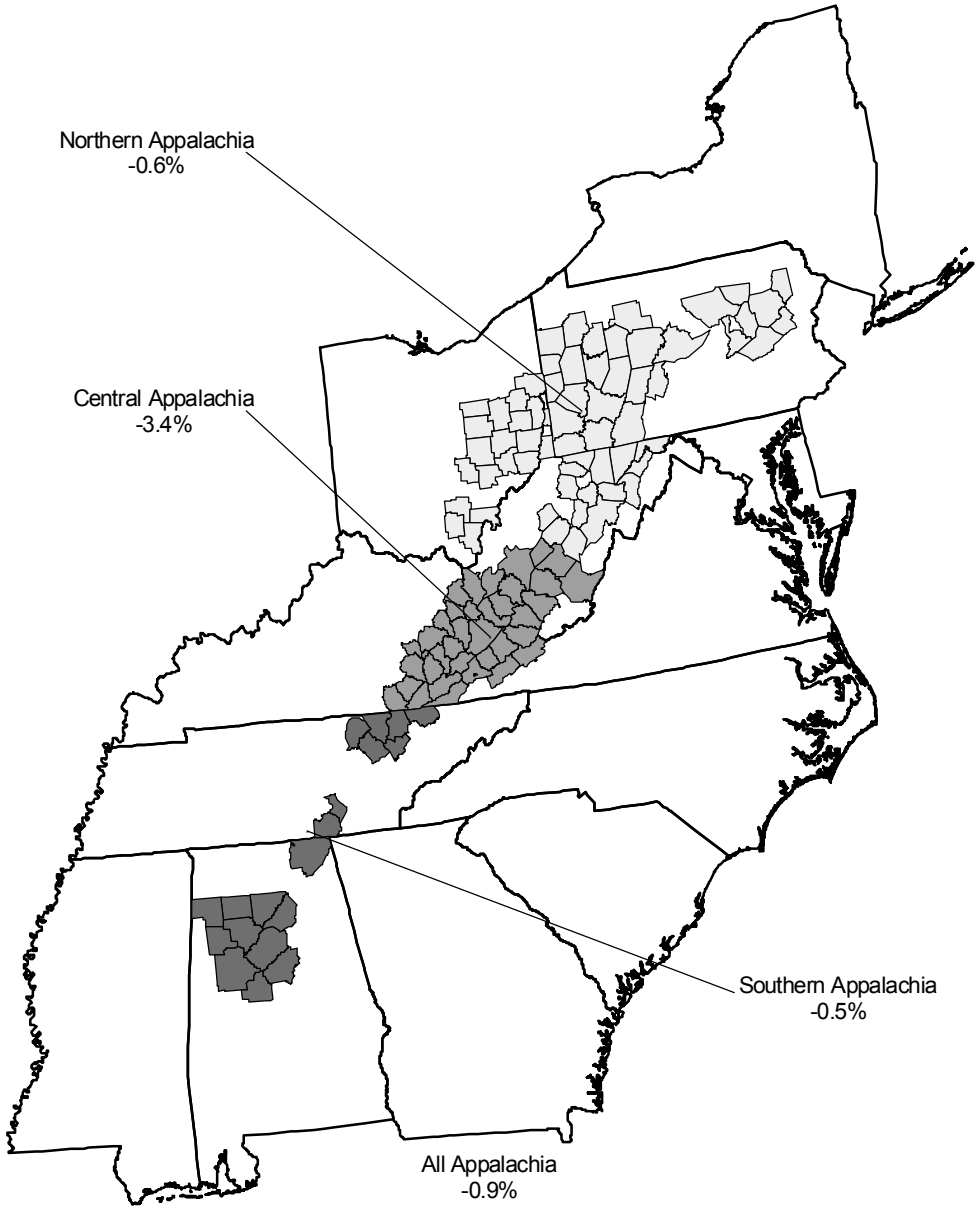
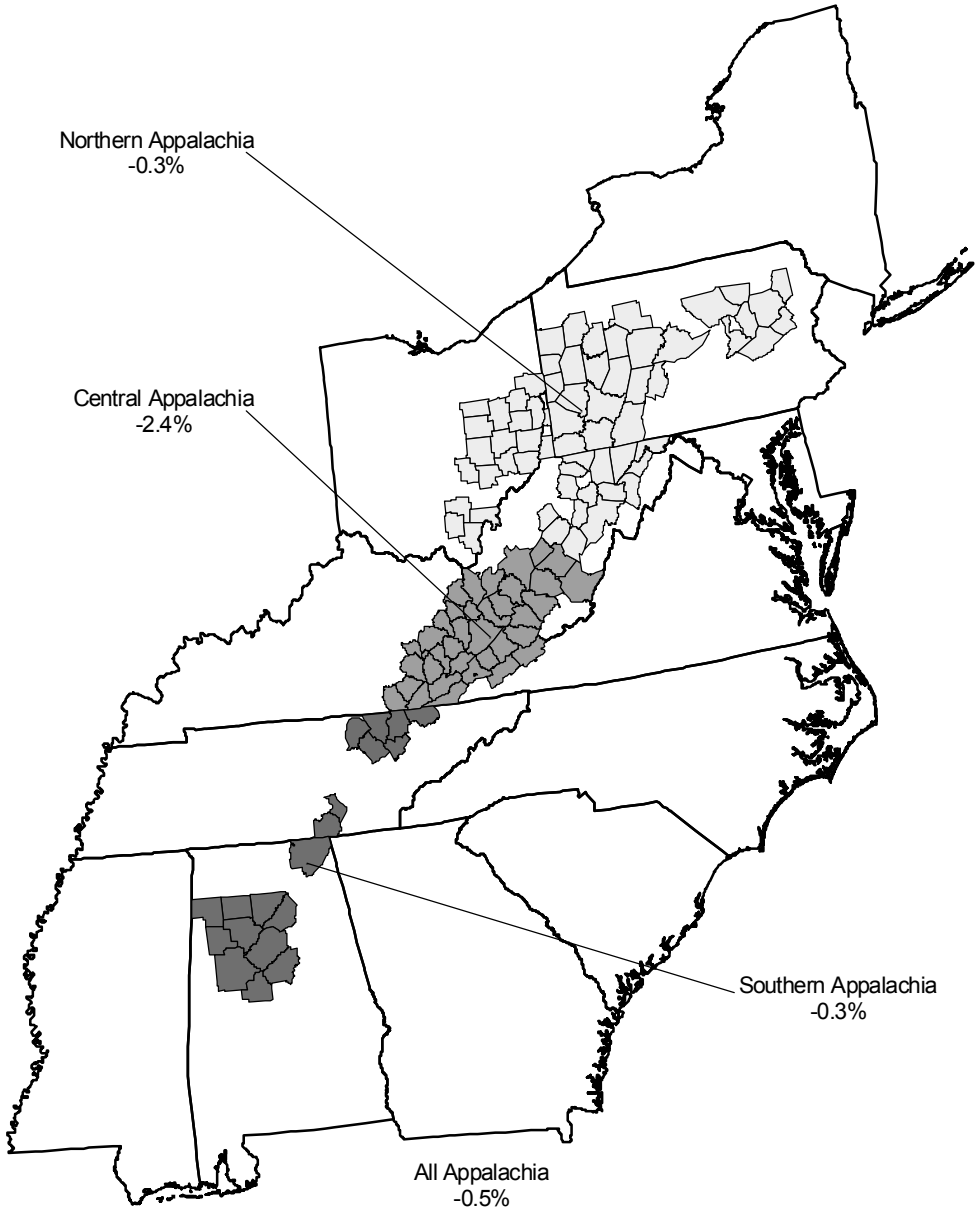


Figure 2.1.7: Lost Coal Employment as a Share of All Employment Under Baseline Scenario



Summary

While production is forecast to remain steady overall, significant losses in coal industry earnings, employment, and output are forecast under the baseline scenario. These losses are forecast to be substantial, with approximately 15,000 jobs and over $1 billion in annual earnings lost in the entire Appalachian region. These losses are expected to occur throughout the region. Even these signficant losses, however, may not have a large direct effect on the overall Appalachian economy. Losses forecast for the coal mining industry would account for less than 1% of the current employment and earnings in the major Appalachian coal-producing counties overall. However, the direct effect is forecast to be much greater in Central Appalachia, where the coal mining accounts for a larger share of the local economy.

Forecast Scenarios

Forecasts for any industry are always made with a degree of uncertainty. Two factors that create uncertainty for coal industry forecasts are future macroeconomic conditions of the economy, which can effect demand for coal, and future environmental regulation. This section considers the forecast for the Appalachian coal industry through 2010 under a number of alternative macroeconomic scenarios. It also considers the forecast under six alternative emissions reduction scenarios related to the Kyoto protocol. The baseline scenario also is presented in order to make comparisons with these alternative forecast scenarios.

Table 2.1.2 illustrates the relative growth rates of coal production under the baseline forecast as well as under each macroeconomic and Kyoto scenario. Overall Appalachian growth rates are presented along with the forecast growth rates in each of the three coal-producing regions in Appalachia. Forecast production levels are only modestly affected by changes in future macroeconomic conditions. Overall Appalachian production growth rises to just 4.1% under high growth macroeconomic conditions, and falls to 0.3% under low growth macroeconomic conditions. Given that these figures are totals over the entire 1997 to 2010 period, it is fair to say that Appalachian coal production will be essentially unchanged, or grow very modestly, whether economic growth is rapid, average or slow. The same could be said regarding production under alternative scenarios for the price of oil. The growth in Appalachian coal production is just 3.4% over the 1997 to 2010 period in the high oil price scenario and 1.4% in the low oil price scenario.

As was the case for total Appalachian production, coal production in the regions of Appalachia is not greatly altered in the alternative macroeconomic scenarios. Each macroeconomic forecast scenario calls for a modest drop in production in Central Appalachia, the largest coal-producing region. Each macroeconomic scenario calls for a significant percentage growth in production in Northern Appalachia, but a significant percentage decline in production in Southern Appalachia.

However, there are great differences in Appalachian production forecasts under alternative scenarios for the environmental regulations under the Kyoto protocols. All Kyoto scenarios would lead to less coal production in Appalachia than forecast under the baseline scenario, or under any macroeconomic scenario. However, the forecast loss is much greater under the most strict emissions reductions. Compared to a baseline forecast of 1% growth, Appalachian production would fall by roughly 50% if emissions levels must be reduced to 1990 levels, or less. However, if emissions in 2010 are allowed to exceed the 1990 level by 24%, forecast coal production can be expected to decline by only 13.5%. The manner in which the Kyoto agreements are regulated can have a substantial effect on the level of coal production in Appalachia in the future.

There are significant reductions in all three Appalachian coal-producing regions under the Kyoto scenarios. However, the Southern Appalachian region appears to be less effected by the Kyoto scenarios. While production growth in the Southern Appalachian region was the weakest in the baseline scenario, production losses in the the Southern region were similar to those in Northern and Central Appalachia under most Kyoto scenarios. At the same time, Northern Appalachia would be particularly hard hit under the stricter Kyoto emission reduction scenarios. Production in Northern Appalachia is forecast to grow significantly under the baseline scenario, but under scenarios where 2010 emissions would be at 1990 levels or less, production would contract the most rapidly in Northern Appalachia.

In summary, baseline and alternative macroeconomic scenario forecasts each call for little change in Appalachian production during the 1997 to 2010 period. Each of these scenarios also calls for a small change in Central Appalachian production, significantly rising Northern Appalachian production, and significantly falling Southern Appalachian production. Further, changing environmental regulations such as the Kyoto protocol appear to have a much more profound impact on production in the coal industry than macroeconomic concerns. Appalachian production would fall under all emission control scenarios, and would fall rapidly under strict emission reduction regimes. The Kyoto emissions reductions would effect Southern Appalachian production the least, and under the strict reduction scenarios, would effect Northern Appalachian production the most.

These results for Northern and Southern Appalachia may occur due to the relative importance of premium coal in the production of each region. Premium coal is most likely to be used for industrial purposes or exported. Therefore, demand for premium coal is less directly affected by the implementation of the Kyoto Protocol in the United States. Premium coal accounts for a relatively small share of coal mined in Northern Appalachia, but a relatively large share in Southern Appalachia

Table 2.1.2: Growth Rate in Appalachian Coal Production, 1997-2000, by Macroeconomic and Kyoto Scenarios

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level		1990	More than 1990 Level		
	Baseline	Low	High	Low	High	7%	3%	Level	9%	14%	24%
Total Appalachian	1.0%	4.1%	0.3%	3.4%	1.4%	-57.8%	-52.4%	-48.6%	-34.4%	-23.4%	-13.5%
Northern Appalachia (PA, OH, MD, & Northern WV)	15.6%	24.7%	16.2%	22.0%	12.0%	-65.3%	-58.4%	-52.6%	-26.8%	-5.9%	-6.2%
Medium Sulfur (Premium)	2.4%	47.1%	-4.0%	37.4%	-1.9%	-7.9%	-7.9%	-7.8%	-7.5%	-7.2%	-5.9%
Low Sulfur (Bituminous)	-14.7%	55.0%	-23.6%	-4.2%	41.6%	-84.5%	-81.0%	-78.0%	-68.2%	-58.9%	-34.2%
Medium Sulfur (Bituminous)	35.1%	39.6%	38.4%	39.3%	23.3%	-70.8%	-64.2%	-59.0%	-33.5%	-8.7%	-5.4%
High Sulfur (Bituminous)	10.7%	18.0%	9.7%	16.7%	10.5%	-70.7%	-61.0%	-52.2%	-17.9%	-2.4%	-8.9%
High Sulfur (Gob)	-68.8%	-69.6%	-66.7%	-64.7%	-67.0%	-19.7%	-19.0%	-24.1%	-14.2%	25.5%	16.5%
Central Appalachia (Southern WV, VA, & Eastern KY)	-4.8%	-4.7%	-6.2%	-4.4%	-2.1%	-54.3%	-49.9%	-47.1%	-38.9%	-33.0%	-16.5%
Medium Sulfur (Premium)	-9.2%	-13.8%	-8.3%	-13.2%	-8.4%	-13.4%	-13.3%	-13.2%	-12.8%	-12.4%	-10.8%
Low Sulfur (Bituminous)	-1.3%	2.9%	-6.0%	-0.9%	6.6%	-72.3%	-67.5%	-65.6%	-56.5%	-43.7%	-14.1%
Medium Sulfur (Bituminous)	-4.4%	-4.2%	-5.3%	-2.2%	-3.1%	-65.2%	-58.9%	-54.5%	-43.4%	-37.8%	-19.8%
Southern Appalachia (TN & AL)	-21.7%	-20.5%	-22.5%	-20.8%	-22.4%	-52.0%	-44.9%	-41.7%	-30.6%	-24.3%	-22.3%
Low Sulfur (Premium)	-15.4%	-15.5%	-15.1%	-15.9%	-14.5%	-7.8%	-7.8%	-7.6%	-7.6%	-7.5%	-7.1%
Low Sulfur (Bituminous)	-21.7%	-20.8%	-22.4%	-19.5%	-23.5%	-73.7%	-60.1%	-57.8%	-36.2%	-19.4%	-16.8%
Medium Sulfur (Bituminous)	-26.7%	-24.1%	-28.5%	-26.0%	-27.3%	-57.4%	-51.9%	-46.4%	-68.0%	-37.1%	-34.6%

Source: Unpublished data, Energy Information Administration

Table 2.1.3 illustrates the production growth forecasts shown in Table 2.1.2 in terms of absolute change rather than in percentage terms. Data in Table 2.1.3 indicate the magnitude of lost production forecast under some of the most restrictive Kyoto emission reduction scenarios. Coal production in Appalachia would be forecast to fall by well over 200 million tons per year under half of the scenarios, and by 63 millions tons a year even in the least restrictive scenario.

Data in this table also illustrate that the largest absolute declines in production tend to be in Central Appalachia, the largest coal-producing region. This pattern holds under each of the macroeconomic and Kyoto scenarios. Although, the Kyoto scenarios have nearly as large an impact on production levels in Northern Appalachia as in Central Appalachia, as can be seen in Table 2.1.4. Results in Table 2.1.4 indicate that relative to the baseline scenario the absolute losses due to Kyoto scenarios are nearly as great in Northern Appalachia as in Central Appalachia. This is particularly true under the more strict Kyoto reduction scenarios, such as a return to 1990 emission levels, or to 3% to 7% below 1990 emissions levels.

Table 2.1.3: Level of Growth in Appalachian Coal Production, 1997-2000, by Macroeconomic and Kyoto Scenarios (Thousands of Tons)

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	4,282	18,605	944	15,378	6,310	-270,826	-245,725	-227,819	-161,618	-110,754	-63,128
Northern Appalachia (PA, OH, MD, & Northern WV)	24,013	37,954	24,925	33,830	18,480	-100,263	-89,740	-80,854	-41,146	-9,099	-9,549
Central Appalachia (Southern WV, VA, & Eastern KY)	-3,701	-13,659	-17,720	-12,677	-5,961	-156,119	-143,503	-135,376	-111,979	-94,899	-47,379
Southern Appalachia (TN & AL)	-6,301	-5,690	-6,261	-5,776	-6,209	-14,444	-12,482	-11,589	-8,493	-6,755	-6,200

Source: Unpublished data, Energy Information Administration

Table 2.1.4: 2010 Coal Production Relative to Baseline by Macroecconomic and Kyoto Scenarios

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	474,256	14,323	-3,338	11,096	2,028	-275,108	-250,007	-232,101	-165,900	-115,036	-67,410
Northern Appalachia (PA, OH, MD, & Northern WV)	182,709	13,941	911	9,817	-5,533	-124,276	-113,754	-104,867	-65,160	-33,113	-33,563
Central Appalachia (Southern WV, VA, & Eastern KY)	269,809	41	-4,019	1,024	7,739	-142,419	-129,803	-121,675	-98,278	-81,199	-33,679
Southern Appalachia (TN & AL)	21,738	341	-230	255	-178	-8,413	-6,451	-5,558	-2,462	-724	-169

Source: Unpublished data, Energy Information Administration

Data in Table 2.1.5 show the forecast for future coal prices in Appalachia through 2010. The table also shows the average 1997 prices for the major Appalachian coal-producing counties overall and by region. Note that the Southern Appalachian region has by far the highest prices, presumably due to higher coal production costs in the region.

The expected price change does not vary significantly by forecast scenario. The forecast price decline is very similar in the baseline scenario and in each macroeconomic scenario. The forecast price decline is also similar among each of the Kyoto scenarios. Each scenario also has the same pattern of somewhat higher price declines in Northern Appalachia, and much smaller price declines in Southern Appalachia. Any differences between the price declines in the Kyoto scenarios and the macroeconomic and baseline scenarios occured because the Kyoto scenarios were part of a separate model run which generally called for smaller price declines, apart from any specific modeling of Kyoto emission reductions.

Table 2.1.5: Current and 2010 Coal Price (Minemouth) by Macroeconomic and Kyoto Scenarios

		Macroeconomic Scenarios					Kyoto Scenarios					
			Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Current Prices	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	$26.41	-16.1%	-15.3%	-17.1%	-16.0%	-16.0%	-12.3%	-12.5%	-12.6%	-13.5%	-14.1%	-13.2%
Northern Appalachia (PA, OH, MD, & Northern WV)	$24.48	-18.5%	-19.5%	-19.6%	-18.0%	-18.6%	-19.2%	-18.7%	-18.6%	-17.8%	-17.7%	-17.1%
Central Appalachia (Southern WV, VA, & Eastern KY)	$26.10	-14.2%	-13.9%	-15.1%	-14.1%	-14.1%	-11.7%	-11.9%	-11.7%	-12.0%	-12.1%	-11.5%
Southern Appalachia (TN & AL)	$38.38	-8.4%	-7.6%	-9.2%	-8.4%	-8.7%	-5.9%	-5.6%	-6.0%	-4.7%	-4.1%	-3.9%

Source: Unpublished data, Energy Information Administration

The previous tables have shown forecasts for coal industry production and price through the year 2010. Table 2.1.6 shows forecasts for coal industry output (price*production). The output forecasts in Table 2.1.6 reflect what was found in the production and price forecast information presented above. As was the case with production forecasts, the amount of lost output is greatest in Central Appalachia in each of the scenarios. Under the macroeconomic scenarios, the absolute amount of output lost is modest for both Northern Appalachia and Southern Appalachia (there is an output gain in Northern Appalachia in a few scenarios), although the losses are large in Southern Appalachia on a percentage basis. However, under the Kyoto scenarios, the losses in Northern Appalachia are large in both an absolute and percentage basis. Further, relative to the baseline scenario, the percentage absolute loss of output is as large in Northern Kentucky as in Central Kentucky under most Kyoto scenarios. The percentage loss is higher. This same pattern also was observed in the case of Appalachian coal production.

These large forecast losses in coal output have important implications for the economic impact of the coal mining industry on the Appalachian economy. Changes in industry output reflect changes in the direct effect of the coal mining industry, and have a substantial influence on the indirect effect. These substantial declines in industry output likely portend a similar reduction in the economic impact of the coal mining industry.

Table 2.1.6: Level and Percentage of Growth in Appalachian Coal Industry Output, 1997-2010, by Macroeconomic and Kyoto Scenarios (Billions of 1997 Dollars)

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	-$1.90B	-$1.47B	-$2.09B	-$1.63B	-$1.84B	-$7.80B	-$7.23B	-$6.83B	-$5.35B	-$4.24B	-$3.08B
	(-15.3%)	(-11.9%)	(-16.9%)	(-13.2%)	(-14.9%)	(-63.0%)	(-58.4%)	(-55.1%)	(-43.2%)	(-34.2%)	(-24.8%)
Northern Appalachia	-$0.22B	$0.16B	-$0.25B	$0.00B	-$0.34B	-$2.74B	-$2.53B	-$2.34B	-$1.52B	-$0.86B	-$0.85B
(PA, OH, MD, & Northern WV)	(-18.3%)	(4.1%)	(-6.6%)	(0.1%)	(-8.9%)	(-71.9%)	(-66.2%)	(-61.4%)	(-39.8%)	(-22.6%)	(-22.3%)
Central Appalachia	-$1.37B	-$1.35B	-$1.53B	-$1.34B	-$1.19B	-$4.47B	-$4.19B	-$4.00B	-$3.47B	-$3.08B	-$1.96B
(Southern WV, VA, & Eastern KY)	(-18.3%)	(-17.9%)	(-20.3%)	(-17.9%)	(-15.9%)	(-59.6%)	(-55.9%)	(-53.5%)	(-46.2%)	(-41.1%)	(-26.1%)
Southern Appalachia (TN & AL)	-$0.30B	-$0.28B	-$0.32B	-$0.29B	-$0.31B	-$0.28B	-$0.51B	-$0.48B	-$0.36B	-$0.29B	-$0.27B
	(-28.3%)	(-26.5%)	(-29.7%)	(-27.4%)	(-29.2%)	(-54.9%)	(-48.0%)	(-45.2%)	(-33.8%)	(-27.5%)	(-25.4%)

Source: Authors' calculations

Table 2.1.7 shows the forecast employment change for the coal mining industry in Appalachia through 2010 under the baseline scenario, each macroeconomic scenario and the Kyoto scenarios. As with the baseline forecast, scenario employment forecasts were based on the forecasts for production presented above and expected changes in mine labor productivity. The results for the macroeconomic forecasts are similar to those in the baseline forecast, with roughly 1,000 fewer lost jobs in the high growth and high oil price scenarios. However, the Kyoto forecasts are quite different from the baseline forecast. Job losses are much larger under the Kyoto scenarios, although, it should be noted that none of these scenarios consider any mitigation or adjustment programs to offset these impacts. Under the most restrictive emission scenarios from Kyoto, roughly 60% of coal industry employment would be lost compared with only about 25% in the baseline scenario. This translates into roughly 39,000 of 60,000 coal mining jobs present in Appalachia as of 1997. Although, it must be mentioned that under the least restrictive Kyoto emission scenario, job losses would be just slightly above what is expected under the baseline forecast scenario. As with production, while the largest percent losses occurred in Northern Appalachia, particularly under the most restrictive Kyoto scenarios, the largest absolute loss of employment occurred in Central Appalachia.

Table 2.1.8 shows the forecast change in earnings for the coal mining industry under each scenario. Both the absolute and percentage change are listed. Note that the forecast annual loss in earnings is a billion dollars or more for Appalachia as a whole in each of the scenarios, and is particularly large in the case of the Kyoto scenarios. In some scenarios, the absolute losses in earnings are larger in Northern Appalachia than in Central Appalachia. This was not the case for employment, and reflects that average earnings per job are somewhat higher in Northern Appalachia than in Southern Appalachia.

Table 2.1.7: Level and Percentage of Growth in Appalachain Coal Industry Employment, 1997-2010, by Macroeconomic and Kyoto Scenarios (Jobs)

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	-15,677	-14,421	-16,017	-14,697	-15,463	-39,067	-36,337	-34,441	-27,457	-22,155	-17,262
	(-25.9%)	(-23.9%)	(-26.5%)	(-24.3%)	(-25.6%)	(-64.6%)	(-60.1%)	(-57.0%)	(-45.4%)	(-36.7%)	(-28.6%)
Northern Appalachia	-6,194	-5,008	-6,116	-5,359	-6,664	-15,939	-14,882	-13,988	-9,996	-6,775	-6,820
(PA, OH, MD, & Northern WV)	(-29.1%)	(-23.5%)	(-28.7%)	(-25.2%)	(-31.3%)	(-74.8%)	(-69.9%)	(-65.7%)	(-46.9%)	(-31.8%)	(-32.0%)
Central Appalachia	-7,720	-7,716	-8,093	-7,624	-7,000	-19,818	-18,536	-17,710	-15,333	-13,598	-8,771
(Southern WV, VA, & Eastern KY)	(-23.3%)	(-23.3%)	(-24.4%)	(-23.0%)	(-21.1%)	(-59.7%)	(-55.9%)	(-53.4%)	(-46.2%)	(-41.0%)	(-26.4%)
Southern Appalachia (TN & AL)	-1,763	-1,698	-1,714	-1,808	-1,798	-3,309	-2,920	-2,742	-2,127	-1,782	-1,672
	(-29.6%)	(-28.5%)	(-28.8%)	(-30.8%)	(-30.2%)	(-55.6%)	(-49.0%)	(-46.0%)	(-35.7%)	(-29.9%)	(-28.1%)

Source: Authors' calculations

Table 2.1.8:Level and Percentage of Growth in Appalachain Coal Industry Earnings, 1997-2010, by Macroeconomic and Kyoto Scenarios (Billions of 1997 Dollars)

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	-$1.06B	-$0.97B	-$1.08B	-$0.99B	-$1.06B	-$2.64B	-$2.46B	-$2.32B	-$1.83B	-$1.46B	-$1.17B
	(-26.3%)	(-23.9%)	(-26.8%)	(-24.5%)	(-26.2%)	(-65.4%)	(-60.8%)	(-57.6%)	(-45.4%)	(-36.1%)	(-28.1%)
Northern Appalachia	-$0.48B	-$0.38B	-$0.47B	-$0.41B	-$0.51B	-$1.22B	-$1.14B	-$1.07B	-$0.77B	-$0.52B	-$0.52B
(PA, OH, MD, & Northern WV)	(-29.1%)	(-23.5%)	(-28.7%)	(-25.2%)	(-31.3%)	(-74.8%)	(-69.9%)	(-65.7%)	(-46.9%)	(-34.8%)	(-32.0%)
Central Appalachia	-$0.46B	-$0.46B	$0.48B	-$0.45B	-$0.42B	-$1.18B	-$1.10B	-$1.05B	-$0.91B	-$0.81B	-$0.52B
(Southern WV, VA, & Eastern KY)	(-23.3%)	(-23.3%)	(-24.4%)	(-23.0%)	(-21.1%)	(-59.7%)	(-55.9%)	(-53.4%)	(-46.2%)	(-41.0%)	(-26.4%)
Southern Appalachia (TN & AL)	-$0.16B	-$0.12B	-$0.13B	-$0.12B	-$0.13B	-$0.24B	-$0.21B	-$0.20B	-$0.15B	-$0.13B	-$0.12B
	(-29.6%)	(-28.5%)	(-30.8%)	(-28.8%)	(-30.2%)	(-55.6%)	(-49.0%)	(-46.0%)	(-35.7%)	(-29.9%)	(-28.1%)

Source: Authors' calculations

The Relative Impact of Coal Industry Change Under Each Scenario

Tables 2.1.9 and 2.1.10 below compare forecast losses in the coal mine industry with total employment in Appalachian coal-producing counties, overall and by region. Results in the tables indicate that forecast losses in the coal mining industry are likely to have the largest effect on the economy of Central Appalachia, the region where coal mining is the largest part of the economy. Note that these large losses are only the direct effect of coal mining industry earnings and employment, and do not consider the additional "multiplier" effect on the economy.

As the tables illustrate, the percentage losses can be much higher than the baseline in several of the Kyoto scenarios, but percentages change little in the macroeconomic scenarios. In the macroeconomic scenarios, the same regional pattern also is evident, with the largest percent losses in earnings and employment occuring in Central Appalachia, where the economy is most dependent on the coal mining industry. The loss of earnings in Appalachia overall is less than 1% in all macroeconomic scenarios, and the percent losses are roughly 0.5% in both Northern and Southern Appalachia.

Percent losses are much higher in the more restrictive Kyoto emissions scenarios. The percent loss of earnings is near or above 2% in the Kyoto scenarios where emissions return to 1990 levels, or lower, while the employment loss is above 1%. In these same scenarios, the percentage losses are most substantial in Central Appalachia where near or above 8% of regional earnings is lost, as is 5.5% to 6.1% of regional employment. The percentage loss in these more restrictive emission scenarios also rise rapidly for Northern Appalachia, but never rise above 1.5% for earnings or 0.8% for employment.

Percent losses are less severe under the less restrictive Kyoto emission scenarios, particularly in Northern and Southern Appalachia. Under each of these scenarios where emissions are restricted above 1990 levels, losses in the coal industry quickly fall toward those in the baseline forecast as emissions standards are relaxed. However, in Central Appalachia, the percent loss of earnings remains above 6.0% even under the scenario where emissions are able to rise to 14% above 1990 levels. Earnings and job losses are similar to those of the baseline forecast only in the scenario where emissions are able to rise 24% above 1990 levels.

Table 2.1.9: The Direct Effect of Coal Industry Changes: Loss in Coal Industry Earnings as a Percentage of 1997 Regional Earnings by Macroeconomic and Kyoto Scenarios (Billions of 1997 Dollars)

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	-0.9%	-0.8%	-0.9%	-0.8%	-0.9%	-2.2%	-2.0%	-1.9%	-1.5%	-1.2%	-1.0%
Northern Appalachia (PA, OH, MD, & Northern WV)	-0.6%	-0.5%	-0.6%	-0.5%	-0.6%	-1.5%	-1.4%	-1.3%	-0.9%	-0.6%	-0.6%
Central Appalachia (Southern WV, VA, & Eastern KY)	-3.4%	-3.4%	-3.6%	-3.4%	-3.1%	-8.8%	-8.2%	-7.9%	-6.8%	-6.0%	-3.9%
Southern Appalachia (TN & AL)	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-1.0%	-0.8%	-0.8%	-0.6%	-0.5%	-0.5%

Source: Authors' calculations

Table 2.1.10: The Direct Effect of Coal Industry Changes: Loss in Coal Industry Employment as a Percentage of 1997 Regional Employment by Macroeconomic and Kyoto Scenarios

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-1.3%	-1.2%	-1.1%	-0.9%	-0.7%	-0.6%
Northern Appalachia (PA, OH, MD, & Northern WV)	-0.3%	-0.2%	-0.3%	-0.3%	-0.3%	-0.8%	-0.7%	-0.7%	-0.5%	-0.3%	-0.3%
Central Appalachia (Southern WV, VA, & Eastern KY)	-2.4%	-2.4%	-2.5%	-2.3%	-2.2%	-6.1%	-5.7%	-5.5%	-4.7%	-4.2%	-2.7%
Southern Appalachia (TN & AL)	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.5%	-0.5%	-0.4%	-0.3%	-0.3%	-0.3%

Source: Authors' calculations

Part 2.2: Estimates of the Future Direct, Indirect, and Induced Economic Effects Attributable to the Coal Industry Using Economic Forecasts through 2010

The purpose of this section is to consider the total economic impact of the coal mining industry on the local economies of major Appalachian coal-producing counties. The first step will be to examine how the total impact would be expected to change under the baseline forecast for the Appalachian coal industry in the year 2010. Next, the baseline forecast will be compared to each of the four alternative macroeconomic scenarios, and the six Kyoto emissions reduction scenarios.

The proceeding section considered how the direct effect of the coal industry on Appalachia could be expected to change by the year 2010, under a number of alternative forecast scenarios. Forecasts were provided for a number of coal industry indicators such as production and price, and the direct effects of the industry in terms of output, employment, and earnings. The primary findings in these forecasts is that the direct effect of the coal mining industry was expected to fall in most areas of Appalachia by 2010, and under most forecast scenarios. Losses in industry output, employment, and earnings would have a direct effect on the Appalachian economy, ranging from small in some areas to large in others.

These direct effects, as large as the effects were in some cases, only represent a portion of the total impact that future changes in the coal mining industry would have on the Appalachian economy. There also would be indirect or "multiplier" effects due to the changes in the output, employment, and earnings generated in the coal mining industry. These indirect effects occur because the coal mining industry supports economic activity throughout the economies of many of the major Appalachian coal-producing counties. Coal companies often support the activities of their suppliers in the manufacturing, machine shop, construction, and business services industry. The wages earned by coal miners supports their spending for a range of retail goods and services throughout the economy. These sorts of additional spending indicate that the total impact of the coal mining industry will be larger in magnitude than the change in the direct employment and earnings in the coal industry itself.

The Baseline Forecast

The baseline forecast, as reported in the last section, called for substantial changes in the coal mining industry through the year 2010. In particular, the baseline forecast called for a significant decline in the direct employment and worker earnings in the coal mining industry itself. In some regions of Appalachia, and in many individual major coal-producing counties, these forecast declines in employment and earnings would account for a significant share of the overall employment and earnings in this area. These county and multi-county areas can expect to be significantly affected by the

expected declines in mining job opportunities described in the baseline forecast. This is even more evident when the total impact of the coal mining industry is examined. This total impact not only includes the coal mining industry itself, but changes in other industries due to the indirect and induced effect of changes in the coal mining industry. The total economic impacts are substantially larger than the direct impacts discussed in the last section.

Total Baseline Forecast Ouput Impact

Figure 2.2.1 illustrates the total output impact of the forecast changes in the coal mining industry for Appalachia overall and for each of the three Appalachian regions. The total output decline forecast for the Appalachian region from 1997 to 2010 is $3.21 billion dollars. A majority of this total output impact is forecast to occur in Central Appalachia, where the total lost output is forecast to reach $2.32 billion dollars. The total output loss is forecast to reach $0.38 billion in Northern Appalachia, and $0.51 billion in Southern Appalachia. These total output impacts are one illustration of the full impact of a decline in coal industry output on the Appalachian economy, and point to a significant reduction in the economic impact of the coal industry on the Appalachian regions, particularly in Central Appalachia.

The total impact of forecast declines in the coal industry are substantial for both employment and earnings. The total impact is a loss of nearly 43,000 jobs and $1.76 billion in worker earnings in the major Appalachian coal-producing counties. These figures suggest that there is a substantial "multiplier" effect from lost jobs in the coal mining industry due to high wages in the industry, with the total job impact exceeding the forecast loss in coal mining jobs by 150%, while earnings are roughly 75% higher.

Total Baseline Forecast Earnings Impact

Figure 2.2.2 shows the forecast total earnings impact in Northern Appalachia, Central Appalachia, and Southern Appalachia under the baseline scenario. It also relates that earnings impact as a share of total earnings in each region. For Appalachia overall, the total earnings impact remains a relatively small share, at roughly 1.4% of total earnings. However, this is a significant share of earnings loss to be generated by any one industry. The relative size of the loss is most pronounced in Central Appalachia, where the forecast decline in total earnings impact would account for over 6% of current regional earnings. In absolute terms, the total earnings loss impact in Central Appalachia would $0.81 billion. In absolute terms, the loss of earnings would be nearly as great in Northern Appalachia, where the total earnings loss impact is forecast as $0.73 billion.

Total Baseline Forecast Employment Impact

Figure 2.2.3 shows the forecast total employment impact for each region, both in absolute terms, and as a share of employment in each industry. Again, the decline in employment is equivalent to 1.4% of current employment in the Appalachian region overall. However, the total employment impact would be equivalent to 6.5% of current employment in the Central Appalachian region. In absolute terms, the total impact would be a loss of 21,000 jobs in Central Appalachia, and 16,500 jobs in Northern Appalachia. The absolute jobs impact would be approximately 5,000 jobs in Southern Appalachia.

Figure 2.2.1: Total Ouput Impact Under Baseline Scenario

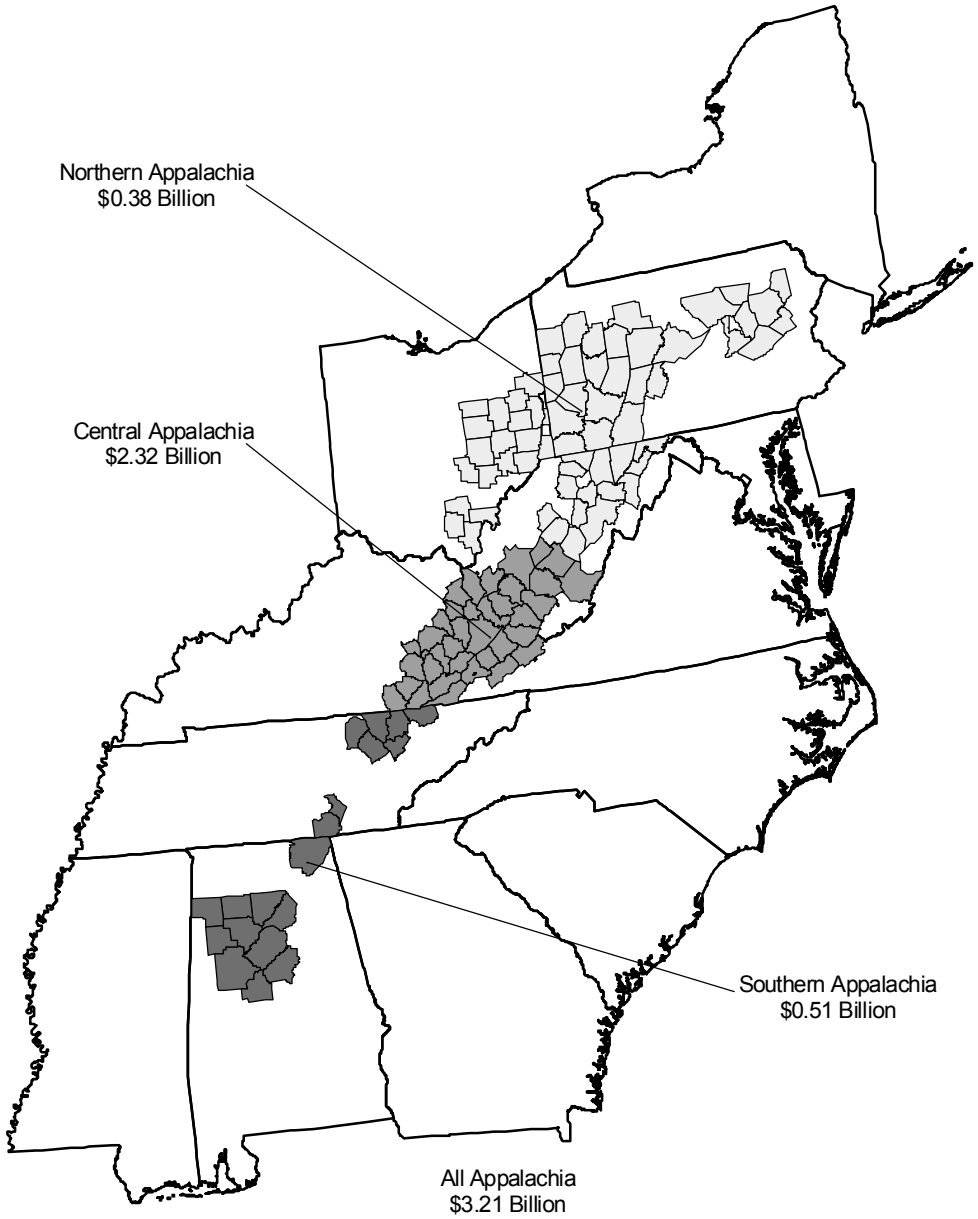


Figure 2.2.2: Forecast Total Earnings Impact Overall and as a Share of All Earnings Under Baseline Scenario

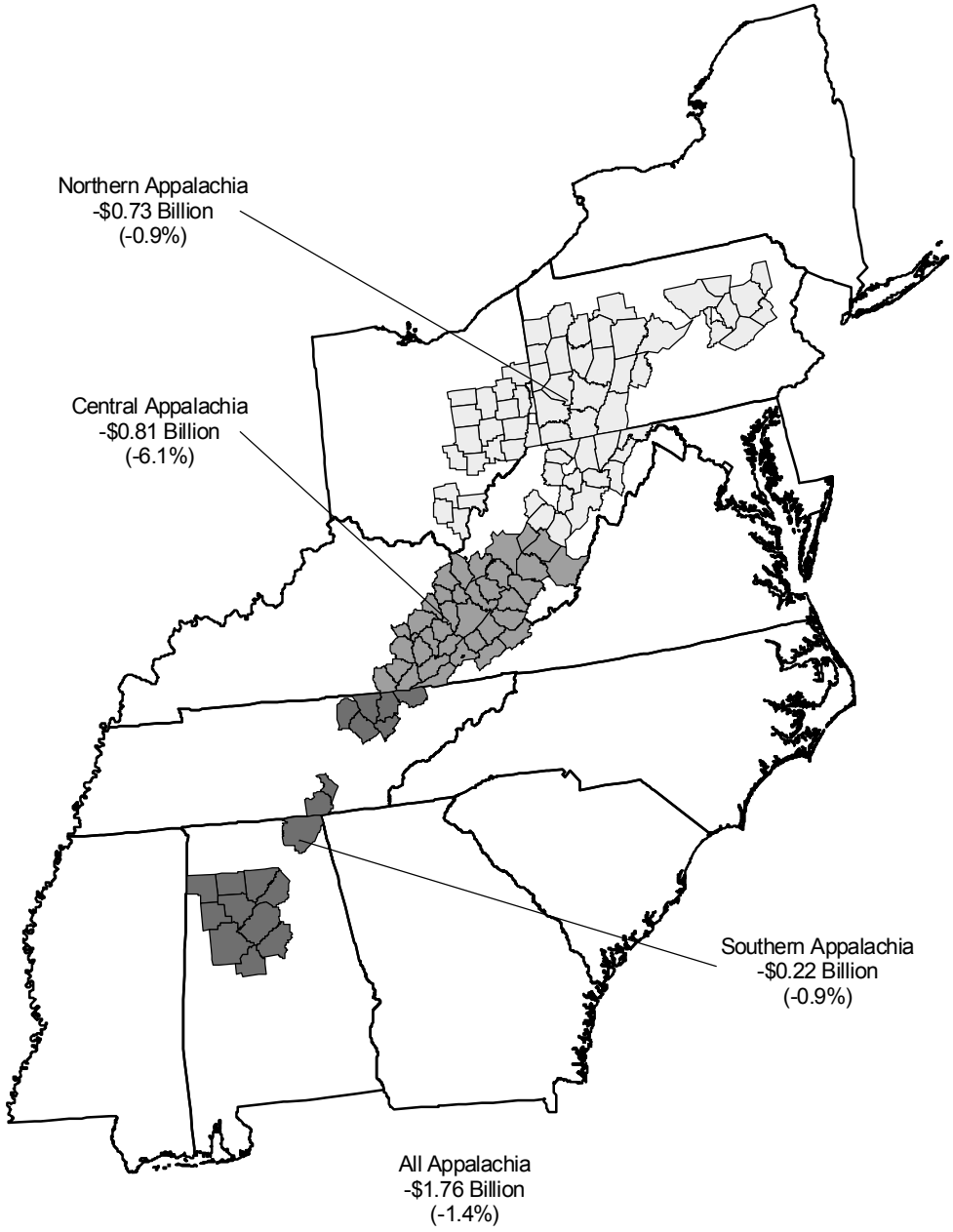
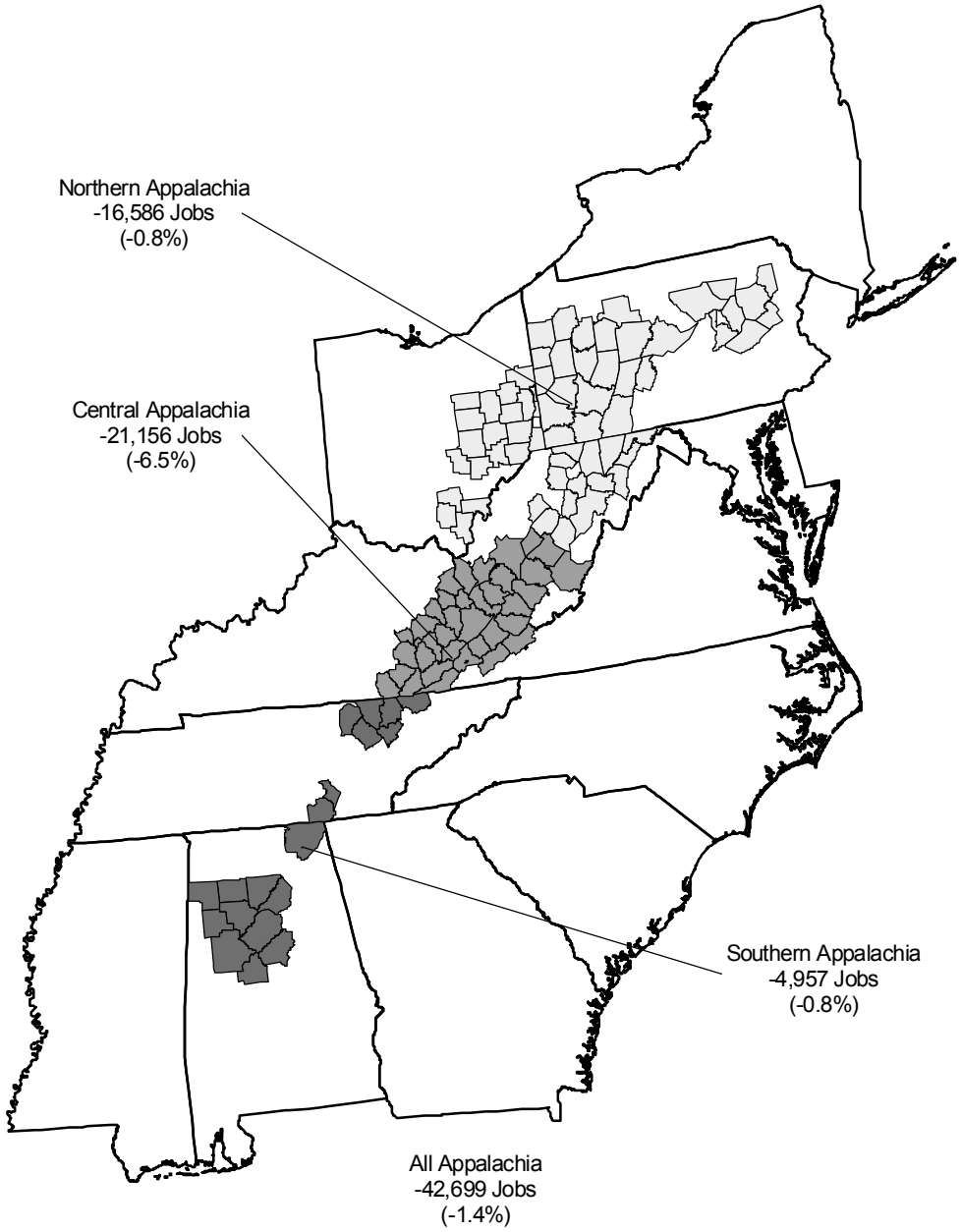


Figure 2.2.3: Forecast Total Employment Impact Overall and as a Share of All Employment Under Baseline Scenario



Overall, impact estimates presented in Figures 2.2.1 through 2.2.3 indicate the total impact of forecast losses in the coal mining industry will be substantial even under baseline forecast conditions. The large total impacts would still account for a modest share of overall employment and earnings in the 118 Appalachian major coal-producing counties. The shares would be substantial, however, in specific areas. The total impact of forecast losses would account for more than 6% of employment and earnings in the Central Appalachian region overall. The share of forecast losses would likely be even

larger in a number of individual counties in Central Appalachia, as well as in selected counties in other areas of Appalachia.

Total Impact under Forecast Scenarios

The total economic impact of the coal mining industry is substantially larger than its direct economic impact, as was illustrated for the case of the baseline forecast. As a result, even in the baseline scenario, forecast declines in coal mining output, employment, and earnings lead to a large decline in total economic activity in the Appalachian region. This impact will be even larger under some of the alternative forecast scenarios that have been considered in this report. In particular, while the total impact of industry losses will be similar under alternative macroeconomic scenarios, it will be much larger in those environmental scenarios where there are strict emissions limitations under the Kyoto protocol.

This section of the report illustrates the total change in the economic impact of the coal industry under each of the alternative macroeconomic and environmental forecasts. In particular, Tables 2.2.1 and 2.2.2 illustrate the forecast change in the total jobs and earnings from 1997 through 2010 as a result of the forecast for the coal mining industry. The Tables also show these total job and earnings impacts as a share of total jobs and earnings in the 118 Appalachian coal-producing counties, and in the Northern, Central, and Southern Appalachia regions.

Macroeconomic Forecast Scenarios

The results for the macroeconomic forecasts are similar to those in the baseline forecast. Under these alterantive scenarios, the total earnings impact of the coal mining industry drops to between $1.57 and $1.81 billion dollars, depending on the scenario. The total employment impact drops to between 38,000 and 44,000 jobs under the alternative forecasts. Again, these are findings for the total impact, including losses in the mining industry, and losses throughout the economy due to a diminished "multiplier effect" from the coal mining industry. Generally speaking, the losses are somewhat less under the high growth and high oil price scenarios, and somewhat more given lower oil prices or slower overall economic growth. As a share of the economy, these losses represent roughly 1.5% of employment and earnings in these 118 Appalachian coal-producing counties, as was the case in the baseline scenario. The losses represented about 6% to 7% of employment and earnings in the more coal-dependent Central Appalachia region.

Kyoto Forecast Scenarios

The relative size of the total impact, however, rises under some of the more restrictive Kyoto emission reduction scenarios. Under the least restrictive scenario,

where emissions can grow to 24% higher than their 1990 level, the total impact is similar to that in the baseline scenario. The total earnings impact is forecast to be a loss of $2.01 billion in earnings and 50,000 jobs, compared to $1.75 billion in earnings and 42,000 jobs in the baseline scenario. But, the size of the impact rises rapidly as greater emission reductions are made necessary, particularly in the Central Appalachia.

The largest reduction in total impact occurs in the three Kyoto scenarios where emission reduction must fall to 1990 levels, or below. The total impact of coal mining on worker earnings declines by $4 to $5 billion per year under each of these scenarios, and by over 100,000 jobs. The total impact is centered in both Central Appalachia and Northern Appalachia. These regions each lose around $2 billion in earnings, and 40,000 to 50,000 jobs. The absolute impact is more modest in Southern Appalachia where the total impact declines by roughly $400 million and 8,000 to 9,000 jobs.

As a share of the economy, the total impact of losses in the coal mining industry rise sharply as a share of the economy under these more restrictive Kyoto emission reductions. For the 118 county coal-producing region, the total impact would account for a loss of between 3% to 4% of all employment and earnings in the economy. As always, the relative impact would be greatest in the Central Appalachia region. In particular, the reduction in the total impact of the coal mining industry would be equivalent to between 14% to 18% of total employment and earnings in the region, depending on the particular scenario. The losses would account for less than 2% of employment and earnings in Southern Appalachia, and between 2% and 2.5% of employment and earnings in Northern Appalachia. However, there would be selected counties in these regions where the losses would be more on a par with what would be seen in Central Appalachia.

These findings for the Kyoto scenario again suggest that it is very important how much emissions reduction will be required. If the most significant emissions reductions are required, then the total impact of the policy could be quite substantial in terms of the economy of some parts of Appalachia. In particular, the total impact of forecast losses in the coal mining industry could rise from 6% of the economy under the baseline scenario to from 14% to 16% under the more restrictive Kyoto scenarios. Under any of these scenarios, the employment and earnings impacts could change if a mitigation program were considered to address the adverse job and income effects.

Table 2.2.1: The Total Effect of Coal Industry Changes: Loss in Earnings Overall and as a Percentage of 1997 Regional Earnings by Macroeconomic and Kyoto Scenarios (Billions of 1997 Dollars)

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	-$1.76B	-$1.57B	-$1.81B	-$1.62B	-$1.75B	-$4.67B	-$4.43B	-$4.19B	-$3.29B	-$2.61B	-$2.06B
	-1.4%	-1.3%	-1.5%	-1.3%	-1.4%	-3.9%	-3.6%	-3.4%	-2.7%	-2.1%	-1.7%
Northern Appalachia	-$0.73B	-$0.55B	-$0.72B	-$0.60B	-$0.79B	-$2.14B	-$1.99B	-$1.87B	-$1.32B	-$0.87B	-$0.87B
(PA, OH, MD, & Northern WV)	-0.9%	-0.7%	-0.9%	-0.7%	-0.9%	-2.5%	-2.4%	-2.2%	-1.6%	-1.0%	-1.0%
Central Appalachia	-$0.81B	-$0.81B	-$0.86B	-$0.80B	-$0.73B	-$2.21B	-$2.07B	-$1.98B	-$1.71B	-$1.52B	-$0.98B
(Southern WV, VA, & Eastern KY)	-6.1%	-6.0%	-6.4%	-6.0%	-5.5%	-16.5%	-15.4%	-14.7%	-12.8%	-11.3%	-7.3%
Southern Appalachia (TN & AL)	-$0.22B	-$0.21B	-$0.22B	-$0.21B	-$0.22B	-$0.41B	-$0.37B	-$0.34B	-$0.26B	-$0.22B	-$0.21B
	-0.9%	-0.8%	-0.9%	-0.9%	-0.9%	-1.7%	-1.5%	-1.4%	-1.1%	-0.9%	-0.8%

Source: Authors' calculations

Table 2.2.2: The Total Effect of Coal Industry Changes: Loss in Employment Overall and as a Percentage of 1997 Regional Employment by Macroeconomic and Kyoto Scenarios

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	-42,699	-38,273	-44,027	-39,465	-42,217	-115,571	-107,427	-101,698	-80,447	-64,264	-49,949
	-1.4%	-1.3%	-1.4%	-1.3%	-1.4%	-3.8%	-3.5%	-3.3%	-2.6%	-2.1%	-1.6%
Northern Appalachia	-16,586	-12,460	-16,471	-13,795	-18,134	-48,887	-45,537	-42,720	-30,087	-19,907	-19,991
(PA, OH, MD, & Northern WV)	-0.8%	-0.6%	-0.8%	-0.7%	-0.9%	-2.3%	-2.2%	-2.0%	-1.4%	-0.9%	-0.9%
Central Appalachia	-21,156	-21,062	-22,453	-20,854	-19,021	-57,329	-53,647	-51,233	-44,389	-39,382	-25,302
(Southern WV, VA, & Eastern KY)	-6.5%	-6.5%	-6.9%	-6.4%	-5.9%	-17.7%	-16.5%	-15.8%	-13.7%	-12.1%	-7.8%
Southern Appalachia (TN & AL)	-4,957	-4,750	-5,108	-4,816	-5,063	-9,355	-8,242	-7,745	-5,971	-4,975	-4,656
	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-1.5%	-1.3%	-1.2%	-1.0%	-0.8%	-0.7%

Source: Authors' calculations

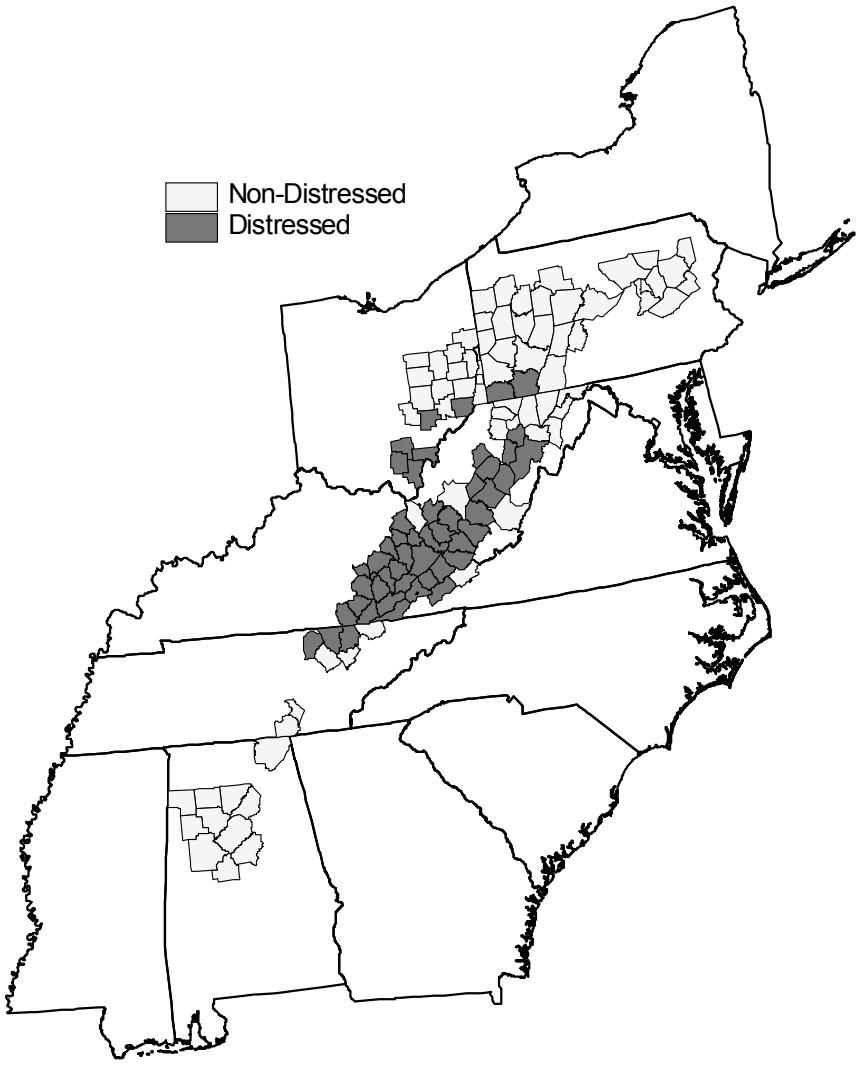
Distressed Regions and Counties

The proceeding results indicate that the declining impact of the coal mining industry over the next decade will have a relatively large effect on the economies of selected Appalachian counties that are heavily specialized in coal mining and in many counties in the Central Appalachian region. As will be disucssed in a later section, the decline of the industry also may have a significant influence on the rate of population growth and transfer dependency in these counties.

These counties will have a significant task in diversifying their economies in order to replace job opportunities lost in coal mining or affected industries, and perhaps, to adjust towards a declining population, since it may be difficult for some areas to replace all coal-related employment. Further, in some cases it may not be clear which sorts of additional industries would be an appropriate fit for these counties as part of diversification efforts. Perhaps the most effective approach would be to attempt to raise education levels and other aspects of human capital in these counties in order to raise wage rates, labor force participation, and the capacity for entrepreneurship in new industries. In order to facilitate this transition and mitigate the repercussions, workforce and community adjustment programs might be established to help fund the employment and training services and the transition planning process for coal-dependent, distressed communities.

Whatever approach is chosen, the task is made all the more challenging, and urgent, because these most affected economies also are among the poorest in the Appalachian region, and the nation. Figure 2.2.4 illustrates this by displaying on the same map each of the 118 Appalachian coal-producing counties and each of the Appalachian counties among the coal-producing counties that have been designated as economically "distressed" by the Appalachian Regional Commission. Such distressed counties were identified as having high rates of both poverty and unemployment as well as lower per capita income. The map clearly shows that many of the distressed counties were the same counties where the coal mining industry is the most significant share of the economy. In particular, many of the coal-producing counties of Central Appalachia have been designated as economically distressed. These "distressed" counties expected to be most impacted by declines in employment and earnings in the coal mining industry over the next decade.

Figure 2.2.4: Distressed Counties in the ARC Coal-Producing Region



Conclusion

The purpose of this section has been to consider the total economic impact of the coal mining industry on the local economies of major Appalachian coal-producing counties. This total impact includes the direct losses in the coal mining industry itself, plus the indirect and induced losses in other parts of the economy which are supported by coal mining industry activity. The total impact of forecast losses in the coal mining industry was found to be substantial even under baseline forecast conditions, with a total loss of $1.76 billion in earnings and 42,000 jobs. The large total impacts would still

account for a modest share of overall employment and earnings in the 118 Appalachian major coal-producing counties. The shares would be substantial, however, in specific areas such as Central Appalachia overall, and in selected counties throughout the Appalachian region.

As for forecasts under the alternative scenarios, the results for the macroeconomic forecasts are similar to those in the baseline forecast. The relative size of the total impact is somewhat greater under the very least restrictive Kyoto emissions reduction scenarios. However, the size of the impact rises rapidly as greater emission reductions are made necessary, particularly in the Central Appalachia. Under the most restrictive scenarios, the total impact would account for a loss of between 3% to 4% of all employment and earnings in the economy for the 118 county Appalachian coal-producing region overall. As always, the relative impact would be greatest in the Central Appalachia region. In particular, the reduction in the total impact of the coal mining industry would be equivalent to between 14% to 18% of total employment and earnings in Central Appalachia.

Part 2.3: Estimates of Future Tax Revenue Impacts Related to Coal Production and Exports Using Economic Forecasts through 2010

The baseline and economic analysis discussed earlier in this report forecast falling output, earnings, and employment in Appalachian coal-producing counties due to changes in the coal mining industry. Even coal production was found to fall in some of the Appalachian regions, at least in several of the alternative scenarios. Each of these forecast declines in economic activity in the coal industry and the economy overall portends a declining tax impact for the coal mining industry. A falling direct and total earnings impact will lead to a declining income tax impact. A declining direct and total output impact will lead to lower severance tax and sales tax revenues.

This section measures how the tax impact of the coal mining industry can be expected to change from 1997 through 2010 under the baseline scenario and each of the alternative scenarios. The change in revenue will be discussed for revenues overall and separately for severance tax, income tax, and sales tax revenue. Forecast changes in the economic impact of the coal mining industry will be used to develop the expected changes in coal mining tax impact by 2010. The baseline forecast is discussed first, followed by the alternative macroeconomic and Kyoto forecasts.

In the analysis that follows, recall that the previous forecasts for earnings, output, and sales were in real (inflation adjusted) dollars. This means that the tax revenue forecasts also will reflect changes from 1997 to 2010 in real dollars. Inflation will cause the nominal tax collections in 2010 to be much higher than the value of these revenues in constant dollars. Thus, while this report may talk of declines in the tax revenue impact in real terms, that is, in the actual spending power of the government revenues, the nominal tax revenues will decline by less, or may even rise.

Tax Revenue Impact Under the Baseline Forecast

The tax revenue impact of the Appalachian coal mining industry will fall from 1997 to 2010 under the baseline forecast for the industry. This decline in revenue will result from a decline in the constant dollar output and earnings of the coal mining industry, and the resulting decline in the industry's total economic impact. Recall that under the baseline scenario, the constant dollar output of the coal mining industry was forecast to fall by 15.3% from 1997 to 2010, while the constant dollar earnings was forecast to fall by 26.3%.

Table 2.3.1 shows the forecast change in tax revenues from severance, income, and sales taxes from 1997 to 2010 for the 118 major Appalachian coal-producing counties overall, and in each of the three regions. Both the absolute dollar decline and

the percent decline are reported. Recall that the annual tax revenue impact of the coal mining industry was estimated as $559.5 million in 1997.

Under the baseline forecast, total tax revenue is forecast to decline by $113.2 million in Appalachia overall from 1997 to 2010, which is a 20.2% decline. Most of this decline is forecast to occur in Central Appalachia. Roughly three-quarters of the lost tax revenue will be lost in the Central Appalachian region. This occurs both because Central Appalachia is the region with the most mining and production, and because Central Appalachia has the highest tax rates, and for severance taxes, by far the highest tax rates. The percentage decline in severance taxes is so modest in Northern Appalachia because severance taxes are levied on production rather than output in some Northern Appalachian states, and output was forecast to increase in Northern Appalachia under the baseline scenario.[20] As is seen in Figure 2.3.1, the percentage decline in the overall tax revenue impact of coal mining is similar in Northern and Central Appalachia, but higher in Southern Appalachia.

Table 2.3.1: Forecast Change in the Tax Revenue Impact of the Appalachian Coal Mining Industry Under the Baseline Scenario

Area	Total	Severance	Income	Sales
All Appalachia	-$113.2 million (-20.2%)	-$56.1 million (-16.5%)	-$40.5 million (-27.7%)	-$16.6 million (-22.4%)
Northern Appalachia	-$18.8 million (-16.6%)	-$1.8 million (-4.5%)	-$15.1 million (-30.5%)	-$1.9 million (-8.1%)
Central Appalachia	-$85.5 million (-20.4%)	-$53.1 million (-18.1%)	-$21.5 million (-25.2%)	-$10.9 million (-26.5%)
Southern Appalachia	-$8.9 million (-33.9%)	-$1.2 million (-21.7%)	-$3.9 million (-34.2%)	-$3.7 million (-41.1%)

Source: Authors' calculations

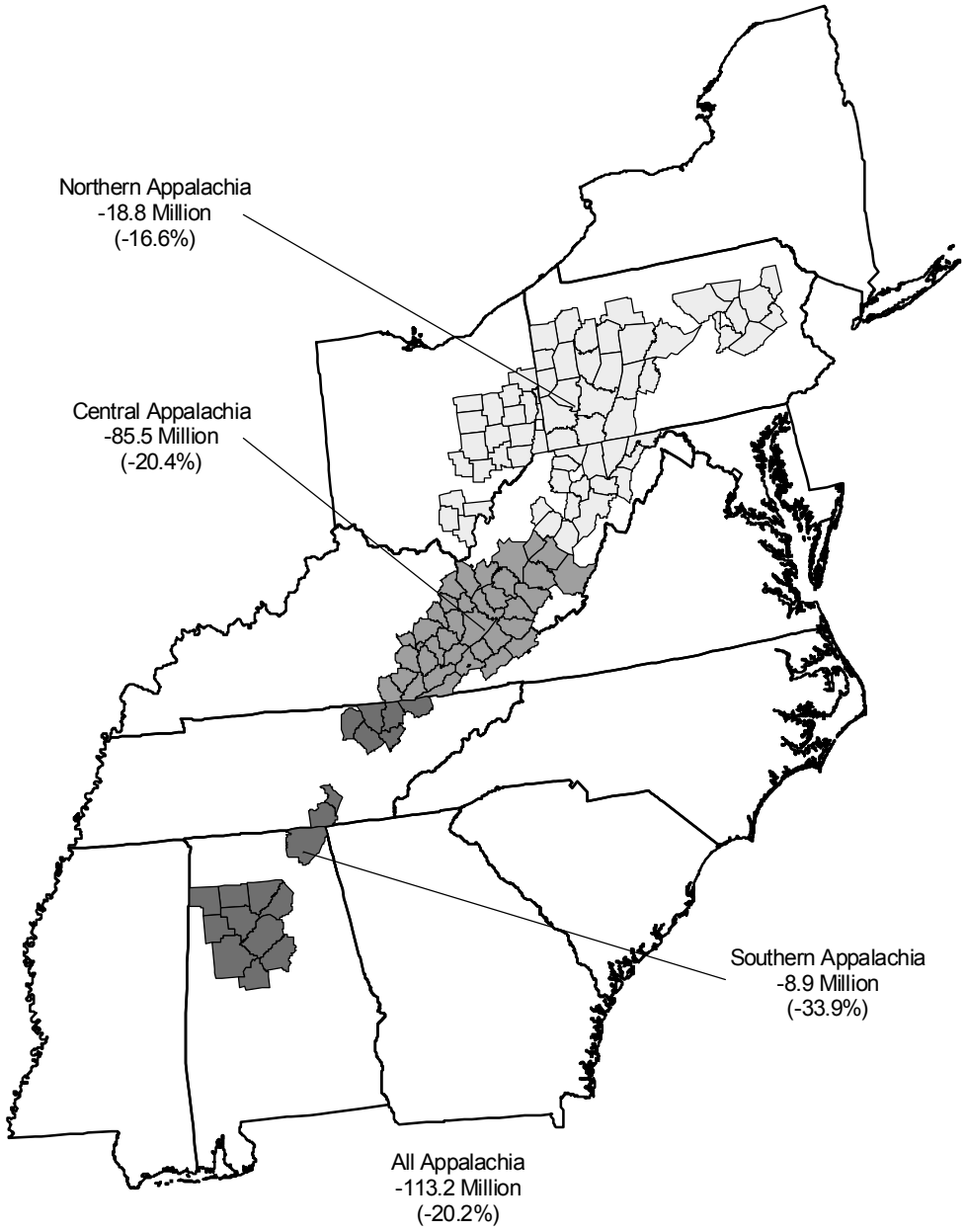
There is a substantial decline in the income tax impact of the coal mining industry in all regions from 1997 to 2010. This mirrors the forecast decline in the earnings impact of the coal mining industry, which was discussed in the last section. Note that while the absolute decline is largest in Central Appalachia, the percentage declines are higher in Northern and Southern Appalachia. Overall, the lost income tax impact is $40.5 million for Appalachia overall, which is over one-third of all lost tax revenue. Lost sales tax revenues account for about 15% of the forecast decline in the tax revenue impact.

In summary, under the baseline scenario the coal-producing states and counties of Appalachia can expect to experience a significant decline over the next decade in the

[20] Production refers to the amount of coal mined, usually measured in tons, and output refers to production multiplied by the minemouth price of coal.

real tax revenue generated due to the coal mining industry, particularly in the Central Appalachian region. About one-half of this decline will be seen in revenues from the direct (severance) taxation of the Appalachian coal mining industry, while the remainder will be in general tax revenues from income and sales taxes. There may be additional losses in local property taxes or other local taxes, but these types of local tax impacts were not modeled here.

Figure 2.3.1: Forecast Change in Tax Revenue Impact of Appalachian Coal Industry Under Baseline Scenario



Tax Revenue Impact Under Alternative Forecast Scenarios

This section examines changes in the tax revenue impact of the Appalachian coal mining industry under the four alternative macroeconomic and six alternative Kyoto protocol scenarios. Table 2.3.2 shows the absolute and percentage change in overall tax revenues from 1997 to 2010 under each scenario. This is the combined change in severance, income, and sales tax revenues. Table 2.3.3 shows the change in the severance tax revenue alone.

As was the case with economic impact forecasts, the tax impact forecasts change relatively little for the macroeconomic forecasts compared to the baseline forecast. The forecast decline in taxes overall and severance taxes are fairly similar under the high and low growth, and high and low oil price scenarios. The declines are smaller in the high growth and high oil price scenarios than in the baseline. Severance tax payments actually are forecast to increase in Northern Appalachia under the high growth and high oil price scenarios. The greatest decline in real tax revenues is greatest in the low growth scenario. In all macroeconomic scenarios, the vast majority of revenue losses will occur in Central Kentucky. This is particularly true for severance taxes.

Forecast tax revenues do differ greatly between most of the Kyoto protocol scenarios relative to the baseline scenario. The loss of revenue is modestly higher under the least strict emissions reduction scenario, which calls for emissions at just 24% above 1990 levels in the year 2000. Real tax revenue is forecast to decline by 28.5% by 2010 in this scenario compared to 20.2% in the baseline. However, the loss in revenues grows steadily as the emissions reductions become increasingly strict. The lost annual tax revenue rises to over $330 million per year under the three strictest scenarios where emissions are forecast to decline to 1990 levels or below. Under these scenarios, overall real tax revenues would decline by between 60.3% and 68.3%. More than half of these losses will be lost severance tax revenue. Real severance taxes are forecast to decline by $180 million or more under the three strictest scenarios, with the decline ranging from 53.6% to 60.5%. None of these calculation consider the possible offsetting effects on transfer payments of any special financial transition benefits for affected workers and communities.

As under the baseline and macroeconomic scenarios, the vast majority of tax revenues are lost in the Central Appalachian region. However, the share of revenues lost in Northern Appalachia does rise substantially under the most strict Kyoto emission reduction scenarios, which call for a return of emissions to 1990 levels or lower by 2010. In particular, roughly one-quarter of all tax revenue is lost in the Northern Appalachian region under these scenarios.

Conclusion

The forecasts call for the tax revenue generated by the coal mining industry to fall in real terms in Appalachia in the next decade. This is true of revenue from both severance taxes levied directly on coal as well as general taxes such as sales and income taxes that are generated due to the overall economic impact of the coal mining industry. These forecast declines in the tax impact are consistent with the expected losses in industry output and worker earnings over the next decade. Lost severance tax revenues are expected to account for a little more than half of all tax revenues, while another third of revenues will result from lost income tax revenues. Under all forecast scenarios, the vast majority of revenue losses are forecast to occur in Central Appalachia. This makes sense given that most production occurs in Central Appalachia, and the region has higher tax rates, particularly higher severance tax rates.

Tax revenues due to the coal mining industry are forecast to decline by $113 million per year from 1997 to 2010 under the baseline forecast. This is roughly a 20% decline in revenue. These losses are a significant decline in the real tax revenue generated due to the coal mining industry, particularly in the Central Appalachian region. The forecast tax impact under each of the alternative macroeconomic scenarios is similar to this baseline forecast. However, the forecast decline in tax revenues is much greater in the Kyoto environmental scenarios that limit emissions most strictly. The three scenarios where emissions are limited to at or below 1990 levels call for a forecast decline in tax revenues of over $330 million. This represents a 60% or greater reduction in the tax revenues generated due to the coal mining industry. Lost revenues are more modest, however, under less strict emission reductions. Under the scenario where 2010 emissions are allowed to be 24% above 1990 levels, real tax revenue declines by only 28% by 2010 compared to the 20% decline forecast in the baseline scenario.

Table 2.3.2: Forecast Change in Overall Tax Revenue Impact of Appalachian Coal Mining Industry, 1997-2010, by Macroeconomic and Kyoto Scenarios (Millions of 1997 Dollars)

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	-113.2M	-100.3M	-122.4M	-104.3M	-106.6M	-382.3M	-355.9M	-337.3M	-274.6M	-227.2M	-159.6M
	-20.2%	-17.9%	-21.9%	-18.6%	-19.0%	-68.3%	-63.6%	-60.3%	-49.1%	-40.6%	-28.5%
Northern Appalachia	-18.8M	-7.7M	-19.2M	-11.9M	-22.5M	-97.8M	-90.5M	-84.3M	-56.7M	-34.4M	-34.3M
(PA, OH, MD, & Northern WV)	-16.6%	-6.8%	-17.0%	-10.5%	-19.9%	-86.2%	-79.8%	-74.4%	-50.0%	-30.4%	-30.3%
Central Appalachia	-85.5M	-84.2M	-94.0M	-83.8M	-75.0M	-267.0M	-250.1M	-238.6M	-207.1M	-183.9M	-117.1M
(Southern WV, VA, & Eastern KY)	-20.4%	-20.0%	-22.4%	-19.9%	-17.8%	-63.5%	-59.5%	-56.8%	-49.3%	-43.8%	-27.9%
Southern Appalachia (TN & AL)	-8.9M	-8.4M	-9.2M	-8.6M	-9.1M	-17.5M	-15.3M	-14.4M	-10.9M	-8.9M	-8.3M
	-33.9%	-32.2%	-35.3%	-32.9%	-34.8%	-67.1%	-58.8%	-55.2%	-41.7%	-34.1%	-31.7%

Source: Authors' calculations

Table 2.3.3: Forecast Change in Severance Tax Revenue Impact of Appalachian Coal Mining Industry, 1997-2010, by Macroeconomic and Kyoto Scenarios (Millions of 1997 Dollars)

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	-56.1M	-51.0M	-62.3M	-52.5M	-50.5M	-205.4M	-191.8M	-182.1M	-152.0M	-129.5M	-85.7M
	-16.5%	-15.0%	-18.3%	-15.4%	-14.9%	-60.5%	-56.4%	-53.6%	-44.7%	-38.1%	-25.2%
Northern Appalachia	-1.8M	-2.2M	-2.1M	-0.6M	-3.1M	-29.6M	-27.2M	-25.2M	-16.1M	-8.9M	-8.8M
(PA, OH, MD, & Northern WV)	-4.5%	-5.6%	-5.2%	-1.6%	-7.7%	-73.2%	-67.2%	-62.3%	-39.9%	-22.0%	-21.7%
Central Appalachia	-53.1M	-52.1M	-59.0M	-51.9M	-46.2M	-172.9M	-162.1M	-154.6M	-134.2M	-119.2M	-75.7M
(Southern WV, VA, & Eastern KY)	-18.1%	-17.7%	-20.1%	-17.7%	-15.7%	-58.9%	-55.2%	-52.6%	-45.7%	-40.6%	-25.8%
Southern Appalachia (TN & AL)	-1.2M	-1.1M	-1.3M	-1.2M	-1.2M	-2.9M	-2.5M	-2.3M	-1.7M	-1.4M	-1.2M
	-21.7%	-20.5%	-22.5%	-20.8%	-22.4%	-52.0%	-44.9%	-41.7%	-30.6%	-24.3%	-22.3%

Source: Authors' calculations

Part 2.4: Analysis of Demographic and Transfer Payment Impacts Using Economic Forecasts through 2010

Research by Black and others (1996; 1999) suggests that the changing fortunes of the coal mining industry, more than many industries, have the potential to significantly impact socioeconomic conditions in coal-producing counties. This occurs in part because the industry is often a large part of the local economy, but it also is related to the nature of employment in the coal industry. Coal mining is one of the few industries that offers high-wage jobs for worker's which on average have low general skills. [21] The coal jobs, once lost, may be difficult to replace, at least in the local area, which could affect both family incomes and local population.

The estimates, in the form of elasticities, were reported earlier in this report in Table 1.5.1. The elasticity estimate for population was .22, which means that for each 1% decline in local earnings due to a declining coal mining industry, there would be a 0.22% decline in local population. The elasticity estimates for TANF/AFDC, SSI, Food Stamps, and Unemployment Insurance ranged between –0.95 and –2.6, indicating that these transfer payments would rise at least as fast as earnings falls, and by more than twice as fast in one case. Elasticity estimates were smaller for the two largest transfer payment categories of medical transfers (-0.41) which includes Medicare and Medicaid, and Social Security (-0.15).[22]

These elasticity values can be combined with findings in the last section about the total impact of the coal industry in order to forecast expected changes in transfer payments or population through 2010. To give an example, lost output and earnings in the coal mining industry are expected to lead directly and indirectly to a total decline in earnings equivalent to 6.1% of 1997 earnings in the Central Appalachian region. This percentage could be combined with the elasticity value of for earnings and population to estimate the coal industry losses would lead to a 1.34% decline in population in Central Appalachia by 2010.

This approach will be used below to estimate the future change in population and transfer payments in each region of Appalachia due to forecast changes in the coal mining industry through 2010. Results will first be presented for the baseline scenario for population growth as well as for each of the six types of transfer payments that have

[21] However, such workers clearly would have built up great skill which they utilize in their work as coal miners.

[22] Research by Dr. Dan Black and others has demonstrated a relationship between the coal mining industry, local earnings and important socioeconomic indicators such as population growth and transfer payments. These researchers have even developed specific econometric relationships showing the response of a specific transfer payment to a change in total local earnings as the coal industry expands or contracts. The relationship between local earnings growth and population growth also was examined.

been examined in this report. These include TANF/AFDC, SSI, Food Stamps, Unemployment Insurance, Medical Transfers, and Social Security (OASDI). Afterwards, estimates will be made for each of the 4 alternative macroeconomic scenarios and each of the 6 Kyoto environmental scenarios.

Finally, some caution should be used when evaluating the forecasts in this section. First of all, recall that the relationship between the fortunes of the coal industry and the change in total earnings that were developed by Black and others (1996; 1999) were based on a regression analysis, rather than the input-output approach used here. The two approaches are not necessarily equivalent, which suggests some caution when utilizing the statistical relationships between changes in earnings (due to shocks to the coal industry) and changes in population or transfer payments. However, the relationships developed by Black and others do provide a way of utilizing the results of the economic impact forecasts to evaluate potential changes in the socioeconomic conditions in Appalachian coal-producing counties.

The reader also should remember that the impacts discussed in this section represent estimated responses to changing coal industry conditions *cetirus paribus*, that is, keeping other factors unchanged. Forecast results should not be interpreted to mean that population will fall by a certain amount in Appalachia over the next 10 years, or that transfer payments will rise by a certain amount. Other factors such as changing policies improved educational attainment by area residents. Even the location of new industries in the region could have a large impact on these socioeconomic indicators in the future. The results presented below only show the estimated direction and magnitude that changes in the coal industry could push each of the indicators.

Impact on Population and Transfer Payments Under Baseline Scenario

The baseline forecast scenario called for declining coal industry earnings in each of three Appalachian regions. Industry earnings were forecast to decline rapidly between 1997 and 2010, falling between 20% and 30%, depending on the region. These direct earnings losses lead to even larger declines in the total earnings impact of the coal industry. These total earnings impacts, however, represented a modest share of overall earnings across all industries in most local economies. The earnings lost due to the declining total impact of the coal industry accounted for just 1.5% of 1997 earnings in the 118 Appalachia coal-producing counties overall, and just 0.9% of earnings in the Northern and Southern Appalachia regions. The decline was more significant in the Central Appalachian region, where the reduced impact accounted for 6.1% of total earnings. The impact was even larger in selected counties.

Declines of these magnitudes can be used to estimate the expected impact of coal industry losses on population and transfer payments under the baseline scenario. The approach used would be similar to what was described above. The forecast percent

change in earnings, whether 0.9% or 6.1% of total earnings, would be applied to each of the elasticity estimates made by Black and others (1996; 1999), to estimate the percent change in population or per capita transfer payments.

Results are reported in Figures 2.4.1 through 2.4.3. Figures 2.4.1 shows the forecast loss of population in Northern, Central, and Southern Appalachia as a result of lost output and earnings in the coal mining industry. The population loss is reported in percentages and in the absolute loss of persons. Note that the percentage loss is greatest in Central Appalachia, where the coal mining industry represents the largest part of the local economy. Losses in coal mining earnings and output are forecast to lead to a 1.34% decline in population in Central Appalachia. Population losses are expected to be around 0.2% in Northern and Southern Appalachia, where the coal mining industry represents a smaller share of the economy. The percentage losses would undoubtedly be even larger selected counties throughout the region where the coal mining industry is a large part of the economy.

The absolute loss is largest in Central Appalachia, where population is expected to decline by 16,900 under the baseline forecast for the coal industry. The absolute loss in Northern Appalachia is estimated to be nearly as large, due to the greater population of the region, at 12,300. Population is forecast to decline by approximately 3,000 in Southern Appalachia. The total decline in population in all 118 counties is expected to be 32,100, or –0.37% under baseline conditions.

Figure 2.4.2 shows the forecast loss for the three income maintenance transfer programs of TANF/AFDC, SSI, and Food Stamps. The percentage gains for these programs were much larger than for population given the much more elastic relationship between the total earnings impact of the coal industry, and each of these types of transfer payment. The percentage gains also were higher in Central Appalachia given that the coal industry is larger part of its economy. To be specific, forecast losses in the coal mining industry were expected to lead to a 2% increase in per capita TANF and SSI payments across the 118 counties and a 4.5% increase in Food Stamp payments. The expected increase was below this average in Northern and Southern Appalachia, but was much higher in Central Appalachia where there was an expected increase of 5.77% in per capita TANF payments, 4.8% in SSI payments, and 11.35% in Food Stamp payments.

These percent differences corresponded to substantial increases in per capita transfer payments in Central Appalachia, particularly given that this region already had higher payment levels in 1997 than the other parts of Appalachia. The estimate is that there would be $4.92 increase in per capita TANF payments in Central Appalachia, a $14.04 increase in per capita SSI payments, and a $19.20 increase in per capita Food Stamp payments each year. For the 118 counties overall, the average increase in per capita SSI payments was $1.07 per year, while the per capita increase was $2.79 for SSI

and $3.89 for Food Stamps. Another way to examine these increases is to translate the per capita increases into total increases across the total population of each region. In Central Appalachia, this would lead to a $6.2 million annual increase in TANF payments, a $17.7 million increase in SSI payments, and a $24.3 million increase in Food Stamp payments. For the 118 counties overall, the estimate is a $9.3 million increase for TANF, a $24.1 million increase for SSI, and a $33.6 million increase for Food Stamps.

Figure 2.4.1: Estimated Population Loss by Region Under Baseline Scenario

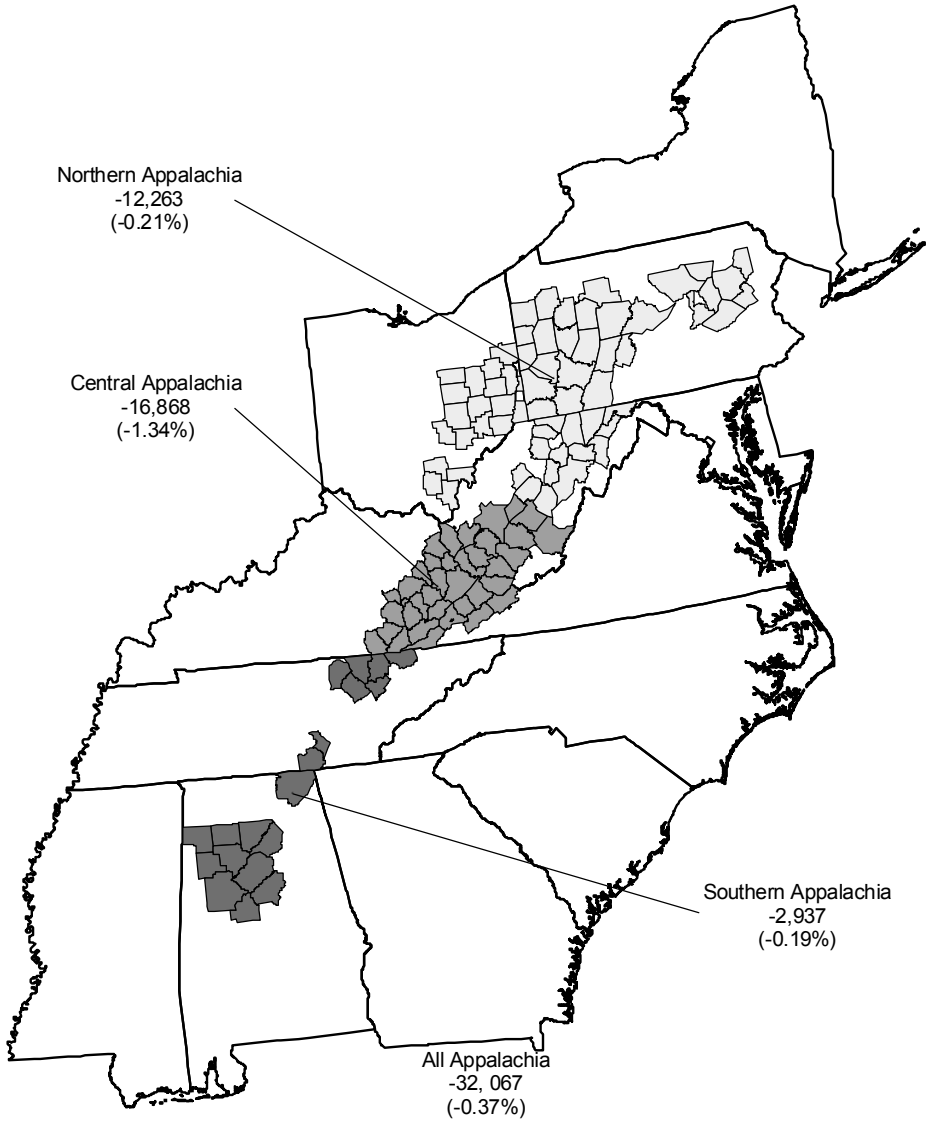


Figure 2.4.2: Estimated Change in Per Capita Transfer Payments by Region Under Baseline Scenario

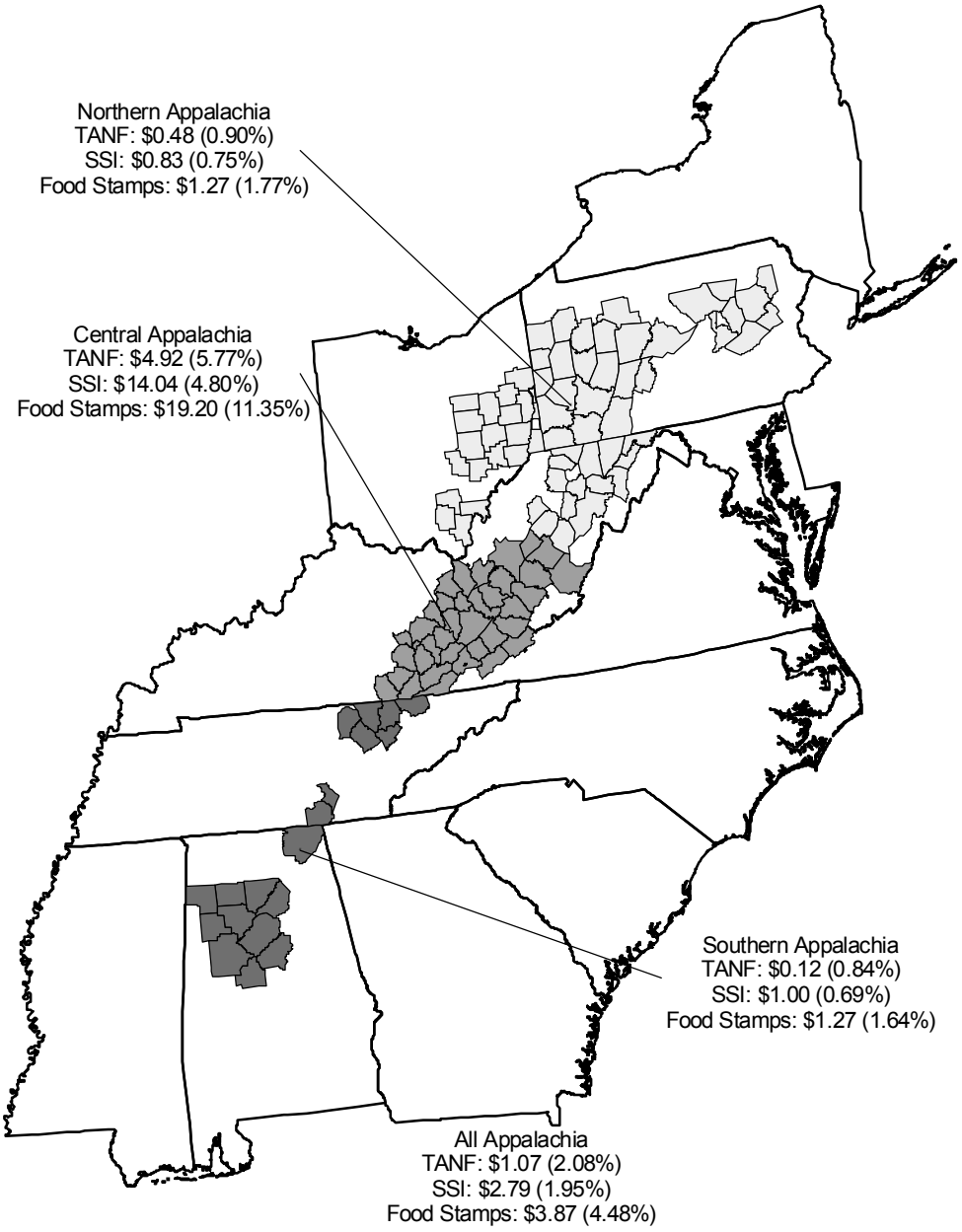
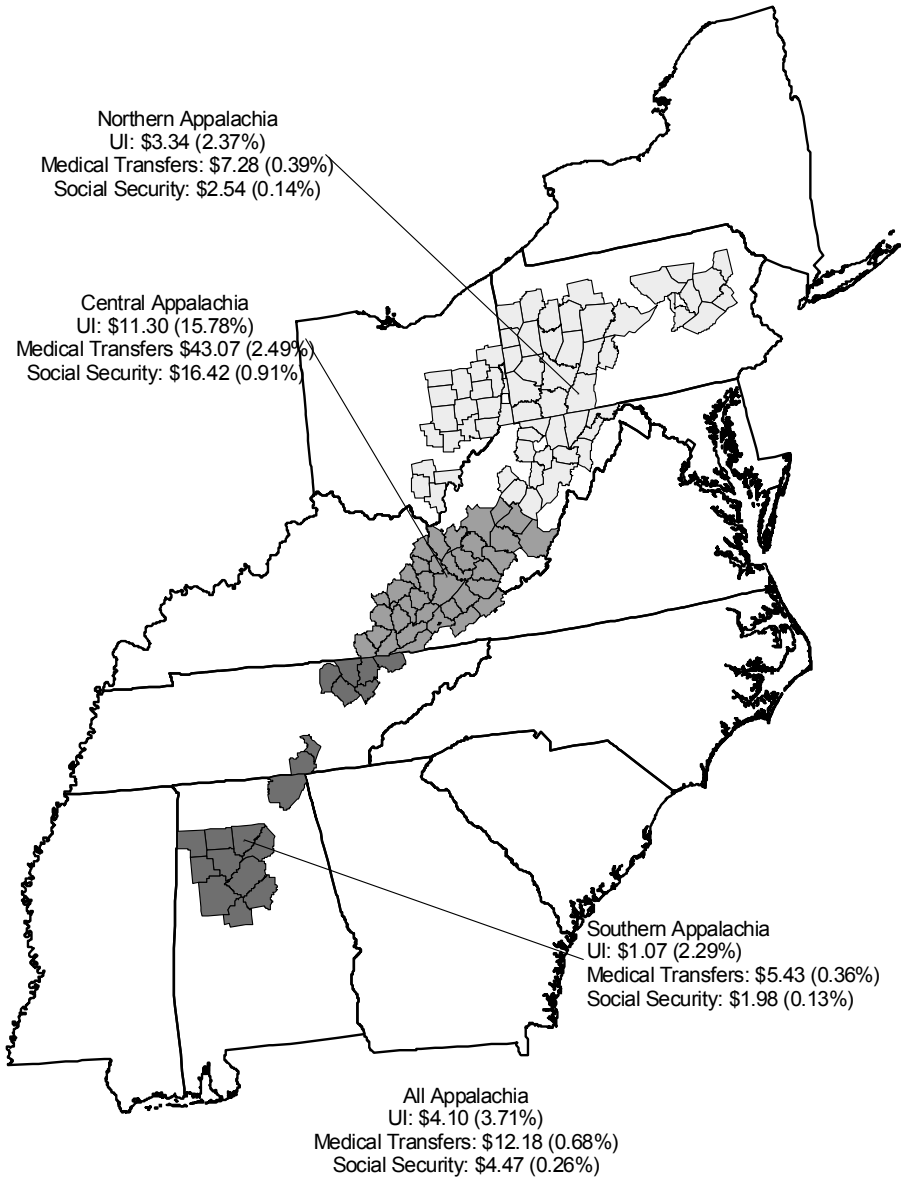


Figure 2.4.3 shows the forecast loss for the three other transfer programs, unemployment insurance, medical transfers (including Medicare and Medicaid), and social security (OASDI). The percentage gains were even larger for the unemployment insurance program than for the Food Stamp program, reflecting the elastic relationship between earnings and unemployment insurance transfers identified in Black's research. However, the percentage increases were much smaller for the social security and medical transfer programs, which makes sense given that these programs are not as

directly linked to labor market conditions as unemployment insurance or the various income maintenance programs. The social security and medical transfer payments, however, are very large programs so that the small percentage gains translate into larger gains in program payments per capita.

Figure 2.4.3: Estimated Change in Income in Per Capita Unemployment Insurance, Medical Transfers, and Social Security Payments by Region Under Baseline Scenario



For all three programs, the percentage gains were largest in Central Appalachia, where on average the coal mining industry accounts for the largest share of the

economy. Unemployment insurance payments are estimated to rise by 15.78% in Central Appalachia over the forecast, while rising by from 2.25% to 2.5% in Northern and Southern Appalachia. Medical transfer payments were estimated to rise by 2.49% in Central Appalachia under the baseline scenario, versus a 0.39% increase in Northern Appalachia and a 0.36% increase in Southern Appalachia. Even in Central Appalachia, social security payments were estimated to increase by 0.91% due to forecast declines in the coal industry, with much smaller gains estimated for other parts of Appalachia.

These smaller percentage gains for the medical transfers and social security do represent significant increases in per capita payments. Per capita social security payments are estimated to increase by $4.47 across all 118 coal-producing counties, and $16.42 in Central Appalachia. Increases in medical transfer payments were even larger, with per capita payments estimated to increase by $12.18 across all 118 counties, and by $43.07 per person in Central Appalachia. Per capita unemployment insurance payments are estimated to increase by $4.10 across all 118 counties in the baseline forecast, and by $11.30 in Central Appalachia. Looking at total rather than per capita payments, there would be a $105.4 million increase in medical transfers in all 118 counties under the baseline scenario, along with a $38.7 million increase in social security payments, and a $35.5 million increase in unemployment insurance payments. Payments in Central Appalachia would account for roughly half of these totals.

Overall, the finding is that forecast declines in the coal mine industry under the baseline scenario are expected to lead to a decline in population and an increase in transfer payments in the coal mining regions of Appalachia. The population loss is expected to reach around 30,000 over 10 years, with about half of the population loss in Central Appalachia. Transfer payments for income maintenance programs are expected to increase by 2% to 4.5% across all 118 coal-producing counties, and by 5% to 11% in Central Appalachia. Roughly two-thirds of the increase in income maintenance transfers is expected to occur in Central Appalachia. Smaller percentage increases are expected for medical transfer and social security payments, but due to the size of these programs, the absolute increase in payments is expected to be higher, reaching $105.4 million in the case of medical transfers. Central Appalachia is expected to account for only about one-half of the increase in medical transfer and social security payments.

These findings suggest that under the baseline scenario forecast declines in the coal mining industry will result in some decline in population and some increase in transfer payments in the coal mining regions of Appalachia. Such impacts on population growth and transfer programs may be even larger under some of the alternative forecast scenarios for the Appalachian coal industry, particularly under some of the alternative environmental scenarios. The following section discusses the estimated impact on population growth and transfer payments under each of the four alternative macroeconomic scenarios, and the six alternative Kyoto environmental scenarios.

Impact on Population and Transfer Payments Under Baseline Scenario

Future changes in the coal mining industry under the baseline scenario could be expected to lead to changes in population growth and transfer payments throughout coal-producing Appalachia, particularly in Central Appalachia. This pattern also holds under the alternative scenarios for the coal industry forecast. Expected changes in population growth and transfer payments are very similar under the alternative macroeconomic forecast scenarios. Impacts on population growth and transfer payments are larger, and sometimes much larger, under most of the Kyoto environmental scenarios.

Table 2.4.1 reports the impact of coal industry forecasts on future population growth within the regions of Appalachia under each of the 10 alternative scenarios, along with the baseline scenario. Forecasts do not vary a great deal between the baseline scenario and each of the 4 macroeconomic scenarios. The estimated population loss is very similar to the baseline under the low growth and low oil price forecast scenarios, and is roughly 4,000 less under the high growth scenario and the high oil price scenario. As in the baseline scenario, the largest population impact is expected to occur in Central Appalachia under each alternative macroeconomic scenario. The lost population impact is expected to exceed 1% of the Central Appalachia population in each of the macroeconomic scenarios.

Table 2.4.1: Forecast Change in Population, 1997-2010, Due to Forecast Growth in the Appalachian Coal Mining Industry by Macroeconomic and Kyoto Scenarios

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	-32,067	-28,003	-32,035	-28,775	-30,374	-84,310	-78,452	-74,329	-59,301	-74,854	-36,456
	-0.37%	-0.32%	-0.37%	-0.33%	-0.35%	-0.97%	-0.91%	-0.86%	-0.69%	-0.55%	-0.42%
Northern Appalachia	-12,263	-8,399	-11,098	-9,297	-12,218	-32,919	-30,664	-28,767	-20,261	-13,407	-13,464
(PA, OH, MD, & Northern WV)	-0.21%	-0.14%	-0.19%	-0.16%	-0.21%	-0.56%	-0.52%	-0.49%	-0.34%	-0.23%	-0.23%
Central Appalachia	-16,868	-16,789	-17,915	-16,624	-15,157	-45,850	-42,906	-40,974	-35,502	-31,449	-20,232
(Southern WV, VA, & Eastern KY)	-1.34%	-1.33%	-1.42%	-1.32%	-1.20%	-3.63%	-3.40%	-3.24%	-2.81%	-2.49%	-1.60%
Southern Appalachia (TN & AL)	-2,937	-2,815	-3,022	-2,853	-2,999	-5,542	-4,883	-4,588	-3,538	-2,948	-2,759
	-0.19%	-0.19%	-0.20%	-0.19%	-0.20%	-0.37%	-0.32%	-0.30%	-0.23%	-0.19%	-0.18%

Source: Authors' calculations

The population impact varies a great deal based on the Kyoto emissions reduction scenario. Under the least restrictive scenario for emissions, 24% above 1990 emissions levels, the population impact is only somewhat greater than in the baseline scenario. The population impact, however, rises quickly if emissions need to be restricted further, and is much greater under the 3 most restrictive scenarios. The total population impact is from 75,000 to 85,000 in these most restrictive scenarios, which is equivalent to a loss of roughly 0.9 to 1.0% of the population in the 118 Appalachian coal-producing counties. The absolute loss of population is somewhat higher in Central Appalachia than in Northern Appalachia. Population impacts range from 40,000 to 45,000 in lost population in Central Appalachia and 28,000 to 33,000 in lost population in Northern Appalachia. In Central Appalachia, this amounts to between 3.24% and 3.63% of regional population.

Tables 2.4.2 through 2.4.4 report the impact of coal industry forecasts on payments for three income maintenance transfer programs: TANF, SSI, and food stamps. Results illustrate a familiar pattern. The impact on these programs varies little between the four alternative macroeconomic scenarios and the baseline scenarios. In all four scenarios, the largest increase by far in the three transfer payments occurs in Central Appalachia, as was the case in the baseline scenario. As for the emissions reduction scenarios, the impact on transfer payments in the least restrictive scenarios is somewhat higher than in the baseline scenario. However, the transfer payments impact is 2 to 3 times as large under the most restrictive scenarios, where emissions must return to or below 1990 levels. Even in Northern and Southern Kentucky, where the impact on transfer payments is expected to be modest, per capita payments in each program are expected to rise to between $0.25 and $4 in these most restrictive scenarios. Transfer payment increases are so low in dollar terms in Southern Appalachia because the region has very low per capita payment levels to begin with in 1997, particularly for the TANF program.

The increase in per capita transfer payments is very large in Central Appalachia under these more restrictive scenarios. Per capita payments rise between 12% and 30%. The 30% increase is expected in Food Stamp payments in these three most restrictive scenarios, while the 12% increase is expected in SSI payments. The 15% increase is expected in TANF program payments. The expected increases are large in dollar terms as well as on a percentage basis. Total per capita payments in the three programs would rise by about $100 per person under these more restrictive scenarios compared to only about $40 in the baseline scenario. This per capita increase would translate into an $125 million expected increase in income maintenance transfer payments across the entire population of Central Appalachia.

Tables 2.4.5 through 2.4.7 report the impact of coal industry forecasts on payments for three other transfer programs under each of the alternative forecast scenarios. These are the unemployment insurance, medical transfers (including

Medicare and Medicaid), and the social security (OASDI) programs. As before, the expected impacts under the 4 alternative macroeconomic scenarios are similar to those in the baseline scenario. Impacts are much higher under the more restrictive Kyoto emissions reduction scenarios, particularly for the unemployment insurance program. Under the three scenarios where emissions must fall to or below 1990 levels, the impact on unemployment insurance payments is expected to reach a 40% increase in program payments in Central Kentucky. This is equivalent to a $29 increase in per capita payments. Even in Northern Appalachia, unemployment insurance payments are expected to increase by roughly $9 per capita (6.62%) under these more restrictive scenarios. The per capita increase is only expected to reach about $2 per capita in Southern Appalachia.

The percentage rate of payment increases is much more modest in the case of the medical transfer and social security programs, even under the most restrictive environmental scenarios in terms of allowable emissions. Even under these most restrictive scenarios, the increase in social security payments is never more than 1% for the 118 Appalachian coal-producing counties, while the increase in medical transfer payments is never more than 2%. The more rapid rate of increase for medical transfer may result because the category includes Medicaid payments, which may be more sensitive to earnings losses than the Medicare component, or the social security program. Even in Central Appalachia, the rates of increase are more modest, with medical transfer payments expected to rise by about 6% under the most restrictive environmental scenarios, while social security payments are forecast to increase by about 2.25%. However, since these programs make such large payments, these modest increases translate into significant dollar amounts. Medical transfer payments are expected to rise by roughly $110 per capita in Central Appalachia under the three most restrictive emissions reduction scenarios, while per capita social security payments are expected to increase by roughly $40. In the other two Appalachian regions, medical transfer payments are expected to increase by $10 to $20 per capita, while social security payments increase by $4 to $7 per capita. Once again, it should be noted that none of these calculation consider the possible offsetting effects on transfer payments of any special financial transition benefits for affected workers and communities.

Table 2.4.2: Forecast Change in Per Capita TANF Program Payments, 1997-2010, Due to Forecast Growth in the Appalachian Coal Mining Industry by Macroeconomic and Kyoto Scenarios

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	$1.07	$0.96	$1.08	$0.98	$1.00	$2.88	$2.69	$2.55	$2.08	$1.72	$1.24
	2.08%	1.87%	2.10%	1.90%	1.93%	5.58%	5.21%	4.95%	4.04%	3.34%	2.41%
Northern Appalachia	$0.48	$0.33	$0.44	$0.37	$0.48	$1.30	$1.21	$1.14	$0.80	$0.53	$0.53
(PA, OH, MD, & Northern WV)	0.90%	0.62%	0.82%	0.68%	0.93%	2.42%	2.25%	2.12%	1.49%	0.99%	0.99%
Central Appalachia	$4.92	$4.90	$5.23	$4.85	$4.42	$13.38	$12.52	$11.96	$10.36	$9.19	$5.91
(Southern WV, VA, & Eastern KY)	5.77%	5.74%	6.12%	5.68%	5.18%	15.67%	14.67%	14.01%	12.14%	10.77%	6.92%
Southern Appalachia (TN & AL)	$0.12	$0.12	$0.13	$0.12	$0.13	$0.23	$0.20	$0.19	$0.15	$0.12	$0.12
	0.84%	0.80%	0.86%	0.81%	0.85%	1.58%	1.39%	1.31%	1.01%	0.84%	0.78%

Source: Authors' calculations

Table 2.4.3: Forecast Change in Per Capita SSI Program Payments, 1997-2010, Due to Forecast Growth in the Appalachian Coal Mining Industry by Macroeconomic and Kyoto Scenarios

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	$2.79	$2.60	$2.87	$2.62	$2.58	$7.42	$6.92	$6.58	$5.46	$4.62	$3.24
	7.95%	1.81%	2.00%	1.83%	1.80%	5.18%	4.83%	4.59%	3.81%	3.22%	2.26%
Northern Appalachia	$0.83	$0.57	$0.75	$0.63	$0.83	$2.24	$2.09	$1.96	$1.38	$0.91	$0.92
(PA, OH, MD, & Northern WV)	0.75%	0.51%	0.68%	0.57%	0.75%	2.01%	1.87%	1.76%	1.24%	0.82%	0.82%
Central Appalachia	$14.04	$13.98	$14.92	$13.84	$12.62	$38.17	$35.72	$34.11	$29.56	$26.22	$16.85
(Southern WV, VA, & Eastern KY)	4.80%	4.77%	5.09%	4.73%	4.31%	13.03%	12.20%	11.65%	10.09%	8.95%	5.75%
Southern Appalachia (TN & AL)	$1.00	$0.95	$1.02	$0.97	$1.02	$1.88	$1.65	$1.55	$1.20	$1.00	$0.93
	0.69%	0.67%	0.71%	0.67%	0.71%	1.31%	1.15%	1.09%	0.84%	0.70%	0.65%

Source: Authors' calculations

Table 2.4.4: Forecast Change in Per Capita Food Stamp Program Payments, 1997-2010, Due to Forecast Growth in the Appalachian Coal Mining Industry by Macroeconomic and Kyoto Scenarios

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	$3.89	$3.59	$3.98	$3.69	$3.60	$10.35	$9.65	$9.17	$7.59	$6.40	$4.52
	4.48%	4.14%	4.59%	4.19%	4.15%	11.93%	11.13%	10.58%	8.75%	7.38%	5.21%
Northern Appalachia	$1.27	$0.87	$1.15	$0.96	$1.26	$3.41	$3.17	$2.98	$2.10	$1.39	$1.39
(PA, OH, MD, & Northern WV)	1.77%	1.22%	1.61%	1.35%	1.77%	4.76%	4.44%	4.16%	2.93%	1.94%	1.95%
Central Appalachia	$19.20	$19.11	$20.39	$18.92	$17.25	$52.19	$48.84	$46.64	$40.41	$35.86	$23.03
(Southern WV, VA, & Eastern KY)	11.35%	11.30%	12.06%	11.19%	10.20%	30.85%	28.87%	27.57%	23.89%	21.20%	13.62%
Southern Appalachia (TN & AL)	$1.27	$1.21	$1.30	$1.23	$1.29	$2.39	$2.11	$1.98	$1.53	$1.27	$1.19
	1.64%	1.58%	1.69%	1.60%	1.68%	3.10%	1.73%	2.57%	1.98%	1.65%	1.54%

Source: Authors' calculations

Table 2.4.5: Forecast Change in Per Capita Unemployment Insurance Program Payments, 1997-2010, Due to Forecast Growth in the Appalachian Coal Mining Industry by Macroeconomic and Kyoto Scenarios

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	$4.10	$3.37	$4.00	$3.53	$3.93	$10.92	$10.18	$9.62	$7.44	$5.75	$4.64
	3.71%	3.05%	3.62%	3.19%	3.56%	9.88%	9.21%	8.70%	6.73%	5.20%	4.20%
Northern Appalachia	$3.34	$2.29	$3.02	$2.53	$3.33	$8.97	$8.36	$7.84	$5.52	$3.65	$3.67
(PA, OH, MD, & Northern WV)	2.47%	1.69%	2.23%	1.87%	2.46%	6.62%	6.17%	5.79%	4.08%	2.70%	2.71%
Central Appalachia	$11.30	$11.24	$12.00	$11.13	$10.15	$30.71	$28.73	$27.44	$23.78	$21.10	$13.55
(Southern WV, VA, & Eastern KY)	15.78%	15.71%	16.76%	15.55%	14.18%	42.90%	40.15%	38.34%	33.22%	29.47%	18.93%
Southern Appalachia (TN & AL)	$1.07	$1.02	$1.10	$1.04	$1.09	$2.01	$1.77	$1.67	$1.28	$1.07	$1.00
	2.29%	2.19%	2.35%	2.22%	2.33%	4.31%	3.80%	3.57%	2.75%	2.29%	2.15%

Source: Authors' calculations

Table 2.4.6: Forecast Change in Per Capita Medical Transfer Program Payments, 1997-2010, Due to Forecast Growth in the Appalachian Coal Mining Industry by Macroeconomic and Kyoto Scenarios

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	$12.18	$10.55	$12.13	$10.87	$11.54	$32.14	$29.92	$28.34	$22.54	$18.09	$13.86
	0.68%	0.59%	0.68%	0.61%	0.65%	1.80%	1.68%	1.59%	1.26%	1.01%	0.78%
Northern Appalachia	$7.28	$4.98	$6.59	$5.52	$7.25	$19.54	$18.20	$17.07	$12.02	$7.96	$7.99
(PA, OH, MD, & Northern WV)	0.39%	0.27%	0.35%	0.30%	0.39%	1.04%	0.97%	0.91%	0.64%	0.43%	0.43%
Central Appalachia	$43.07	$42.87	$45.74	$42.45	$38.70	$117.08	$109.56	$104.63	$90.65	$80.43	$51.66
(Southern WV, VA, & Eastern KY)	2.49%	2.48%	2.64%	2.45%	2.24%	6.76%	6.33%	6.05%	5.24%	4.65%	2.99%
Southern Appalachia (TN & AL)	$5.43	45.20	$5.59	$5.27	$5.54	$10.24	$9.02	$8.48	$6.54	$5.45	$5.10
	0.36%	0.35%	0.37%	0.35%	0.37%	0.68%	0.60%	0.56%	0.43%	0.36%	0.34%

Source: Authors' calculations

Table 2.4.7: Forecast Change in Per Capita Social Security (OASDI) Program Payments, 1997-2010, Due to Growth in the Appalachian Coal Mining Industry by Macroeconomic and Kyoto Scenarios

	Macroeconomic Scenarios					Kyoto Scenarios					
		Growth		Oil Price		Less than 1990 Level				More than 1990 Level	
	Baseline	Low	High	Low	High	7%	3%	1990	9%	14%	24%
Total Appalachian	$4.47	$3.90	$4.47	$4.01	$4.23	$11.80	$10.99	$10.41	$8.32	$6.71	$5.10
	0.26%	0.22%	0.26%	0.23%	0.24%	0.68%	0.63%	0.60%	0.48%	0.39%	0.29%
Northern Appalachia	$2.54	$1.74	$2.30	$1.93	$2.54	$6.83	$6.36	$5.97	$4.20	$2.78	$2.79
(PA, OH, MD, & Northern WV)	0.14%	0.10%	0.13%	0.11%	0.14%	0.38%	0.36%	0.33%	0.24%	0.16%	0.16%
Central Appalachia	$16.42	$16.34	$17.44	$16.18	$14.75	$44.63	$41.77	$39.89	$34.56	$30.66	$19.70
(Southern WV, VA, & Eastern KY)	0.91%	0.91%	0.97%	0.90%	0.82%	2.47%	2.32%	2.21%	1.92%	1.70%	1.09%
Southern Appalachia (TN & AL)	$1.98	$1.90	$2.04	$1.92	$2.02	$3.73	$3.29	$3.09	$2.38	$1.99	$1.86
	0.13%	0.13%	0.14%	0.13%	0.13%	0.25%	0.22%	0.21%	0.16%	0.13%	0.12%

Source: Authors' calculations

Summary

Forecast changes in the coal mining industry are expected to have a significant impact on the level of transfer payments and the rate of population growth in Central Appalachia, but more modest impacts in Northern and Southern Appalachia. Forecast losses in the coal mining industry are expected to cause population to decline by less than 0.5% in both Northern and Southern Appalachia under the baseline scenario, and by 1.33% in Central Appalachia. Overall, this represents a loss of 32,000 in population in the 118 major coal-producing counties of Appalachia. Roughly the same level of population loss is also expected under each of the alternative macroeconomic scenarios, and a somewhat higher loss is expected under the least restrictive emissions reduction scenarios. However, under the more restrictive environmental scenarios for the Kyoto protocol, where emissions must fall to or below 1990 levels, population loss is expected to be roughly 2.5 times greater than in the baseline scenario. Population is expected to decline by roughly 80,000 under these scenarios, with just over half of this population loss occurring in Central Appalachia, and most of the rest occurring in Northern Appalachia.

Transfer payment impacts also are expected to be 2 to 3 times higher under the most restrictive emissions reduction scenarios than under the baseline scenario. In any case, the impact on transfer payments under all scenarios is most dramatic in the case of Central Appalachia. In Central Appalachia, the total increase in per capita payments under the six transfer programs is expected to reach $110 in the baseline scenario, a similar level under each macroeconomic scenario, and rise to around $280 under the more restrictive emissions reduction scenarios. Very large increases are expected in some transfer payments under the most restrictive emissions scenarios. Under these scenarios, transfer payments in the TANF, food stamp, and unemployment insurance programs are expected to rise by between 30% and 40%. More modest transfer payment impacts are expected in Northern Appalachia and Southern Appalachia,

Finally, when examining these figures it is important to remember that these estimates for the future only represent the impact of changes in the coal mining industry on these transfer payment programs, with other factors held constant. These results should not be taken as a forecast that transfer payments will increase by the amounts stated over the next decade since a number of other factors such as policy reforms, education attainment, or industrial recruitment also will drive the future levels of transfer program payments. Changes in payments due to these factors may have a much larger effect than changes in the coal mining industry, and may act to either raise or lower payments overall.

Conclusion

This study examined the current and expected future impact of the coal mining industry in 118 Appalachian coal-producing counties. The results show that coal mining influences not only a sizeable portion of the economic activity in selected counties, but that it also plays an important role in many other counties in Appalachia. The study found that the coal mining industry currently is a large share of the economy in selected counties throughout the region, and in many counties in Central Appalachia. The results show also show that under assumed baseline conditions of modest economic growth with no new restrictive environmental initiatives, the impact of coal mining in the regional economy will decline in the next decade.

The magnitude of this decline will vary among counties, but will adversely affect their tax revenues, population growth, employment, and earnings. The forecast decline in the economic impact of the coal mining industry varies little between the baseline forecasts and four alternative macroeconomic scenarios. However, the decline in the economic impact varies a great deal under alternative scenarios involving the Kyoto Protocol environmental initiative to reduce greenhouse gas emissions. In particular, the size of the decline depends on how much greenhouse gas emissions must be reduced given the protocol. The decline in the coal industry's impact will be only somewhat greater than in the baseline scenario if emissions levels in 2010 are allowed to rise significantly above 1990 levels. However, the decline in the impact of the coal mining industry would be between two and three times greater if emissions must fall to or below 1990 levels.

Current Conditions of the Coal Mining Industry

The study began by examining the current conditions of the coal mining industry in Appalachia and its current impact on affected counties and regions within Appalachia. Three regional groupings are distinguished:

- Northern Appalachia, which includes coal producing counties in Pennsylvania, Ohio, Maryland, and northern West Virginia.
- Central Appalachia, which includes counties in the border region of Kentucky, Virginia, and West Virginia.
- Southern Appalachia, which includes counties in Tennessee and Alabama.

The year 1997 was used as the "current" year due to lags in the data, and coal production data came from the Department of Energy's Energy Information Administration while employment and earnings data came from the Department of Commerce.

An examination of the data revealed a large mining industry that accounted for a modest share of overall Appalachian employment, but a large share in selected counties and county groupings. Data revealed over 470 million tons of coal production in Appalachia in 1997 within 118 coal-producing counties. The total output of the industry in these counties was roughly $12.3 billion during that year. The industry employed just over 60,000 workers and worker earnings topped $4 billion in the 118 coal-producing counties in Appalachia. Reflecting the high wages in the industry, this accounted for roughly 2% of all employment in these 118 counties, and 3.3% of earnings.

The coal mining industry accounted for a much larger share of employment and earnings in selected counties throughout Appalachia, but many of these counties were concentrated in Central Appalachia, particularly in the border area of Kentucky, Virginia, and West Virginia. In the Central Appalachia region, the coal mining industry accounted for roughly 10.4% of employment and 14.7% of earnings.

The total impact of the coal industry on the economy exceeded industry employment and earnings due to the additional indirect and induced impacts on other sectors of the economy. The total impact was approximately 50% higher than the direct industry impact for output, value-added, and earnings, and 100% greater for employment. The total earnings impact was $6.2 billion and the total employment impact was 135,000 jobs in the 118 Appalachian coal-producing counties. These total impacts accounted for 4.4% of 1997 employment and 5.1% of 1997 worker earnings in these 118 counties overall. The shares were much larger in selected counties throughout Appalachia, particularly in Central Appalachia. The total economic impact of the coal mining industry accounted for 29.9% of employment and 27.6% of earnings in the Central Appalachia region.

The tax impact of the coal mining industry was also concentrated in Central Appalachia. The overall tax impact was estimated to be $559.5 billion per year in the 118 coal-producing counties from severance, income, or sales taxes. These figures did not include the tax impact of more locally oriented taxes such as property taxes, utility taxes, or other miscellaneous taxes. Much of the tax impact occurred in Central Appalachia, primarily due to the much higher severance tax on coal in the region. One-third of this overall tax impact occurred in Kentucky, 7% in Virginia, and 45% in West Virginia.

The potential impact of the coal industry on factors such as population growth and participation in transfer programs also would be expected to be greater in Central Appalachia. Research by Black *et. al.* (1996; 1999) has found that local population growth and dependence on transfer payments are affected by significant changes in earnings opportunities in the coal mining industry. And, Central Appalachia is the region most dependent on the coal mining industry. Further, Central Appalachia, along

with Northern Appalachia, already had a falling population during the 1990s. Per capita payments for "income maintenance" transfer programs such as Temporary Assistance to Needy Families (TANF) and food stamps also were much higher in Central Appalachia than in other parts of Appalachia, particularly Southern Appalachia, where transfer payments are low.

Economic and Kyoto Scenarios

The study also examined potential scenarios for the development of the coal mining industry in Appalachia over the next decade. Results changed very little under the four alternative macroeconomic scenarios that were considered. The decline in the industry and its impact was only slightly lower in the favorable high economic growth and high oil price scenarios, and slightly higher in the less favorible low growth or low oil price scenarios. Results, however, did differ a great deal under alternative emissions reduction scenarios related to compliance with the Kyoto environmental protocol. Compliance with the protocol could require significant emissions reductions, although smaller reductions may be possible if emissions trading and other innovative approaches are included when the protocol is implemented. But, even in this case, the level of emissions reduction that would be required is uncertain. The 6 alternative scenarios examined assumed different levels of reduction in greenhouse gas emissions in order to comply with the Kyoto protocol. Under scenarios where there was less restriction on omissions, the forecast decline in the coal mine industry and its impact was only somewhat higher than in the baseline scenario. However, the size of the impact rises rapidly as greater emission reductions are made necessary, particularly in the Central Appalachia.

The total impact rises sharply under more restrictive Kyoto emission reduction scenarios, in which 2010 emissions levels are required to return to or below emissions in 1990. Under the most restrictive scenarios, the direct impact would rise to between between 1.1% and 2.2% of all employment and earnings in the 118 county Appalachian coal-producing region. The total impact including the "multiplier effect" would be a decline of between 3% to 4% of all employment and earnings in the region. As always, the relative impact would be greatest in the Central Appalachia region. In particular, the direct reduction in coal mining employment and earnings would account for between 5.5% and 8.8% of Central Appalachia employment and earnings under these most restrictive emissions scenarios. The reduction in the total impact of the coal mining industry would be equivalent to between 14% to 18% of total employment and earnings in Central Appalachia. Finally, there were many individual counties where the decline in total earnings could exceed even these levels.

Tax Revenue, Demographic, and Transfer Payments Impacts Under Varying Scenarios

In addition to its impact on employment and earnings, the forecast decline in the coal mining industry has the potential to impact tax revenue, population growth, and participation in transfer payment programs. Under the baseline scenario, tax revenues due to the coal mining industry are forecast to decline by $113 million per year from 1997 to 2010. This is roughly a 20% decline in revenue. The forecast tax impact under each of the alternative macroeconomic scenarios is similar to this baseline forecast. However, the forecast decline in tax revenues is much greater in the Kyoto environmental scenarios that limit emissions most strictly. The three scenarios where emissions are limited to at or below 1990 levels call for a forecast decline in tax revenues of over $330 million. This represents a 60% or greater reduction in the tax revenues generated due to the coal mining industry.

At the same time, forecast changes in the coal mining industry are expected to have a significant impact on the level of transfer payments and the rate of population growth in Central Appalachia, but more modest impacts in Northern and Southern Appalachia. Forecast losses in the coal mining industry are expected to cause population to decline by less than 0.5% in both Northern and Southern Appalachia under the baseline scenario, and by 1.33% in Central Appalachia. Overall, this represents a loss of 32,000 in population in the 118 major coal-producing counties of Appalachia. Under the more restrictive emissions reduction scenarios for the Kyoto protocol, where emissions must fall to or below 1990 levels, population loss is expected to be roughly 2 ½ times greater than in the baseline scenario. Population is expected to decline by roughly 80,000 under these scenarios, with just over half of this population loss occurring in Central Appalachia, and most of the rest occurring in Northern Appalachia.

The impact on transfer payments under all scenarios is most dramatic in the case of Central Appalachia. In Central Appalachia, the total increase in per capita payments under the six transfer programs is expected to reach $110 in the baseline scenario, with program payments rising by between 5% and 15% in the TANF, SSI, food stamp, and unemployment insurance programs. A similar level of payments increase is expected under each alternative macroeconomic scenario. Under the most restrictive Kyoto greenhouse gas emission scenarios, total per capita transfer payments are forecast to rise by around $280 per year in Central Appalachia. Forecast payment increases are less than half as large in Northern and Southern Appalachia.

It should remembered that under all of these forecast scenarios, the reductions in employment, earnings, tax revenues, and population that are discussed, along with the increases in transfer payments, are forecast changes due to the coal mine industry alone, with other factors held equal. In particular, no special workforce or community economic adjustment programs are examined to determine how they might alter the

estimated employment, income or transfer payment impacts. Many other factors could occur, such as growth in other industries in these regions or increases in the earnings potential of regional workers, which could have a substantial impact on the fortunes of these regions a decade from now. Indeed, these other factors may have a much larger economic impact on these counties than potential changes in the coal mining industry alone.

Appendices

Appendix A: 118 Major Coal-Producing Counties in the ARC Region

Alabama	Kentucky	Maryland	Ohio	Pennsylvania	Tennessee	Virginia	West Virginia
Bibb	Bell	Allegany	Belmont	Allegheny	Anderson	Buchanan	Barbour
Blount	Breathitt	Garrett	Carroll	Armstrong	Campbell	Dickenson	Boone
Cullman	Clay		Columbiana	Beaver	Claiborne	Lee	Braxton
Fayette	Floyd		Coshocton	Blair	Fentress	Russell	Brooke
Jackson	Harlan		Gallia	Butler	Marion	Tazewell	Clay
Jefferson	Johnson		Guernsey	Cambria	Morgan	Wise & Norton	Fayette
Marion	Knott		Harrison	Carbon	Scott		Gilmer
Shelby	Knox		Holmes	Centre	Sequatchie		Grant
Tuscaloosa	Lawrence		Jackson	Clarion			Greenbrier
Walker	Leslie		Jefferson	Clearfield			Harrison
Winston	Letcher		Meigs	Columbia			Kanawha
	Magoffin		Monroe	Elk			Lincoln
	Martin		Morgan	Fayette			Logan
	Owsley		Muskingm	Greene			McDowell
	Perry		Noble	Indiana			Marion
	Pike		Perry	Jefferson			Marshall
	Whitley		Tuscarawas	Lackawanna			Mineral
			Vinton	Lawrence			Mingo
				Luzerne			Monongalia
				Lycoming			Nicholas
				Mercer			Preston
				Northumberland			Raleigh
				Schuylkill			Randolph
				Somerset			Tucker
				Sullivan			Upshur
				Venango			Wayne
				Washington			Webster
				Westmoreland			Wyoming

Appendix B: Mathematical Derivation of IMPLAN Multipliers

Multipliers used in this analysis are developed using the Micro IMPLAN model. These multipliers serve the purpose of breaking down the stimuli of economic activity into three components: direct effects, indirect effects, and induced effects. These effects are defined as follows[23]:

- *Direct effects* are defined as the economic activity changes that occur in the industry to whom a final demand change was made.
- *Indirect effects* are the changes that occur as a result of the inter-industry purchases as the directly affected industry responds to the direct change.
- *Induced effects* reflect the changes in household spending due to changes in income or population as a result of the changes in production.

These multipliers were generated in the economic activity categories of income, employment, and value-added. The process of developing the multipliers begins with a matrix of input-output transactions of industries. Columns of this matrix represent purchases by that industry to produce its goods and services. Rows of the matrix represent demanders of the column industry's goods. With the Type II multiplier, the household income row and household expenditures column are treated as an industry. Thus they are included in the Leontief inversion explained below. A coefficient matrix is derived by dividing each industry column element by the column total. This is referred to as the A matrix of coefficients. The matrix of coefficients can be rewritten as a series of linear equations as is shown in the following example:

X1 = 0.272*X1 + 0.312*X2 + 0.124*X3*Y1
X2 = 0.123*X1 + 0.324*X2 + 0.313*X3*Y2
X3 = 0.211*X1 + 0.111*X2 + 0.123*X3*Y3

Or, in matrix notation:

$$\begin{vmatrix} X_1 \\ X_2 \\ X \end{vmatrix} = \begin{vmatrix} 0.272 & 0.312 & 0.124 \\ 0.123 & 0.324 & 0.313 \\ 0.211 & 0.111 & 0.123 \end{vmatrix} * \begin{vmatrix} X_1 \\ X_2 \\ X_3 \end{vmatrix} + \begin{vmatrix} Y_1 \\ Y_2 \\ Y_3 \end{vmatrix}$$

The above can also be written in matrix notation as:

$$X = X * A + Y$$

[23] From IMPLAN user's guide, analysis guide, and data guide.

This notation implies that output, designated as X_i, is equal to transactions ($A*X_i$) plus final demand (Y_i). Subtracting transactions from both sides of the above equation yields:

$$X - X * A = Y$$

Using the property of the identity matrix, we can obtain:

$$X * (I - A) = Y$$

Now, after solving for X by multiplying both sides of the above equation by the inverse of the (I-A) matrix, we have:

$$X = (I - A)^{-1} * Y$$

What results is the predictive multiplier model. The verbal interpretation of the above equation is that the change in total industry output, X, is equal to $(I-A)^{-1}$ times the change in final demand. So, the inverse of the (I-A) matrix is the matrix of multipliers.

Appendix C: Data Sources

Energy Information Administration, *Coal Industry Annual,* www.eia.doe.gov/cneaf/coal/page/database.html

Energy Information Administration, *Coal Program, 1997, Annual Report*

U.S. Census Bureau, Bureau of Economic Analysis, *Gross Product by Industry for the United States and States*, and the *Regional Economic Information System 1969 to 1997 (REIS)*.

1996, 1997, and 1998 Income Tax Paid, www.bea.doc.gov/bea/regional/spi/pi.htm

U.S. Census Bureau, www.census.gov/govs/www/state.html.

Unpublished Data, Energy Information Agency

Appendix D: References

Black, Dan, Kermit Daniel, and Seth Sanders, 1996. "How Much Does Local Economic Growth Help the Poor?" Working Paper (January).

Black, Dan, Terra McKinnish, and Seth Sanders, 1999. "How the Availability of High-Wage Jobs for Low-Skilled Men Affects AFDC Expenditures: Evidence from Shocks to the Coal and Steel Industries." Working Paper (June).

Energy Information Agency, United States Department of Energy, 1999. *1999 Annual Energy Outlook*. Washington, D.C.: United States Government Printing Office (or www.eia.doe.gov)

Energy Information Administration, United States Department of Energy, 1998. *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*. D.C.: United States Government Printing Office (or www.eia.doe.gov).

Appendix E: Baseline and Multiplier Data by County

COUNTY	Indirect Output Multiplier	Coal Mining Earnings 1997 (Millions of $)	Total Earnings All Industries 1997 (Millions of $)	Total Coal Mining Employment	Total County Employment	Earnings per Job, Coal Mining	Subsurface Production In Tons, 1997	Surface Production In Tons, 1997	Coal Produced In Tons, 1997	Coal Mining Gross "County" Product, 1997 in $
Bibb, AL	0.000000	344	121644	49	5285	82595	0	21199	21199	683123
Blount, AL	0.160408	1535	309483	49	11260	82595	0	5765	5765	3048173
Cullman, AL	0.097319	94	838399	38	28722	82595	0	74266	74266	186667
Fayette, AL	0.217151	9296	175890	375	7682	82595	1992408	0	1992408	18460715
Jackson, AL	0.117716	1197	572308	53	18510	82595	0	44716	44716	2377639
Jefferson, AL	0.257315	135971	14991912	2052	416260	82595	9068777	1300783	10369560	270014791
Marion, AL	0.225860	2274	374093	43	14102	82595	0	129653	129653	4515759
Shelby, AL	0.249306	6164	1574264	87	55611	82595	853292	0	853292	12241527
Tuscaloosa, AL	0.330238	136846	2444828	1750	85133	82595	6074704	581669	6656373	271751795
Walker, AL	0.370409	99221	626770	750	21300	82595	515403	3562306	4077709	197035243
Winston, AL	0.094868	3944	336519	53	12298	82595	0	243118	243118	7831133
Bell, KY	0.365478	38663	272745	750	9849	60307	3325120	1638298	4963418	76974248
Breathitt, KY	0.262317	6160	91953	10	3765	60307	0	4311949	4311949	12263808
Clay, KY	0.248489	3066	135463	10	5552	60307	0	330451	330451	6104032
Floyd, KY	0.360768	41349	372950	1553	12765	60307	2897926	3460561	6358487	82320814
Harlan, KY	0.368982	71677	266699	1086	8262	60307	9026494	1577883	10604377	142700162
Johnson, KY	0.340763	8481	191828	162	6566	60307	1327652	307587	1635239	16884636
Knott, KY	0.316787	63901	132241	976	3343	60307	5119285	7004536	12123821	127219095
Knox, KY	0.033762	6877	204670	175	7861	60307	444268	115604	559872	13691268
Lawrence, KY	0.196157	964	85142	10	3295	60307	60326	174262	234588	1919206
Leslie, KY	0.286295	12860	131376	255	2247	60307	7354300	2580274	9934574	25603513
Letcher, KY	0.333496	44646	176528	998	6238	60307	6061261	2971004	9032265	88884739
Magoffin, KY	0.026253	10238	68928	175	3092	60307	0	1330763	1330763	20382780
Martin, KY	0.304672	48501	109214	750	3109	60307	7093081	5436740	12529821	96559501
Owsley, KY	0.116985	688	17395	12	1015	60307	0	113279	113279	1370032
Perry, KY	0.388361	56063	360864	1750	11640	60307	4841069	6638687	11479756	111614593
Pike, KY	0.370909	244039	817771	4241	23569	60307	22129237	12823451	34952688	485851876
Whitley, KY	0.296630	6224	328555	152	14430	60307	247641	173950	421591	12391225
Allegany, MD	0.253142	4882	928478	175	31161	N/A	0	561223	561223	10737270
Garrett, MD	0.297661	21501	315783	375	10832	N/A	3300861	297594	3598455	47288414
Belmont, OH	0.271386	39749	589798	622	23638	71854	5101746	1634796	6736542	64358942
Carroll, OH	0.100147	470	190423	10	7064	71854	0	58322	58322	761001
Columbiana, OH	0.165839	8592	1036431	133	35995	71854	336566	442585	779151	13911596

COUNTY	Indirect Output Multiplier	Coal Mining Earnings 1997 (Millions of $)	Total Earnings All Industries 1997 (Millions of $)	Total Coal Mining Employment	Total County Employment	Earnings per Job, Coal Mining	Subsurface Production In Tons, 1997	Surface Production In Tons, 1997	Coal Produced In Tons, 1997	Coal Mining Gross "County" Product, 1997 in $
Coshocton, OH	0.223226	7784	435978	240	18654	71854	0	368363	368363	12603336
Gallia, OH	0.099470	97	344736	60	12078	71854	0	333421	333421	157056
Guernsey, OH	0.138719	9188	417498	347	16503	71854	0	480672	480672	14877008
Harrison, OH	0.276512	14573	101975	175	4465	71854	1385512	704207	2089719	23595634
Holmes, OH	0.120365	2059	460963	60	14986	71854	0	121907	121907	3333796
Jackson, OH	0.249945	16834	317511	146	12328	71854	0	1147401	1147401	27256495
Jefferson, OH	0.222801	3743	703510	63	24071	71854	477480	429286	906766	6060417
Meigs, OH	0.292440	53932	171445	750	5421	71854	6404517	0	6404517	87323256
Monroe, OH	0.234861	20394	198236	375	5699	71854	3243474	0	3243474	33020017
Morgan, OH	N/A	11183	133727	203	3710	71854	0	0	1543498	18106889
Muskingum, OH	0.180242	4356	1066421	60	38702	71854	0	701407	701407	7052193
Noble, OH	0.179742	2337	94547	60	3973	71854	0	869978	869978	3784707
Perry, OH	0.187071	2958	204714	49	7158	71854	0	1234156	1234156	4789397
Tuscarawas, OH	0.230656	18419	1078122	434	38453	71854	0	1316504	1316504	29822822
Vinton, OH	0.275758	10149	66427	175	2817	71854	0	1809362	1809362	16432775
Allegheny, PA	0.183288	128658	29446380	175	752310	99072	330	41057	41387	156469727
Armstrong, PA	0.282739	49141	669096	762	21256	99072	4391584	1557903	5949487	59763706
Beaver, PA	0.156137	3853	2057147	79	58234	99072	0	88661	88661	4686247
Blair, PA	0.147570	759	1853043	10	57994	99072	0	35796	35796	922743
Butler, PA	0.225061	12827	2245150	60	67807	99072	0	111577	111577	15599785
Cambria, PA	0.262487	64364	1832020	361	60400	99072	105923	1322972	1428895	78277429
Carbon, PA	0.126434	1692	464348	53	16801	99072	0	0	318312	2057756
Centre, PA	0.119504	1192	2196554	159	75151	99072	0	387960	387960	1449672
Clarion, PA	0.264750	20909	501537	158	16257	99072	0	683180	683180	25428854
Clearfield, PA	0.337290	38197	982068	750	32683	99072	163374	4438218	4601592	46453964
Columbia, PA	0.100809	512	794225	123	28253	99072	174513	748807	923320	622678
Elk, PA	0.131244	1770	581150	86	17347	99072	0	642795	642795	2152617
Fayette, PA	0.219710	13724	1157213	299	39830	99072	0	388437	388437	16690688
Greene, PA	0.279462	183358	464288	2183	11961	99072	35324489	37580	35362068	222994110
Indiana, PA	0.310788	159666	1111502	1105	32078	99072	3940553	879413	4819966	194180661
Jefferson, PA	0.274739	33328	526697	237	16082	99072	613650	929015	1542665	40532443
Lackawanna, PA	0.134524	1540	3109264	4	103146	99072	0	82951	82951	1872899
Lawrence, PA	0.186184	3775	1082132	60	33857	99072	0	16648	16648	4591034
Luzerne, PA	0.202409	14736	4617495	154	142846	99072	0	896633	896633	17921450
Lycoming, PA	0.163746	1511	1639209	60	54723	99072	0	406519	406519	1837630
Mercer, PA	0.144334	530	1511430	4	51374	99072	0	3972	3972	644569

COUNTY	Indirect Output Multiplier	Coal Mining Earnings 1997 (Millions of $)	Total Earnings All Industries 1997 (Millions of $)	Total Coal Mining Employment	Total County Employment	Earnings per Job, Coal Mining	Subsurface Production In Tons, 1997	Surface Production In Tons, 1997	Coal Produced In Tons, 1997	Coal Mining Gross "County" Product, 1997 in $
Northumberland, PA	0.170379	8603	968055	52	29935	99072	35767	281858	317625	10462692
Schuylkill, PA	0.286212	62129	1616800	1024	51951	99072	208702	2221723	2430425	75559294
Somerset, PA	0.305836	94145	868573	781	26910	99072	2097040	3508069	5605109	114496125
Sullivan, PA	0.098035	225	53144	2	1951	99072	0	16760	16760	273257
Venango, PA	0.164736	2981	697586	9	21306	99072	0	67689	67689	3625396
Washington, PA	0.304702	107168	2530798	1566	78668	99072	7772833	690823	8463656	130334279
Westmoreland, PA	0.169719	14359	4589451	96	143713	99072	0	872073	872073	17462955
Anderson, TN	0.162269	5660	1447732	175	41506	115868	173389	260192	433581	3827192
Campbell, TN	0.272839	13683	277756	60	10644	115868	592873	283102	875975	9252204
Claiborne, TN	0.115886	3783	225579	100	11293	115868	231407	441026	672433	2557998
Fentress, TN	0.186252	801	136399	59	5734	115868	0	288016	288016	541622
Marion, TN	0.171973	3028	184978	28	7119	115868	0	52525	52525	2047193
Morgan, TN	0.117502	1038	119950	53	3938	115868	55744	0	55744	701877
Scott, TN	0.107869	1866	148597	148	7386	115868	107646	0	107646	1261756
Sequatchie, TN	0.221260	4262	72229	117	2971	115868	235420	578731	814151	2881889
Buchanan, VA	0.351391	137528	328065	2991	9898	54113	13219254	1201231	14420485	213647107
Dickenson, VA	0.288905	24806	104583	360	3117	54113	1845209	1212458	3057667	38535645
Lee, VA	0.303049	21590	153560	270	6731	54113	1233966	237380	1471346	33539650
Russell, VA	0.329305	28771	253905	686	10112	54113	897367	236044	1133411	44695196
Tazewell, VA	0.351906	24899	437473	617	17521	54113	1704625	0	1704625	38680118
Wise & Norton, VA	0.373467	122971	553380	2225	13091	54113	8028878	6020272	14049150	191033087
Barbour, WV	0.298138	13145	82061	175	4106	66440	1291963	78763	1370726	29554307
Boone, WV	0.311253	226185	356705	2904	7713	66440	18712172	11890107	30602280	508537775
Braxton, WV	0.089818	2962	102722	45	4209	66440	412769	0	412769	6658976
Brooke, WV	0.212676	11043	285890	168	8376	66440	1539002	0	1539002	24827876
Clay, WV	0.305958	25139	61812	375	2055	66440	0	6901924	6901924	56520504
Fayette, WV	0.305613	35239	379677	1604	14212	66440	861865	2844474	3706339	79228925
Gilmer, WV	0.202508	1604	53930	9	1990	66440	15460	0	15460	3606322
Grant, WV	0.313163	14672	142626	375	5039	66440	1253750	663120	1916870	32987086
Greenbrier, WV	0.258599	6037	360732	80	13519	66440	501160	27018	528178	13573172
Harrison, WV	0.274947	37375	1016105	707	34396	66440	5143801	148411	5292212	84031360
Kanawha, WV	0.274101	85614	3956987	591	114892	66440	4245978	4650637	8896615	192488584
Lincoln, WV	0.191950	1713	81530	8	2840	66440	46818	0	46818	3851390
Logan, WV	0.329049	112345	432456	1341	12725	66440	5275793	15191113	20466906	252588712
McDowell, WV	0.356964	34695	168181	750	6141	66440	4825795	1846966	6672761	78005259

COUNTY	*Indirect Output Multiplier*	*Coal Mining Earnings 1997 (Millions of $)*	*Total Earnings All Industries 1997 (Millions of $)*	*Total Coal Mining Employment*	*Total County Employment*	*Earnings per Job, Coal Mining*	*Subsurface Production In Tons, 1997*	*Surface Production In Tons, 1997*	*Coal Produced In Tons, 1997*	*Coal Mining Gross "County" Product, 1997 in $*
Marshall, WV	0.289783	57919	416277	863	9449	66440	10131444	0	10131444	130221066
Mineral, WV	0.226783	1614	176068	9	6740	66440	0	121862	121862	3628125
Mingo, WV	0.327372	178542	383631	1750	9544	66440	17327072	5097023	22424096	401421459
Monongalia, WV	0.288770	81424	1178636	1213	44677	66440	6365490	1269183	7634673	183069081
Nicholas, WV	0.387196	38016	232981	473	8514	66440	2103904	500868	2604772	85472540
Preston, WV	0.361968	13742	180549	221	7648	66440	1608206	134528	1742734	30895993
Raleigh, WV	0.340815	103019	902465	1238	29977	66440	12812100	1070148	13882248	231620780
Randolph, WV	0.292708	6783	297994	175	11200	66440	625654	0	625654	15249381
Tucker, WV	0.156741	1383	66998	21	3419	66440	0	192696	192696	3108659
Upshur, WV	0.285924	8566	205855	82	8048	66440	1314665	269892	1584557	19259201
Wayne, WV	0.296382	26998	299479	464	11008	66440	3715297	678838	4394135	60700475
Webster, WV	0.327176	27208	75454	522	2640	66440	2548071	2775952	5324023	61172582
Wyoming, WV	0.315483	74947	194139	1750	5960	66440	9038805	775256	9814061	168505641