Coal Production and Employment in Appalachia

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Bureau of Business and Economic Research

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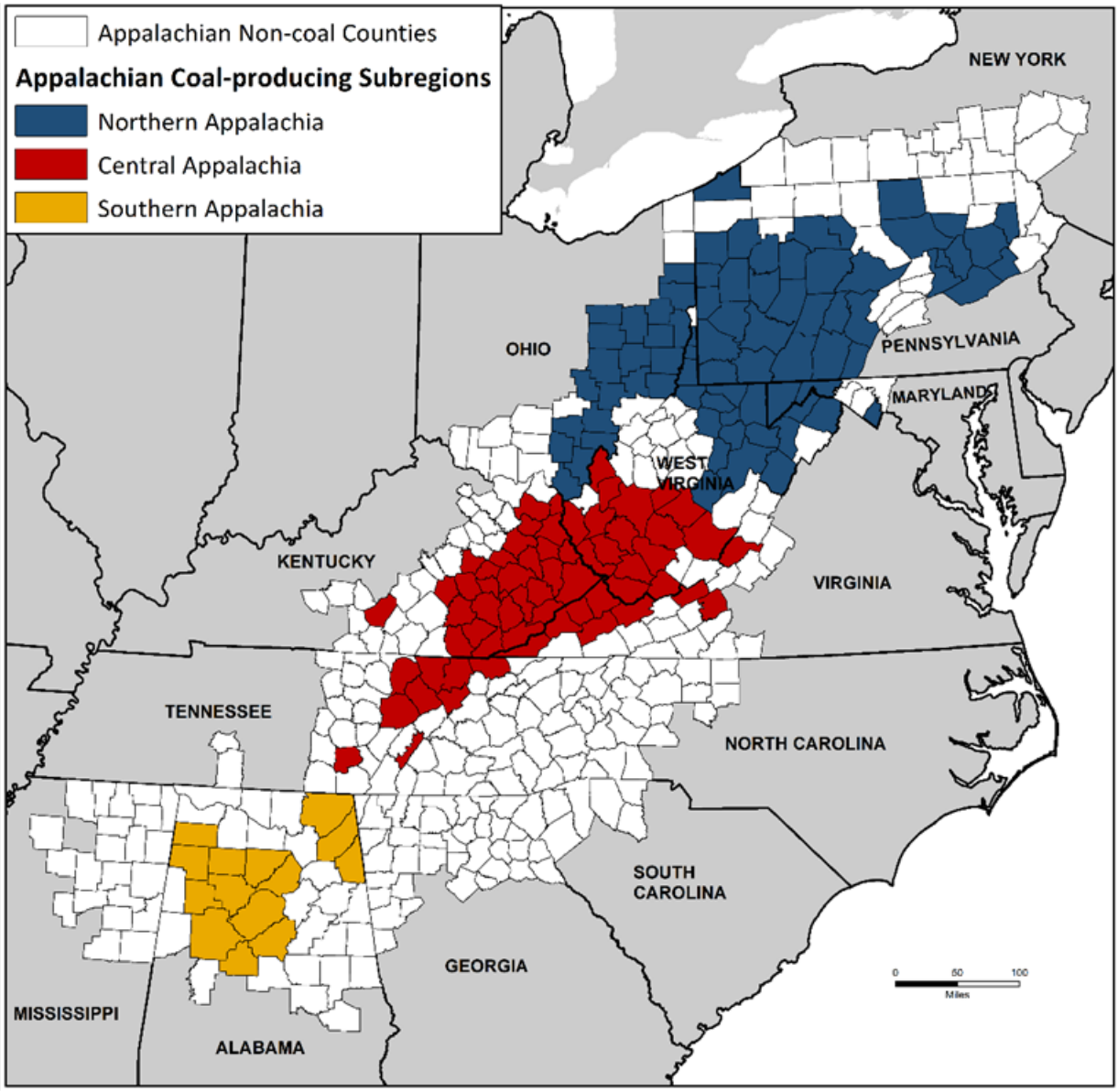
Table of Contents

List of Figures

Figure 1: Appalachian Coal-producing Subregions and Appalachian Non-coal Counties



Source: Appalachian Regional Commission, 2022 and U.S. Energy Information Administration (EIA)
Note: Appalachian coal producing subregions include counties within Appalachia, as defined by EIA, that produced at least one thousand short tons of coal in any year from 2000 through 2022.

Executive Summary

The coal industry—both in Appalachia and in the United States as a whole—has undergone a severe downturn over the last decade as demand for coal has fallen across the United States. The COVID-19 pandemic and associated recession weighed down on coal production even more. On the other hand, the ongoing war between Ukraine and Russia has created an energy crisis that actually led to an increase in the global demand for coal. This report details major trends in coal production and employment in Appalachia over the last two decades and assesses how those trends may affect the economic performance in the Region.

Highlights of this report are as follows:

COAL PRODUCTION AND EMPLOYMENT

- **OVERALL COAL PRODUCTION DECLINE**: U.S. coal production peaked in 2008 before dropping sharply though 2022. Overall, between 2001 and 2022, U.S. coal production dropped by more than 530 million short tons, or nearly 56 percent. The drop was relatively more pronounced in Appalachia, where production fell by 62 percent, compared with a 38 percent decline in the rest of the nation. Coal production dropped sharply in 2020 as the COVID-19 pandemic weighed on the already declining production. Production rose in 2021 and 2022 as the U.S. economy recovered from the pandemic and the ongoing war between Ukraine and Russia created an energy crisis that led to an increase in the global demand for coal. The 2022 production was still well below the 2019 production level.

- **DRIVERS OF NATIONAL DROP IN COAL DEMAND**: Two major national factors contributed to the decline in the demand for coal in the United States: significant reductions in the cost of natural gas and a regulatory environment that increased the cost of burning coal for electric power generators. Overall, the recovery from the COVID-19 pandemic and volatility in international demand in recent years have also contributed to significant swings in production.

- **CONCENTRATION OF COAL PRODUCTION LOSSES**: Losses in coal production are heavily concentrated in the Central Appalachia coal-producing subregion. This concentration of losses can be traced to low coal mine worker productivity in the subregion. After aggressive mining in Central Appalachia for more than a century, the remaining coal is more expensive to extract, compared to other coal subregions, because it tends to be deeper in the ground and/or seams tend to be thinner.

- **COAL INDUSTRY EMPLOYMENT**: As coal production dropped sharply over the last decade, so did coal employment. Between 2011 and 2022, coal industry employment fell by around 57 percent. The drop was more pronounced in Appalachia where coal employment fell by 62 percent, compared with nearly 43 percent in the rest of the United States. These losses in Appalachia were concentrated in the Central Appalachia coal-producing subregion, where coal employment fell by around 63 percent.

- **COAL PRODUCTION FORECAST**: Our forecast calls for a temporary increase in coal production after 2020, as the U.S. and global economies recover from the COVID-19 pandemic and the war between Russia and Ukraine. We expect coal production to increase through 2023 then will gradually decline over the long run through 2043. This results largely from the fact that natural gas and other fuels are expected to continue to account for a growing share of electricity generation domestically and many countries abroad. We expect production losses to be much more gradual over the coming 20 years compared with what was observed over the past decade

or so. We expect future losses to be more pronounced in Central Appalachia subregion than the Northern and Southern Appalachia subregions.

APPALACHIA'S ECONOMIC PERFORMANCE

- **TOTAL PRIVATE SECTOR EMPLOYMENT**: Over the past decade, total private-sector employment in Appalachian coal counties has generally been flat, while it increased substantially in Appalachian non-coal counties, as well as the rest of the United States. Moreover, total private sector employment in Central Appalachia, which has a much larger share of coal mining employment than the other two Appalachian coal-producing subregions, has fallen substantially over the same period. These facts provide evidence that the decline in coal, combined with heavy reliance on coal in some counties, has led to broader negative spillover effects to regional economies. In 2020, private sector employment in Appalachia dropped sharply, mainly because of the COVID-19 pandemic. Employment rose in 2021 and 2022 as the U.S. economy recovered from the pandemic. While the 2022 employment levels in Appalachian non-coal counties and the rest of the U.S. surpassed the pre-pandemic 2019 levels, employment in Appalachian coal counties in 2022 was still well below the 2019 level.

- **UNEMPLOYMENT AND LABOR FORCE**: While private sector employment has been flat over the past decade in Appalachian coal counties—though it dropped sharply in Central Appalachia subregion—unemployment rates in these two geographies still declined like those in Appalachian non-coal counties and the rest of the United States. However, during the same period, the labor force decreased in Appalachian coal counties, particularly so in Central Appalachia—but it increased in Appalachian non-coal counties and the rest of the United States. These trends suggest that the decline in unemployment rate primarily in Central Appalachia was driven by labor force exit, not an employment increase. This further suggests the Region's lack of job opportunities during the period.

- **POPULATION CHANGE**: Total population has been declining since 2010 in Appalachian coal counties, while gradually increasing in Appalachian non-coal counties and the rest of the United States. Central Appalachia has seen relatively sharp population declines over the past decade, compared with a gradual decline in Northern Appalachia and strong growth in Southern Appalachia. Trends in population losses are more pronounced for the prime working-age population.

- **SHARE OF RETIREMENT-AGE POPULATION**: The shares of retirement-age population for Appalachian coal counties, Appalachian non-coal counties, and the rest of the United States have increased over the last two decades, especially so during the most recent ten-year period. Appalachian coal counties have consistently had the highest share of its population in retirement age, and Central Appalachia subregion has seen its share of retirement-age population increase faster than the Northern and Southern Appalachia subregions.

- **WAGES AND SALARY INCOME**: Wages and salaries per job are higher in Appalachian coal counties compared to Appalachian non-coal counties. This is likely the result of wages and salaries for coal mining jobs in Appalachia that are significantly higher than the average wages and salaries in the Region. Wages and salaries in Northern Appalachia and Southern Appalachia constantly increased from 2001 through 2020. In Central Appalachia, however, they stopped increasing in 2012, staying relatively flat through 2016, before rising slowly through 2021.

- **POVERTY**: Poverty rates in the U.S. increased substantially from 2000 to 2012 before gradually improving over the past decade. However, poverty rates increased in 2021, mostly likely due to the lingering effect of COVID-19 pandemic. This increase is likely temporary. The improvement in poverty rates prior to this, however, was slower in Appalachian coal counties than Appalachian non-coal counties and the rest of the United States. Among the three Appalachian

coal-producing subregions, the poverty rate is substantially higher in Central Appalachia than in Northern and Southern Appalachia.

- **EDUCATIONAL ATTAINMENT**: Educational attainment, measured in terms of the share of people 25 years and older with at least a bachelor's degree, is lower in Appalachia than the rest of the United States. Like the rest of the nation, however, Appalachia has made a significant improvement in education over the last two decades. Among the three Appalachian coal-producing subregions, educational attainment is significantly lower in Central Appalachia than in the Northern and Southern Appalachia subregions.

- **HEALTH**: Poor health outcomes represent another significant economic development challenge in Appalachia. Mortality rates in the U.S. stayed relatively flat in the 2000s before gradually increasing through the past decade. Mortality rates spiked in 2020, mainly because of the COVID-19 pandemic. Appalachian coal counties have substantially higher mortality rates than Appalachian non-coal counties and the rest of the nation. Moreover, over the past decade, mortality rates have risen faster in Central Appalachia than in the Northern and Southern Appalachia subregions.

Chapter 1: Introduction

The coal industry—both in Appalachia and in the United States as a whole—has undergone a severe downturn over the last decade as demand for coal has fallen across the United States. The COVID-19 pandemic and associated recession weighed down on coal production even more. On the other hand, the ongoing war between Ukraine and Russia has created an energy crisis that actually led to an increase in the global demand for coal. This report details major trends in coal production and employment in Appalachia over the last two decades and assesses how those trends may affect the economic performance in the Region. This report updates the previous report published in 2022.

In the next section of this report, we look at the recent trends in coal production and employment and discuss several factors contributing to the decline in the demand for coal. In the following section we compare the economic performance of Appalachia to that of the rest of the nation, as well examines the variation across coal-producing subregions in Appalachia.

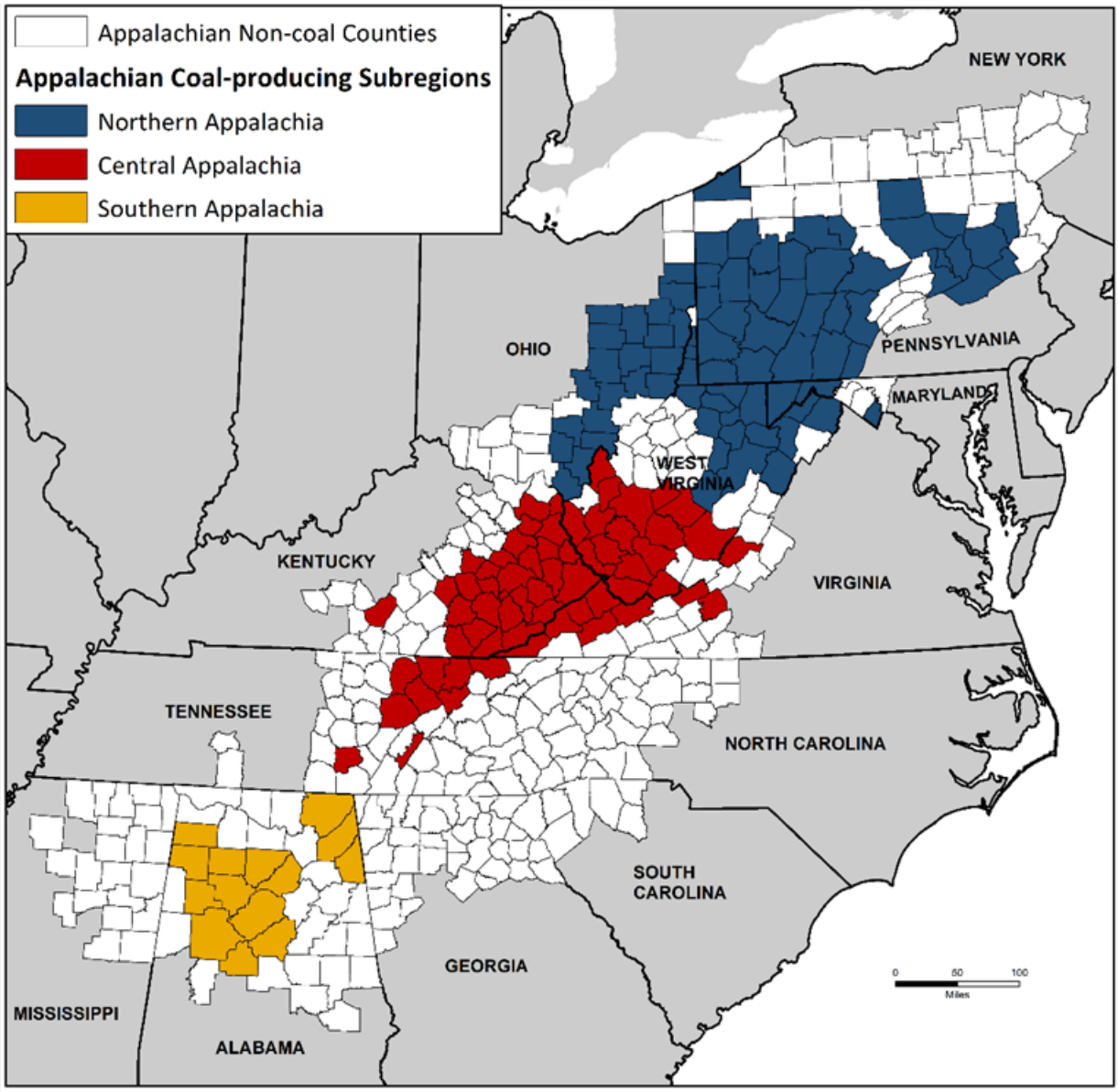
Chapter 2: Coal Production and Employment

COAL-PRODUCING GEOGRAPHIES: Throughout this report we compare trends in coal production, employment, and economic performance across various geographies. We first compare trends among Appalachian coal counties, Appalachian non-coal counties, and the rest of the United States. We define Appalachian coal counties as counties within Appalachia that produced at least one thousand short ton of coal in any year from 2000 through 2022. We identified 153 counties within the 423 counties served by the Appalachian Regional Commission (ARC) as Appalachian coal counties. The rest of the counties within Appalachia are classified as Appalachian non-coal counties, and all counties outside of Appalachia are classified as the rest of the United States.

Second, we compare trends across groups of counties within Appalachian coal counties. We use the Energy Information Administration (EIA)'s definition of coal producing regions to classify these counties into three Appalachian coal-producing subregions: Northern, Central, and Southern Appalachia.[1] Of the 153 Appalachian coal counties, 77 counties belong to Northern Appalachia subregion, 62 counties to Central Appalachia subregion, and 14 counties to Southern Appalachia subregion (see Figure 2).

[1] For more information about EIA's classification of coal producing regions, see: https://www.eia.gov/tools/glossary/index.php?id=Coal-producing%20regions

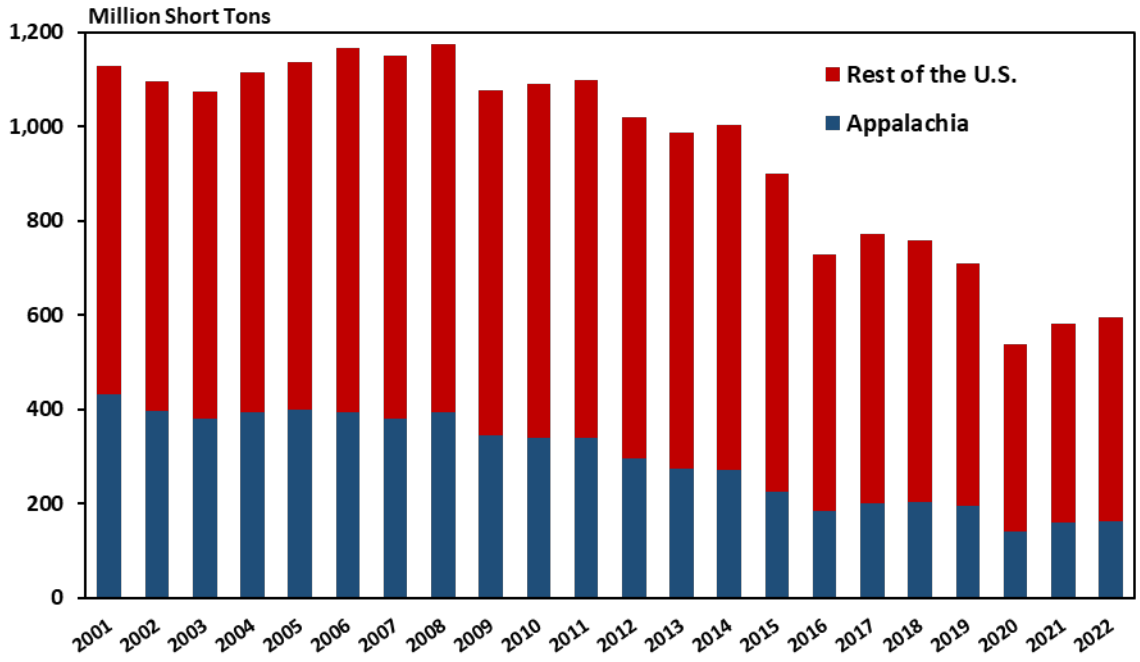
Figure 2: Appalachian Coal-producing Subregions and Appalachian Non-coal Counties



Source: Appalachian Regional Commission, 2022 and U.S. Energy Information Administration (EIA)
Note: Appalachian coal producing subregions include counties within Appalachia, as defined by EIA, that produced at least one thousand short tons of coal in any year from 2000 through 2022.

COAL PRODUCTION IN APPALACHIA: Looking at trends over the last two decades shows that coal production in the U.S. peaked in 2008, before dropping rapidly through 2022. For Appalachia, coal production also increased gradually between 2003 and 2008. Overall, between 2001 and 2022, coal production in the U.S. dropped by more than 530 million short tons. The drop was relatively much more pronounced in Appalachia, where production fell by nearly 270 million short tons, or a 62 percent drop, compared with a 38 percent drop in the rest of the United States (Figure 3). Coal production in both Appalachia and the rest of the U.S. dropped sharply in 2020 as the COVID-19 pandemic weighed on the already declining production. Production rose in 2021 and 2022 as the U.S. economy recovered from the pandemic and the ongoing war between Ukraine and Russia has created an energy crisis that actually led to an increase in the global demand for coal. The production level in 2022, however, was still well below the 2019 production level.

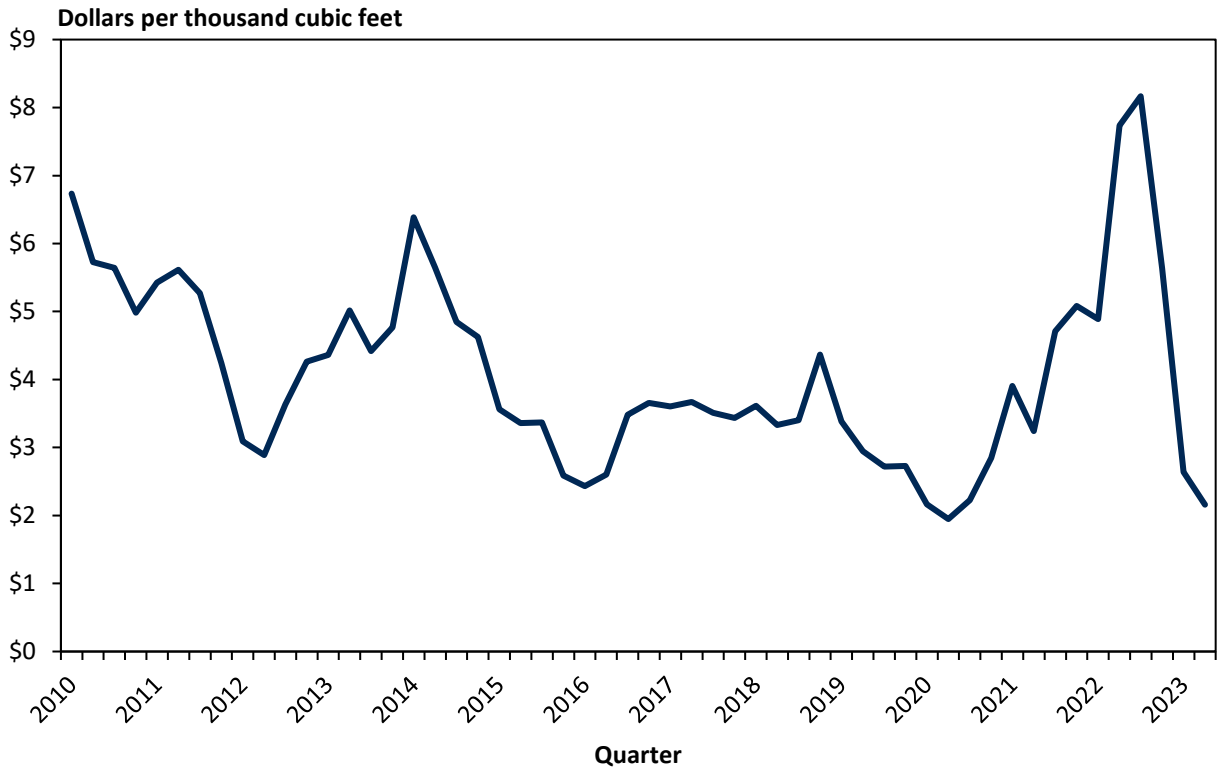
Figure 3: Coal Mining Production, Appalachia and the Rest of the United States



Source: U.S. Mine Safety and Health Administration (MSHA)

NATURAL GAS PRICES: A major contributing factor to the fall in coal demand has been the decline of natural gas prices in the electric power sector, which constitutes the largest source of domestic demand for coal. The price of natural gas—a competitor fuel to coal for electric power generation—had been on a downward trend from 2010 through the pandemic period of 2020. This price drop was the result of the widespread use of horizontal drilling and hydraulic fracturing techniques in shale formations, such as the Marcellus and Utica in Appalachia, that led to a dramatic increase in natural gas production—to the point that the U.S. is now a net exporter of natural gas. However, gas prices more than doubled between the beginning of 2020 and the first quarter of 2022 due to high demand domestically and increased exports of liquified natural gas (LNG). Prices nearly doubled again in the second and third quarters of 2022 as Russia's invasion of Ukraine disrupted natural gas supplies globally. However, prices began to subside toward the end of 2022 and as of the first quarter of 2023 are back below $3 per MMBtu (see Figure 4).

Figure 4: Average Natural Gas Henry Hub Price, United States

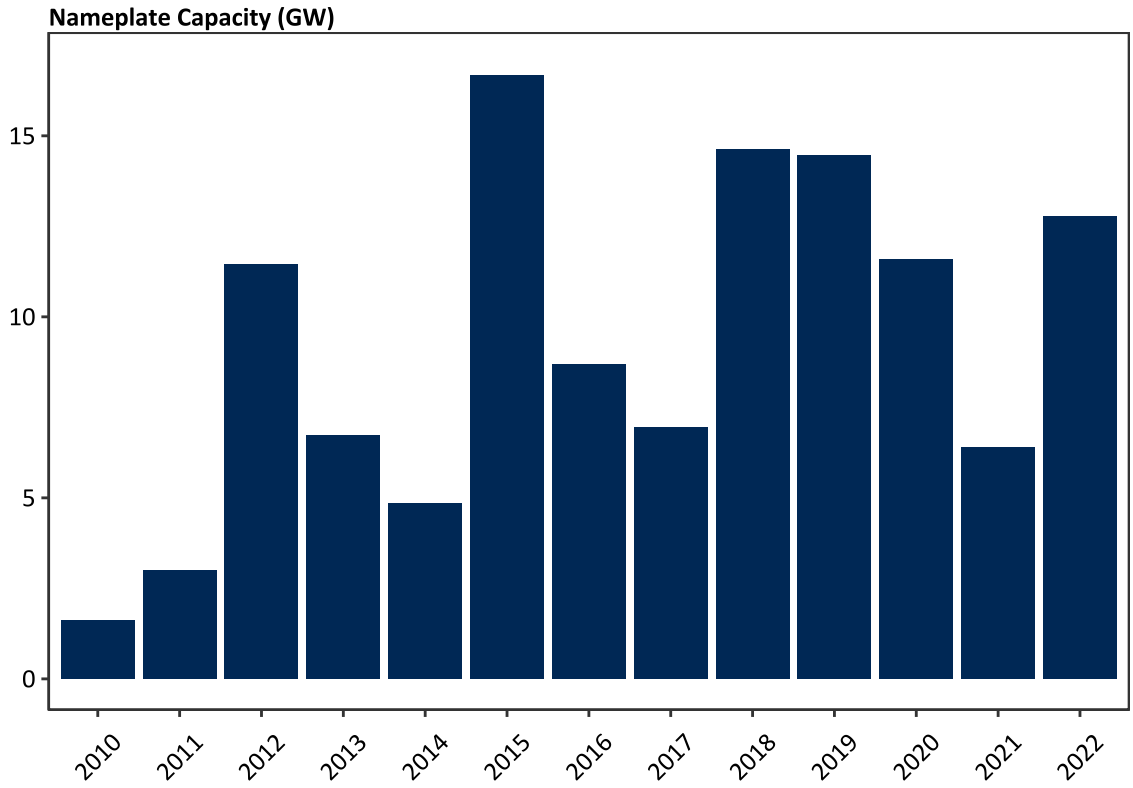


Source: US Energy Information Administration

ENVIRONMENTAL REGULATIONS: While natural gas prices provide the most important factor in declining coal demand in the electric power sector, the federal environmental regulatory climate has also increased the cost of burning coal through a series of regulations. In particular, the Mercury and Air Toxics Standards (MATS) Rule, which was implemented in April 2015, rendered some older, high-emission plants unprofitable to operate. A total of 16.7 GW of coal capacity were retired in 2015 when the MATS rules required compliance.

However, coal capacity retirements have continued at a rapid pace over the seven years following the rule's implementation. Between 2016 and 2022, more than 75 GW of coal capacity was retired, with more than 11 GW in each of the years between 2018 and 2020 (Figure 5). These post-MATS retirements suggest that other factors, such as continuing low natural gas prices and competition from renewables, may be causing the reductions in coal capacity.

Figure 5: Retired Coal Capacity, United States



Source: US Energy Information Administration

Two recently implemented clean energy programs may have the effect of accelerating coal plant retirements over the next few years. The first was the passage of the Inflation Reduction Act (IRA) in August 2022, which contained a wide range of incentives for renewable energy, electric vehicles, and energy efficiency. Many of the incentives, such as those for electric vehicles, energy-efficient electric heating, and electric-grid improvements are likely to increase demand for electricity, which is still

largely provided by fossil fuels in the Appalachian Region. However, the investments in energy efficiency and renewable energy are expected to reduce demand from coal plants. S&P Global Market Intelligence forecasts that the IRA will be the primary cause of 24.3 GW of coal capacity retirements by 2030.[2]

Secondly, in March 2023, the Environmental Protection Agency announced the Good Neighbor Plan rule that requires U.S. power plants to reduce nitrogen oxide (NO_X) pollution. The rule will affect power plants in seven of the 13 Appalachian states[3] and is likely to add additional costs at coal-fired power plants that do not currently have selective catalytic reduction (SCR) technology to remove NO_X from their emissions stream. The EPA's regulatory impact analysis projects that the rule will cause an additional 14 GW of coal capacity retirements by 2030, amounting to approximately 13 percent of existing coal-fired capacity.[4]

From the perspective of electric power generators, these two dynamics have increased the relative cost of burning coal while decreasing the relative cost of burning natural gas. As a result, the share of national electric power generation derived from coal is likely to continue to fall while the share derived from natural gas will increase. As illustrated in Figure 6, generation from natural gas moved from approximately 20 percent of total generation in 2010 to more than 40 percent by 2021, while coal fell from nearly 50 percent to under 20 percent in the same period. At the same time, renewables moved from under 5 percent of generation in 2010 to nearly equal coal's share in 2021.

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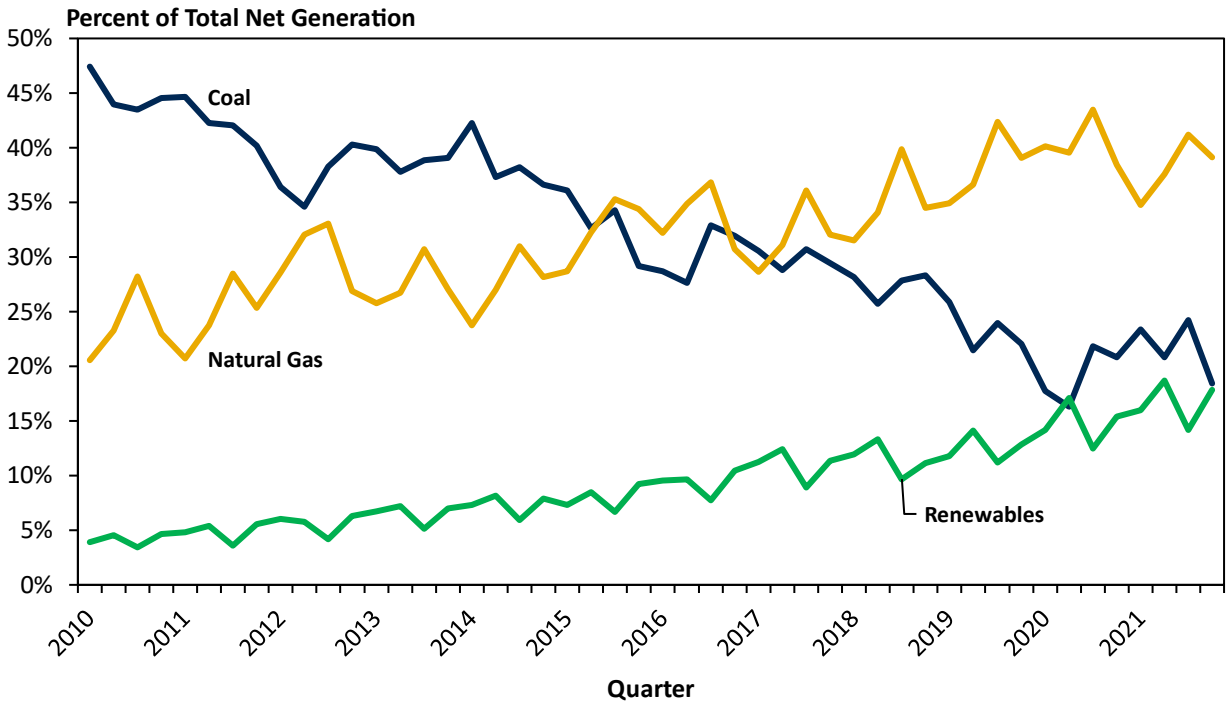
[2] https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/inflation-reduction-act-to-accelerate-us-coal-plant-retirements-74196498

[3] The Good Neighbor rule includes Alabama, Kentucky, Mississippi, New York, Pennsylvania, Virginia, and West Virginia. Source: https://www.epa.gov/csapr/good-neighbor-plan-2015-ozone-naaqs.

[4] https://www.epa.gov/csapr/good-neighbor-plan-2015-ozone-naaqs.

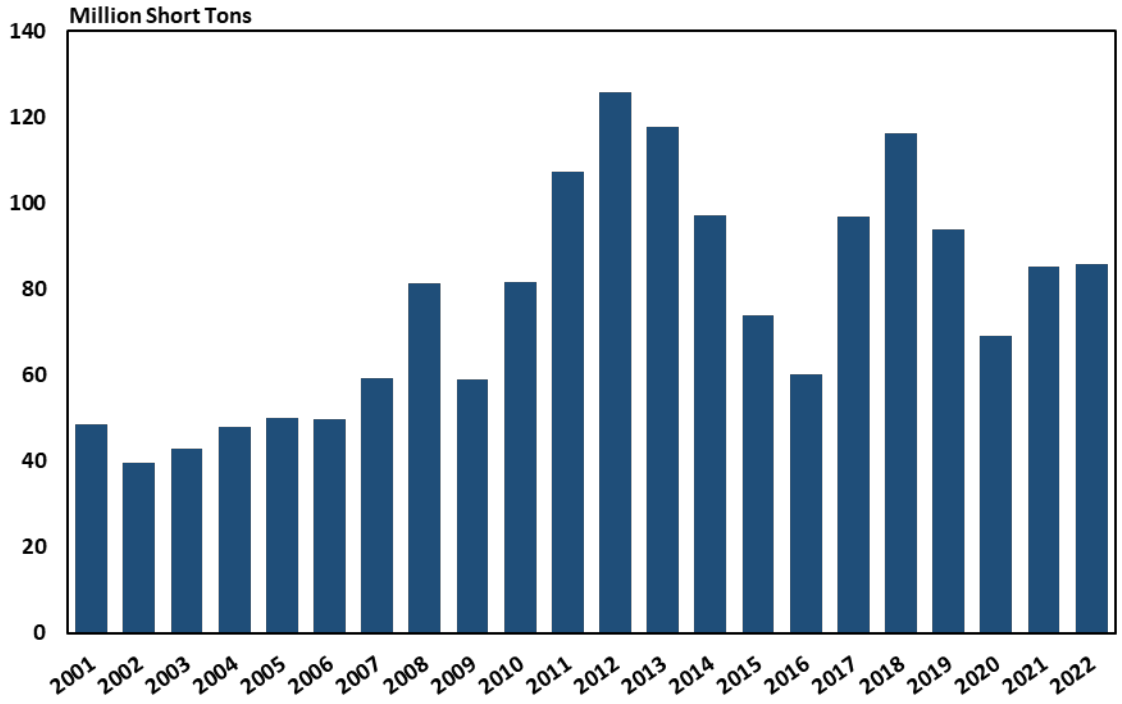
Figure 6: Share of U.S. Electricity Generation from Coal, Natural Gas, and Renewables



Source: US Energy Information Administration

EXPORTS: In addition to the declining natural gas prices and the tightening environmental regulatory climate, international demand for U.S. coal exports has been very volatile over the last decade.[5] Coal exports from the U.S. fell sharply from nearly 126 million short tons in 2012 to 60 million short tons in 2016, but rose back up to around 116 million short tons in 2018 before falling again to less than 86 million short tons through 2022 (Figure 7). While fluctuating, the U.S. coal exports over the last decade show a declining trend in general, contributing to the overall decline in coal production in the last decade. The coal exports increased in 2021 and 2022 but were still below the 2019 level before the pandemic. A combination of factors contributed to the increase in the U.S. coal exports including the world economy's recovery from the COVID-19 pandemic and the war between Ukraine and Russia.

Figure 7: United States Coal Exports

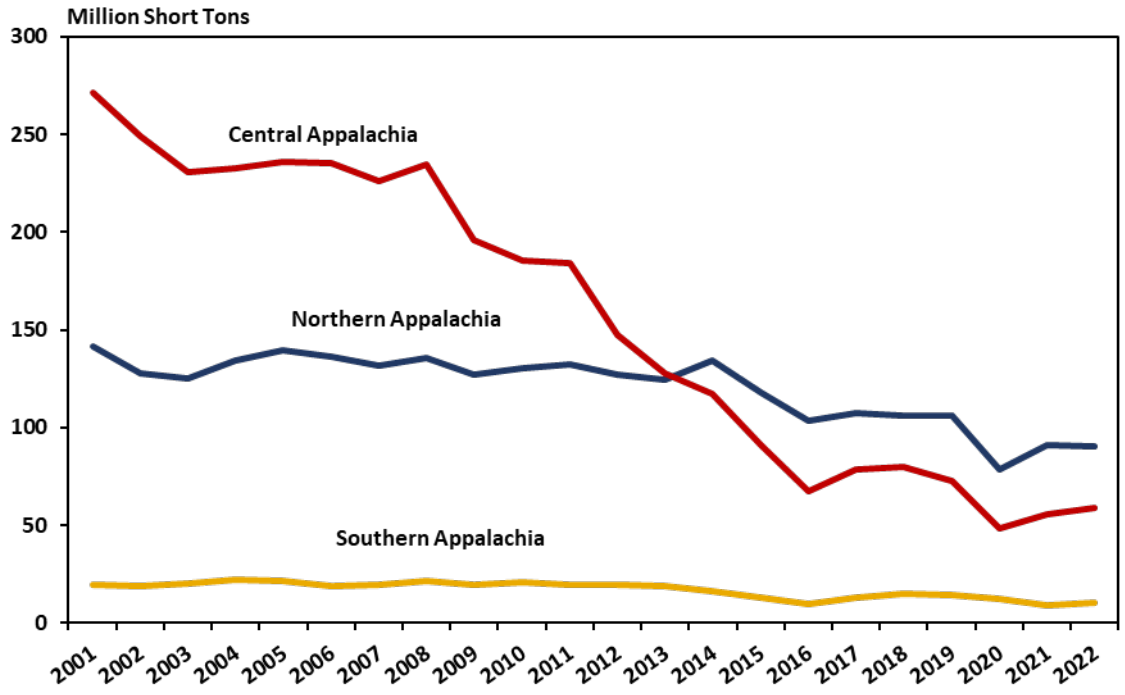


Source: U.S. Energy Information Administration (EIA)

[5] For a more thorough discussion of these issues, see Lego and Deskins (2018).

COAL PRODUCTION IN APPALACHIAN COAL-PRODUCING SUBREGIONS: Earlier, Figure 3 showed that coal production in Appalachian fell by nearly 270 million short tons, or 62 percent, between 2001 and 2022. Looking more closely into the Appalachian coal-producing subregions shows that the majority of this decline came from the Central Appalachia subregion, where coal production dropped from more than 270 million short tons in 2001 to less than 60 million short tons in 2022, a drop of more than 78 percent. During the same period, coal production dropped by 36 percent in the Northern Appalachia subregion and 47 percent in the Southern Appalachia subregion (see Figure 7). Indeed, whereas Northern Appalachian mines produced only a fraction of what was produced in Central Appalachia in 2001, Northern Appalachian mines in 2022 exceeded Central Appalachian production by around 56 percent.

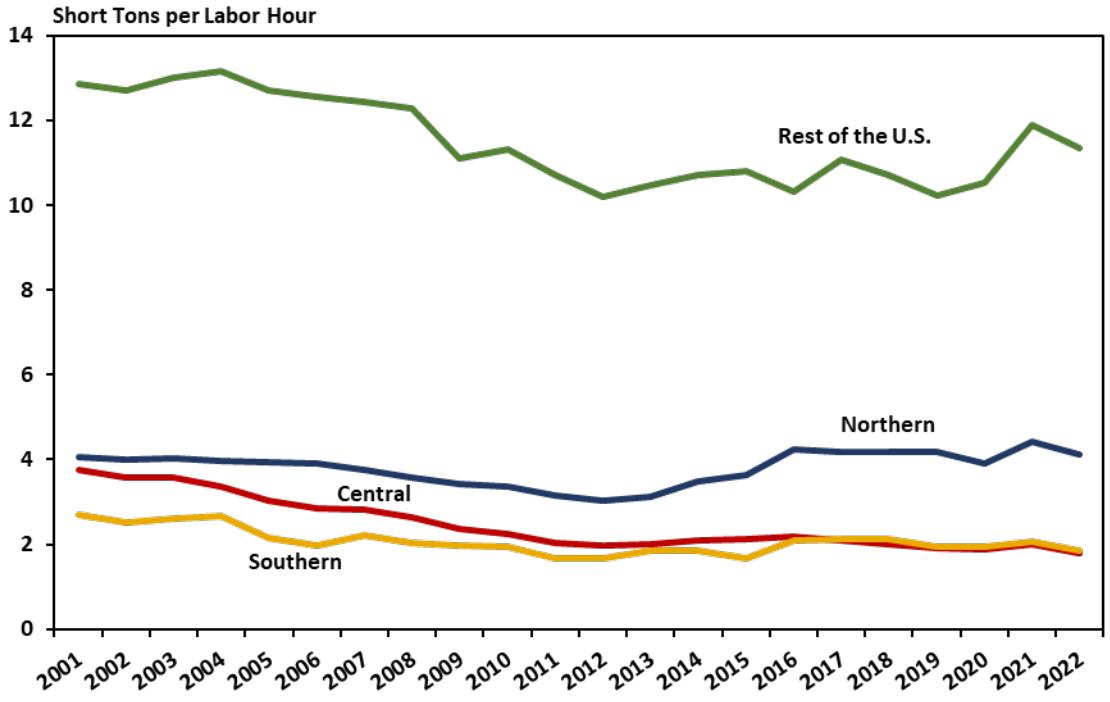
Figure 8: Coal Production, Appalachian Coal-Producing Subregions



Source: U.S. Mine Safety and Health Administration (MSHA)

COAL MINE WORKER PRODUCTIVITY: A key driver of the relative decline in coal production across the Appalachian coal-producing subregions is worker productivity. As illustrated in Figure 8, from 2001 through 2012, coal mine worker productivity in Central Appalachia fell by half, from around 4 short tons per hour to around 2 short tons per hour. Productivity then rose slightly through 2017 but started declining again through 2022 to 1.8 short tons per labor hour. Since the coal in this subregion has been mined aggressively for more than a century, the remaining reserves tend to be deeper underground and/or within thinner seams that require more units of labor to extract. This places a significant production cost premium on the Central Appalachia's lower-value thermal coal reserves when compared to Northern Appalachia and other coal-producing regions in the United States. Similarly, it also places a production cost premium on the Central Appalachia's large metallurgical reserves when compared to nations such as Australia, Indonesia, and South Africa. Thus, declining domestic and global coal demand will be manifest most noticeably in areas with higher-cost production—like the Central Appalachia subregion.

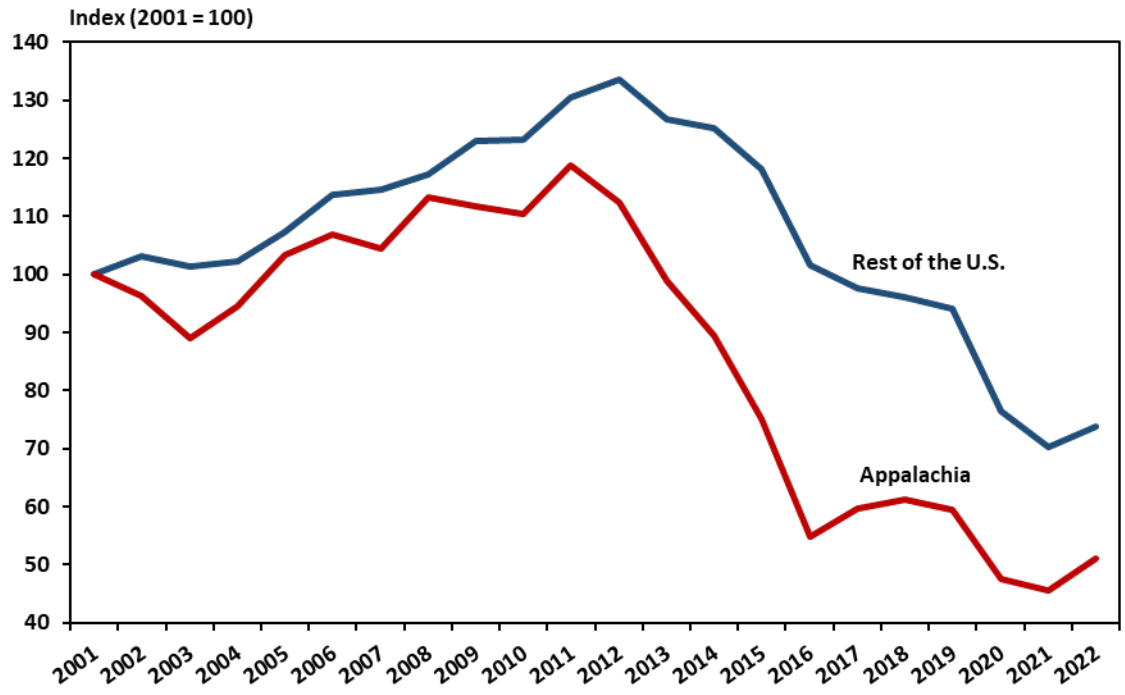
Figure 9: Coal Mining Worker Productivity, Appalachian Coal-Producing Subregions and the Rest of the United States



Source: U.S. Mine Safety and Health Administration (MSHA)

COAL EMPLOYMENT: In Figure 10 we compare coal mining employment in Appalachia versus the rest of the nation. After rising gradually through 2011, coal employment dropped sharply through 2021, before slightly increasing in 2022. Between 2011 and 2022, coal employment in Appalachia declined by 57 percent, considerably larger than the decline of around 43 percent in the rest of the United States. These trends over the last decade are consistent with coal production trends depicted in Figure 2 above.

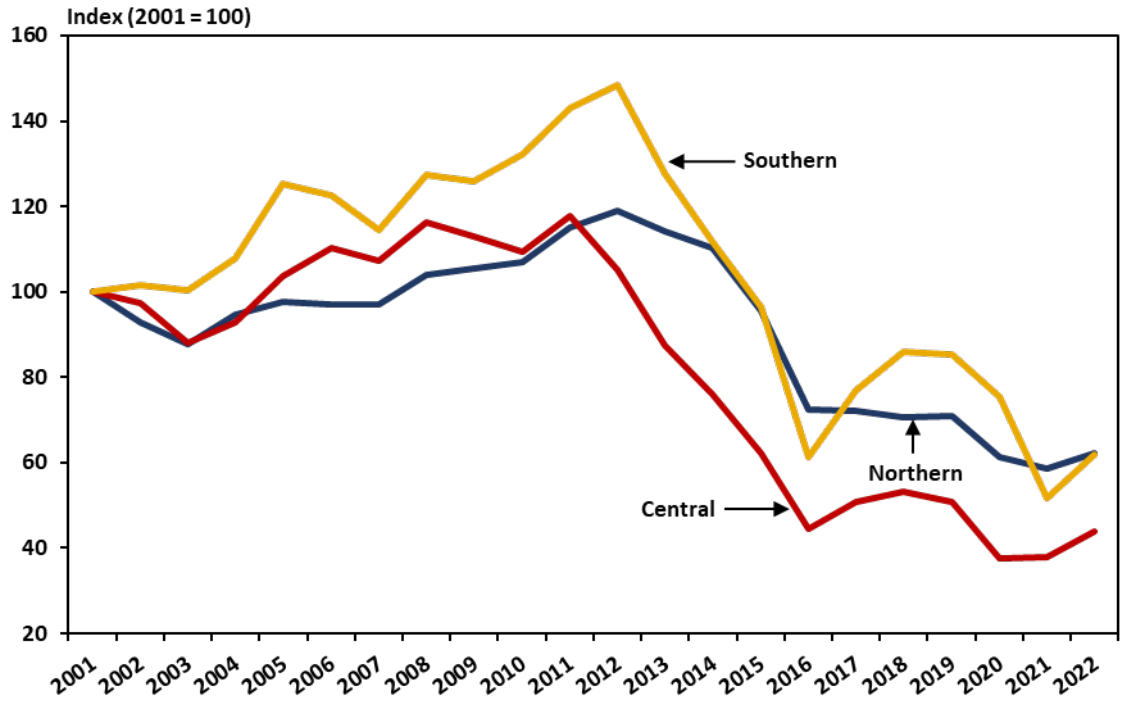
Figure 10: Coal Mining Employment, Appalachia and the Rest of the United States



Source: U.S. Mine Safety and Health Administration (MSHA)

Figure 11 compares coal employment levels within three Appalachian coal-producing subregions for the period from 2001 through 2022. After rising gradually from 2001 through 2011, coal mining employment dropped sharply through 2021 before increasing slightly in 2022. Overall, between 2011 and 2022, employment in the coal mining industry in the three subregions declined by more than 34,000, or around 57 percent. Moreover, Central Appalachia accounted for most of the decline in coal employment, which is consistent with trends in coal production in Appalachia coal counties. During this period, coal employment in the Central Appalachia subregion dropped by 63 percent, compared with 46 percent in Northern Appalachia and 57 percent in Southern Appalachia.

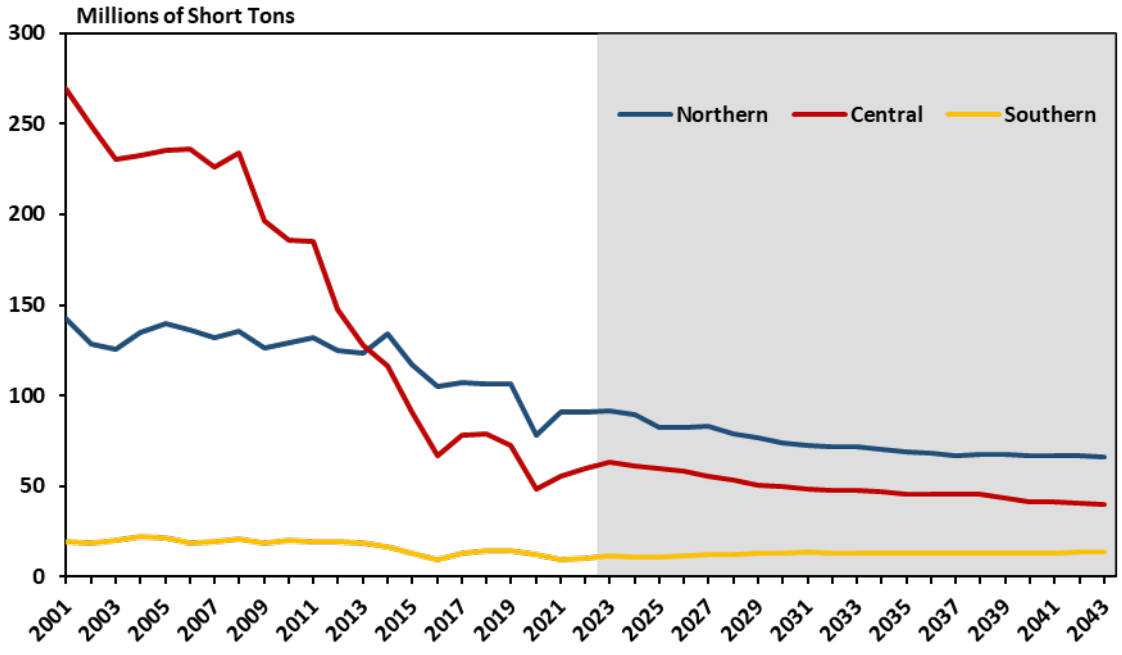
Figure 11: Coal Mining Employment, Appalachian Coal-Producing Subregions



Source: U.S. Mine Safety and Health Administration (MSHA)

COAL PRODUCTION OUTLOOK FOR APPALACHIA COAL-PRODUCING SUBREGIONS: After examining current trends in coal production and employment, we now turn to the 20-year outlook for coal production. We first look at the outlook across three Appalachian coal-producing subregions. Coal production in Northern and Central Appalachia subregions rose in 2021 as the world economy started recovering from the COVID-19 pandemic. In 2022 coal production in Northern Appalachia stayed relatively flat and is expected to stay at about the same level through 2023 before declining gradually over the long term. The Central Appalachia subregion saw coal production continued to increase in 2022. We anticipate coal production will increase through 2023 before declining gradually through 2043. The coal production decline in slightly more pronounced in Central than Northern Appalachia. Unlike the other two subregions, the Southern Appalachia subregion saw coal production drop in 2021. Production rose slightly in 2022 and is expected to rise again in 2023. We expect production to fluctuate but trend slightly upward through 2040, before staying relatively flat through 2043.

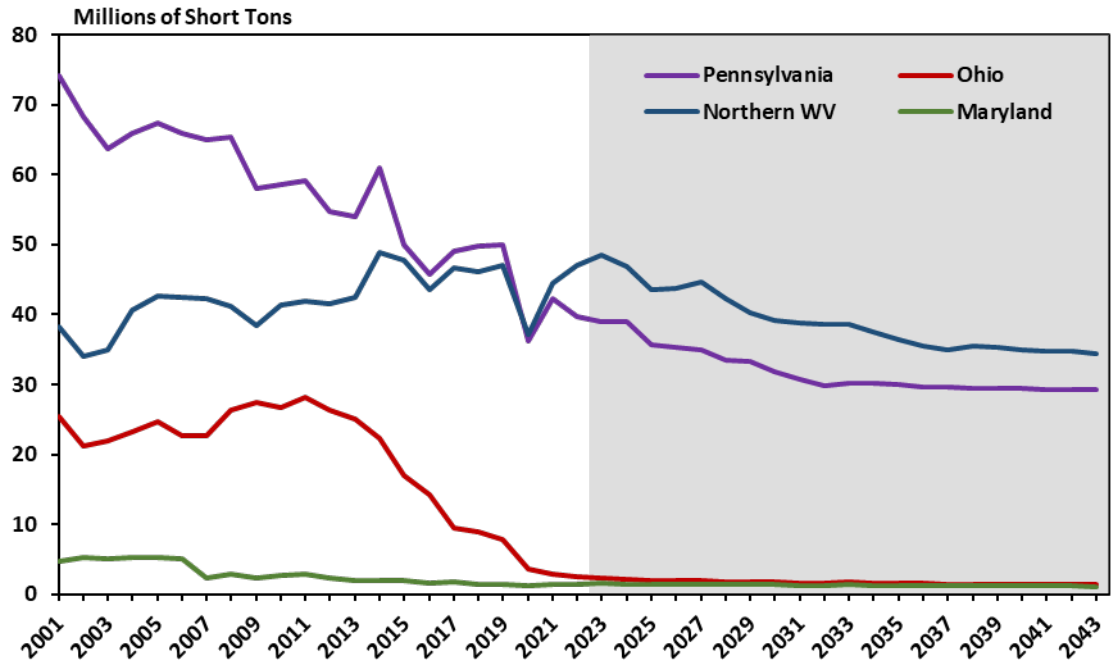
Figure 12: Coal Production Forecast, Appalachian Coal-producing Subregions



Sources: U.S. Energy Information Administration and WVU Bureau of Business & Economic Research
Note: Shaded area indicates forecast.

COAL PRODUCTION OUTLOOKS FOR APPALACHIA STATES: In figures 13, 14, and 15, we provide a forecast of coal production for each of the states (or portions of states) in the Northern Appalachia, Central Appalachia, and Southern Appalachia subregions. Coal production in Pennsylvania rose significantly in 2021 and 2022 following the world economy's recovery from the COVID-19 pandemic. Coal production is expected to continue to rise through 2023 before declining gradually over the long term. Northern West Virginia also saw a significant increase in coal production in 2021. However, coal production declined again in 2022 and is expected to continue declining gradually through 2035 before staying relatively flat through 2043. Coal production for Maryland increased more modestly in 2021 and is expected to continue to increase slowly through 2023 before gradually declining over the long run through 2043. In contrast, coal production in Ohio dropped in 2021 and 2022, and is expected to continue declining gradually through 2043.

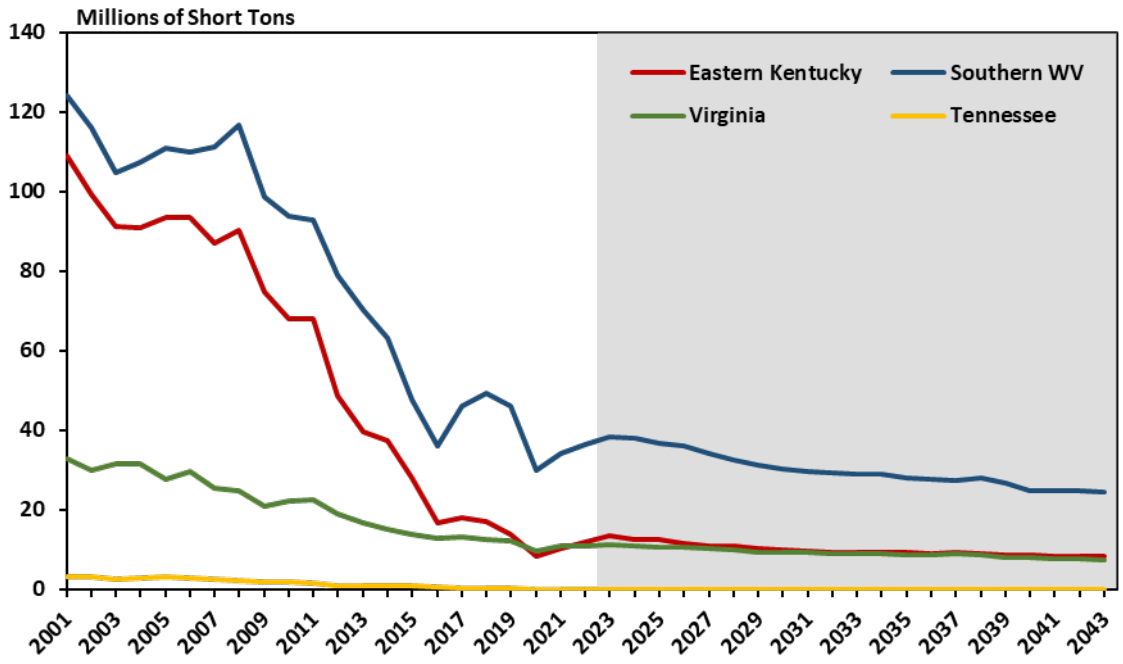
Figure 13: Coal Production Forecast by State, Northern Appalachia



Sources: U.S. Energy Information Administration and WVU Bureau of Business & Economic Research
Note: Shaded area indicates forecast.

Two portions of states within the Central Appalachia subregion—eastern Kentucky and southern West Virginia—saw their coal production increase significantly in 2021 and 2022. We expect production to continue to increase through 2023 before declining gradually over the long term through 2043. These trends are similar to the trends for the Central Appalachia subregion as a whole shown in Figure 13 above. Coal production in Virginia has stayed relatively flat in 2021 and 2022. Production is expected to stay flat through 2023 before declining gradually through 2043. Tennessee, on the other hand, stopped producing coal in 2021, and is not expected to produce coal in the next two decades.

Figure 14: Coal Production Forecast by State, Central Appalachia

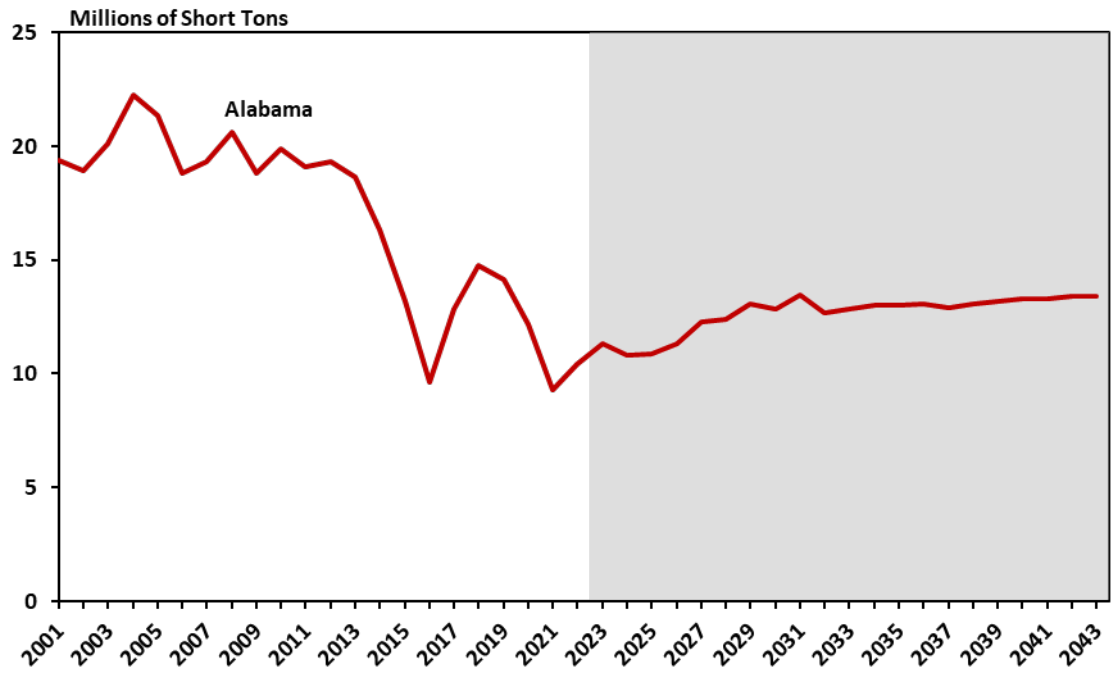


Sources: U.S. Energy Information Administration and WVU Bureau of Business & Economic Research
Note: Shaded area indicates forecast.

Unlike most other regions in Appalachia, Alabama in the Southern Appalachia subregion saw coal production drop in 2021. Production rose slightly in 2022 and is expected to rise again in 2023. We expect production to fluctuate but trend upward through around 2040 before staying relatively flat through 2043 (Figure 15).

There is always significant uncertainly given volatility in global steel demand. In the longer term, global economic growth will inevitably push steel demand higher, but capacity constraints at regional ports and production cost disadvantages compared to global coal powers will limit growth overall.

Figure 15: Coal Production Forecast, Southern Appalachia



Sources: U.S. Energy Information Administration and WVU Bureau of Business & Economic Research
Note: Shaded area indicates forecast.

Chapter 3: Appalachia's Economic Performance

In the previous sections we examined recent trends in coal production and employment and learned that Appalachia experienced a steep drop in coal production and employment over the last decade, from around 2010 through 2021. Moreover, we also learned that the drop in coal production and employment is more pronounced in Appalachian coal counties when compared with Appalachian non-coal counties and the rest of the nation. The drops in coal production and employment are also more pronounced in the Central Appalachia subregion when compared with the Northern and Southern Appalachia subregions.

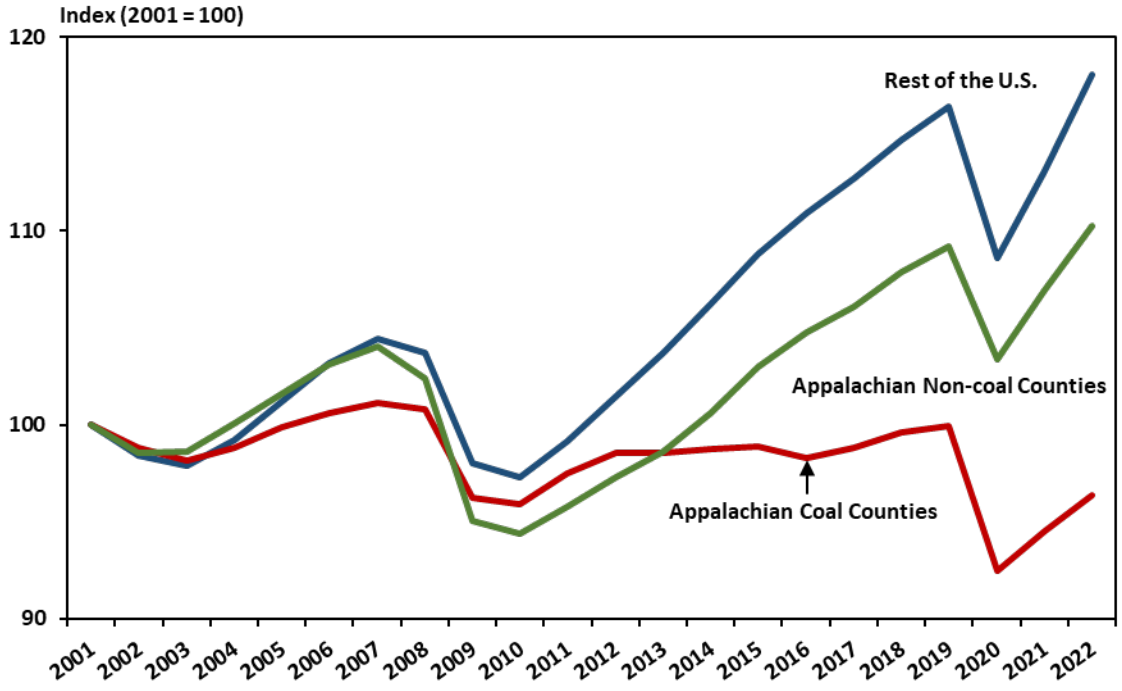
In this section, we examine trends in economic performance of these geographies during the same period. More specifically, we want to examine if the sharp declines in coal production and employment in the last decade affect the regions' overall economic performance. Naturally, we expect to see that regions with larger coal mining industry shares of total employment will likely be more affected by the decline than other regions. For that reason, it is important to note that as of 2010, which was around the coal employment peak, Appalachia's coal mining share of total employment (1.7 percent) was well above the rest of the nation's (less than 0.1 percent). Similarly, in that same year, Central Appalachia's coal employment share (7 percent) was well above the less than one percent shares in both the Northern and Southern Appalachia subregions.[6]

We look at a variety of measures of economic performance including overall employment, unemployment, population, labor force, wages and salaries, poverty, educational attainment, and mortality rates.

[6] These employment shares are estimated by dividing coal mining employment from the U.S. Mine Safety and Health Administration (MSHA) by all private industries employment from the U.S. Bureau of Labor Statistics.

OVERALL EMPLOYMENT: In Figure 16 we examine broader trends in employment in Appalachia. More specifically, we present total private sector employment trends for Appalachian coal counties, Appalachian non-coal counties, and the rest of the United States. As depicted, total private sector employment in Appalachian coal counties was relatively flat between 2012 and 2019, while that in Appalachian non-coal counties and the rest of the United States increased substantially. This evidence suggests that coal production decline causes not only a significant direct employment loss in the coal industry but also an employment loss in other industries that are related to coal. Both effects have suppressed the overall employment growth in the Appalachian coal counties. Total private sector employment in the three geographies dropped sharply in 2020 because of the COVID-19 pandemic. Employment rose in 2021 and 2022 as the U.S. economy recovered from the pandemic. In 2022 the employment level in Appalachian non-coal counties and the rest of the U.S. had surpassed the 2019 level before the pandemic. In contrast, the employment level in the Appalachian coal counties was still well below the 2019 level.

Figure 16: Private Sector Employment, Appalachian Coal Counties, Appalachian Non-coal Counties, and the Rest of the United States

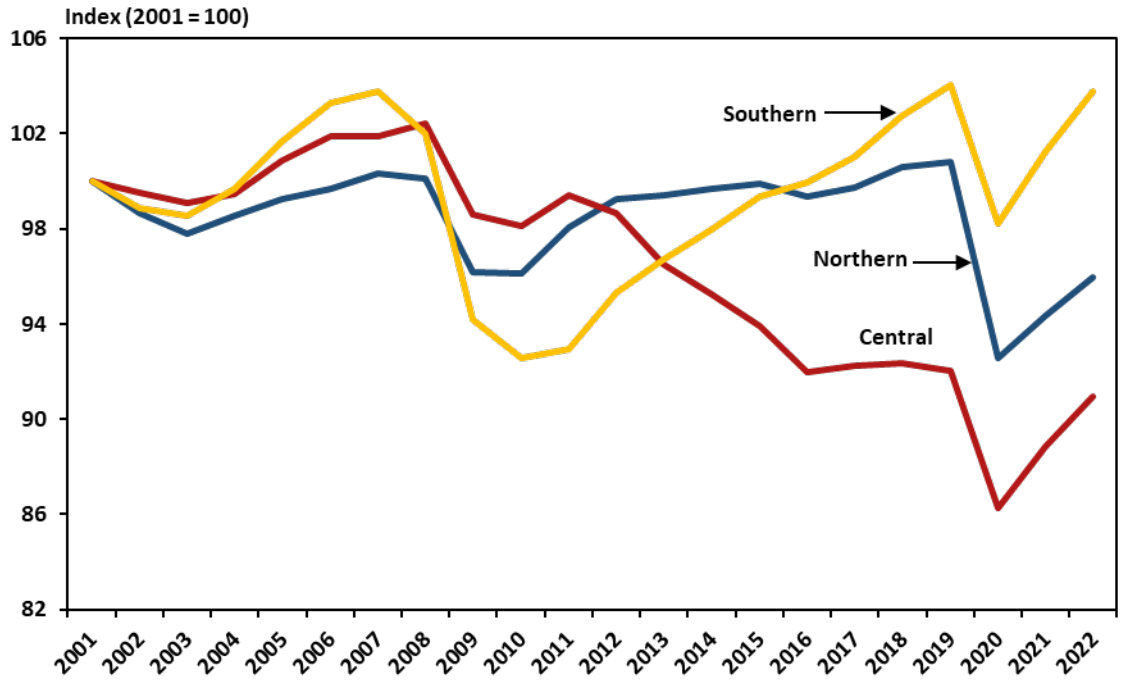


Source: Quarterly Census of Employment and Wages (QCEW), U.S. Bureau of Labor Statistics
Note: 2022 figures are January through September averages.

In Figure 17 we report total private sector employment for the three Appalachian coal-producing subregions. As shown, while total private sector employment continued to increase in Northern and Southern Appalachia subregions between 2011 and 2019, it dropped sharply instead in Central Appalachia. These trends agree with what we expect to find considering Central Appalachia's significantly bigger share of coal mining employment than the other two Appalachian coal-producing subregions.

In 2020, private sector employment in each of the three regions dropped sharply, mainly because of the COVID-19 pandemic. Employment rose in 2021 and 2022 but it was still below the level in 2019, primarily in the Northern and Central Appalachia.

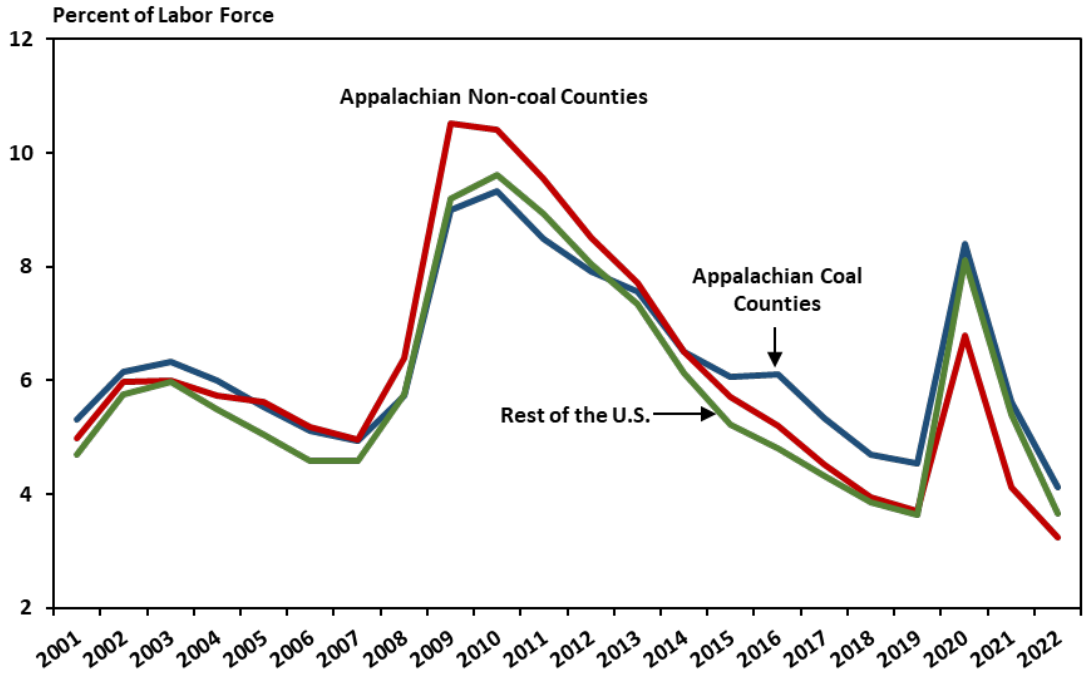
Figure 17: Private Sector Employment, Appalachian Coal-producing Subregions



UNEMPLOYMENT: In Figure 18 we report the incidence of unemployment in Appalachian coal counties, Appalachian non-coal counties, and the rest of the United States. The three geographies exhibited similar fluctuations of unemployment rates over the last two decades. The national recession that started at the end of 2007 caused unemployment rates in the three geographies to rise sharply in the second half of 2000s, though they then dropped sharply through 2022. While the three geographies show the same declining trends in unemployment rate, the reasons for the decline, however, could be different. Two major factors, individually or together, could cause unemployment rate to decline. First, it is an increase in employment. This is the common cause of unemployment rate decline, and it represents growth in the economy. Second, it is labor force exit, which can happen when there is a lack of job opportunities during a downturn.

For both Appalachian non-coal counties and the rest of the nation, the steep decline in unemployment rates from 2010 through 2019 was accompanied by an employment increase (as shown in Figure 12 above). However, during that same period, Appalachian coal counties saw employment stay relatively flat instead. These trends suggest that the unemployment rate decline in Appalachian coal counties over the past decade was more likely driven by labor exit and much less by an employment increase. In 2020, unemployment rates for the three geographies rose sharply because of the COVID-19 pandemic, and then declined again through 2022 as the effect of the pandemic subsided and the economy continued to grow in general.

Figure 18: Unemployment Rate, Appalachian Coal Counties, Appalachian Non-coal Counties, and the Rest of the United States

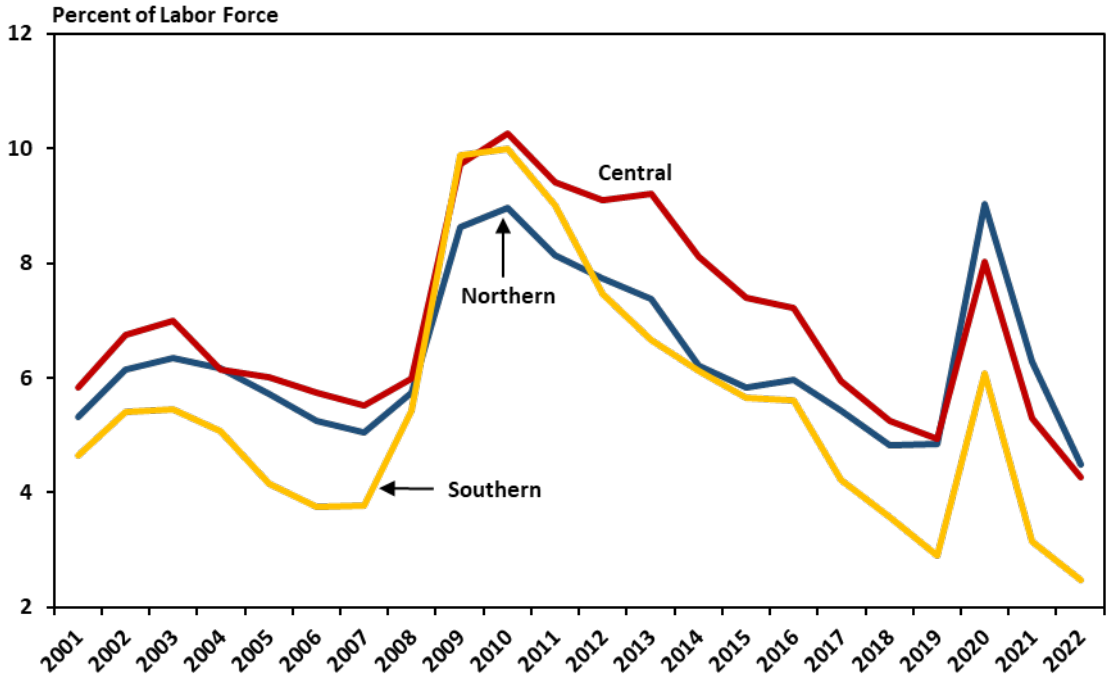


Source: Local Area Unemployment Statistics (LAUS), US Bureau of Labor Statistics
Note: 2022 figures are preliminary.

In Figure 19 we report the unemployment rate for the three Appalachian coal-producing subregions. From 2010 through 2019, the unemployment rate was always higher in Central Appalachia than the other two subregions. During the same period, the unemployment rates in the three subregions continued to decline but, similarly, the reasons for the decline for each of the three subregions were not necessarily the same. During that period the private sector employment declined sharply in Central Appalachia (as shown in Figure 13 above), and so did its labor force (as will be seen in Figure 17 below). Northern Appalachia and Southern Appalachia saw their employment increase. These trends suggest that the unemployment rate decline in Central Appalachia was driven more by labor force exit[7] and much less by employment increase, indicating worsening job opportunities in the subregion.

In 2020, unemployment rates for the three subregions rose sharply because of the COVID-19 pandemic, and then declined again through 2022 as the effect of the pandemic subsided and the economy continued to grow.

Figure 19: Unemployment Rate, Appalachian Coal-producing Subregions

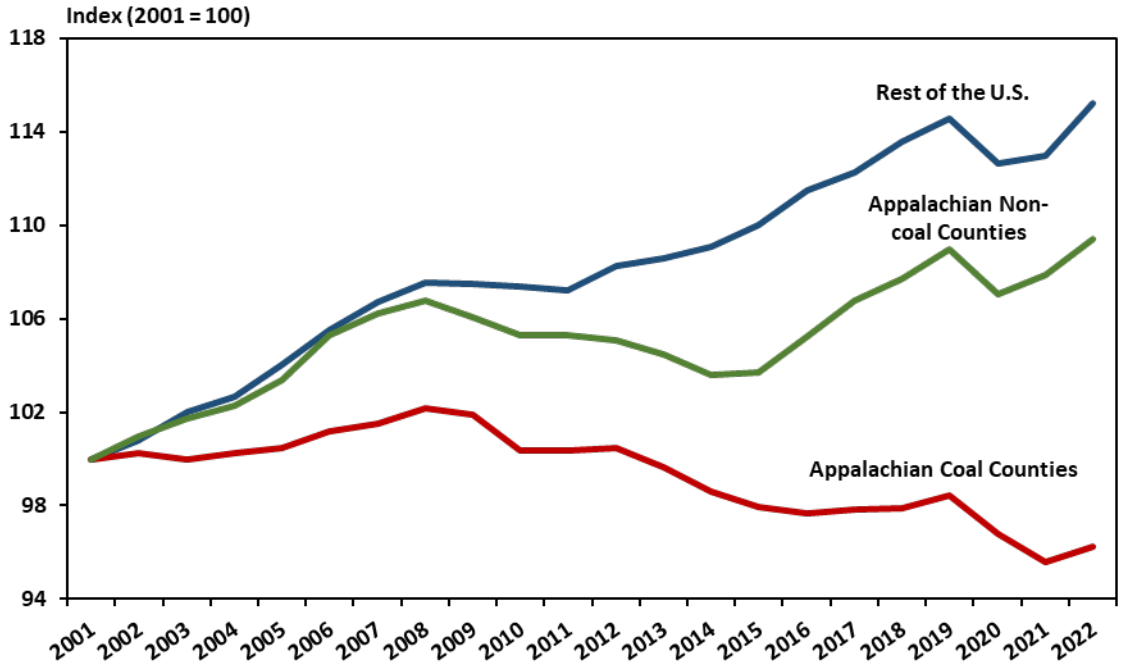


Source: Local Area Unemployment Statistics (LAUS), US Bureau of Labor Statistics
Note: 2022 figures are preliminary.

[7] A labor force exit can be in the form of people moving out of the region or people quitting their search for job.

LABOR FORCE: In Figure 20 we report the labor force trends for Appalachian coal counties, Appalachian non-coal counties, and the rest of the United States. From around 2010 through 2019, the labor force for Appalachian coal counties continued declining, while that for Appalachian non-coal counties declined modestly over the first half of the period then rose back up sharply over the second half of the period. Meanwhile, the labor force for the rest of the nation continued increasing throughout the period. As discussed above, a sustained increase in the labor force combined with a sustained decline in unemployment rate is indicative of economic growth. On the other hand, a sustained decline in both labor force and unemployment rate, like the trends seen in Appalachian coal counties, indicates people are exiting from the region's labor force, which may be the result of a lack of job opportunities in the region.

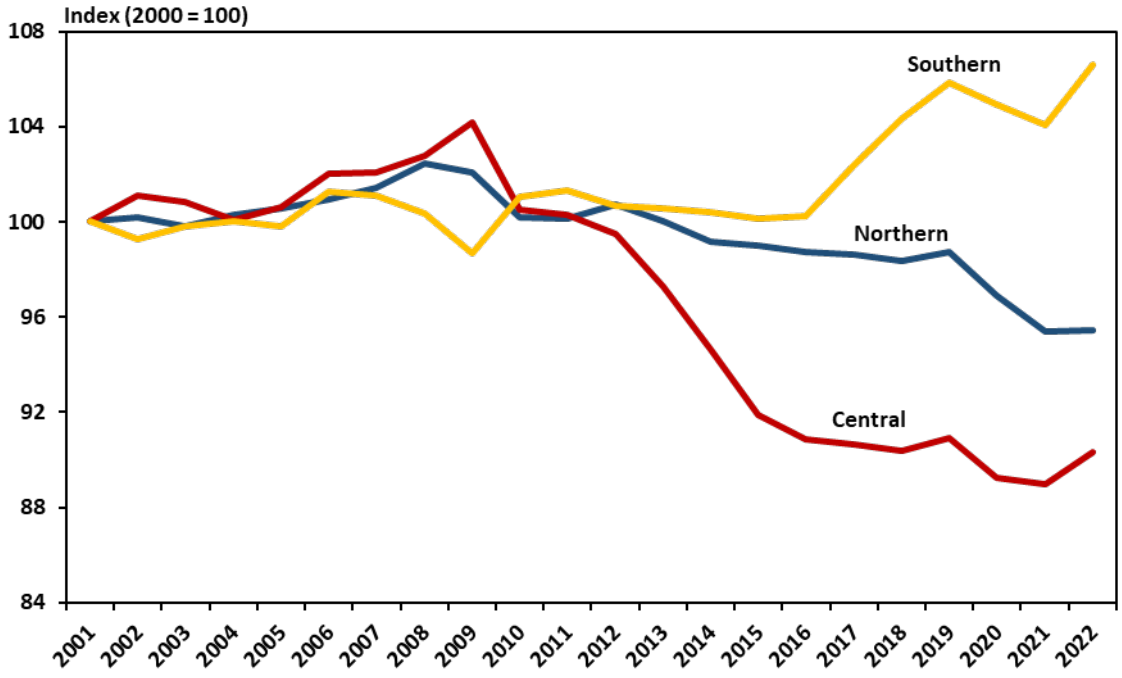
Figure 20: Civilian Labor Force, Appalachian Coal Counties, Appalachian Non-coal Counties, and the Rest of the United States



Source: Local Area Unemployment Statistics, U.S. Bureau of Labor Statistics
Note: 2022 figures are preliminary.

In Figure 21 we show the labor force trends for three Appalachian coal-producing subregions. Here we see an extremely sharp drop in the labor force in Central Appalachia from 2010 to 2019, and only a moderate decline in Northern Appalachia. In contrast, the labor force in Southern Appalachia increased during the same period. We learned from Figure 15 above that unemployment rate for the three subregions declined during the same period. These trends suggest that compared with the other two coal-producing subregions, Central Appalachia had the biggest rate of labor force exit, which indicates the subregion's lack of job opportunities during that period.

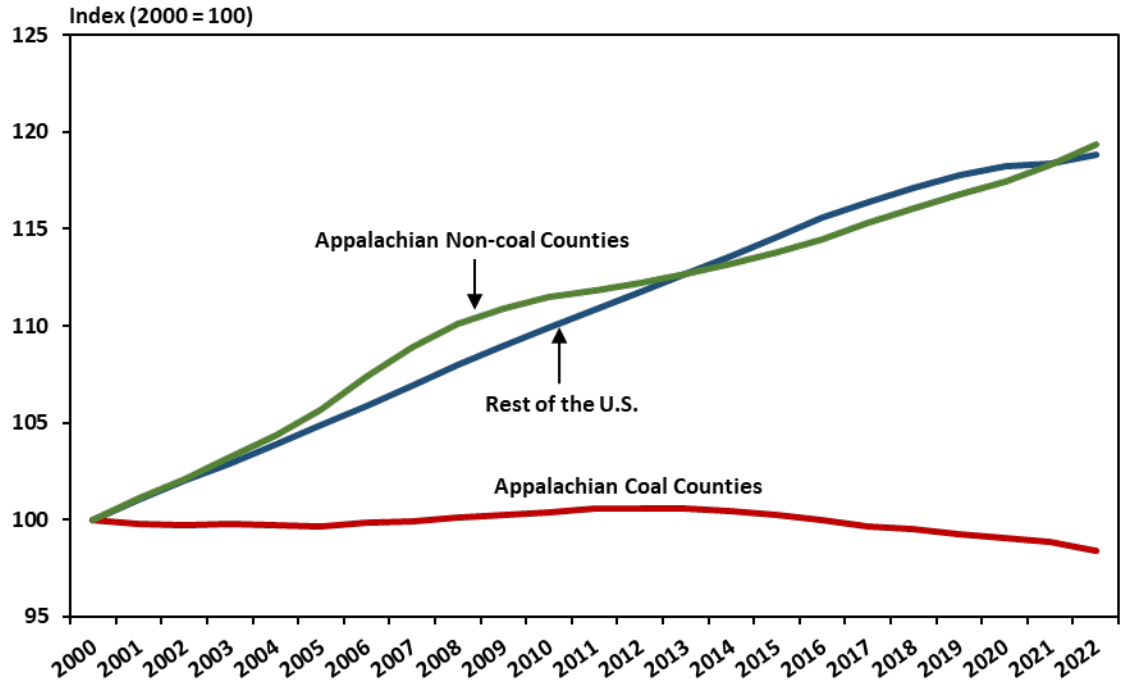
Figure 21: Civilian Labor Force, Appalachian Coal-producing Subregions



Source: Local Area Unemployment Statistics, U.S. Bureau of Labor Statistics
Note: 2022 figures are preliminary.

POPULATION: In this section we turn to population change in Appalachia, as this may also be affected by the coal industry. In Figure 22 we report the change in total population for Appalachian coal counties, Appalachian non-coal counties, and the rest of the United States. Here we see that Appalachian coal counties have seen a population decline since 2010, while Appalachian non-coal counties and the rest of the U.S. have seen population increases over the same period. These trends suggest the sharp decline in coal production in the last decade may have also suppressed the population growth in Appalachian coal counties.

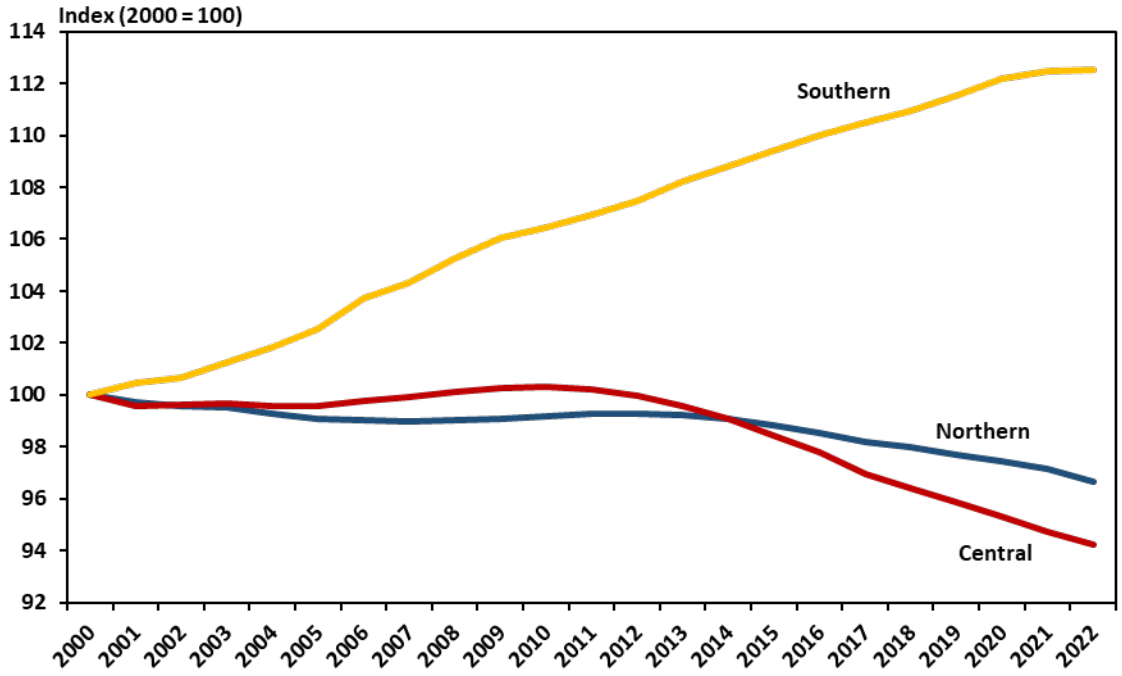
Figure 22: Total Population, Appalachian Coal Counties, Appalachian Non-coal Counties, and the Rest of the United States



Source: 2000-2009 Intercensal and 2022 Population Estimates, U.S. Census Bureau and 2010-2019 Intercensal, Authors' calculations.

In Figure 23 we report trends in population for the three Appalachian coal-producing subregions. Here Central Appalachia has seen a relatively sharp population decline over the past decade. This compares with a more gradual decline in Northern Appalachia and strong growth in Southern Appalachia.

Figure 23: Total Population, Appalachian Coal-producing subregions

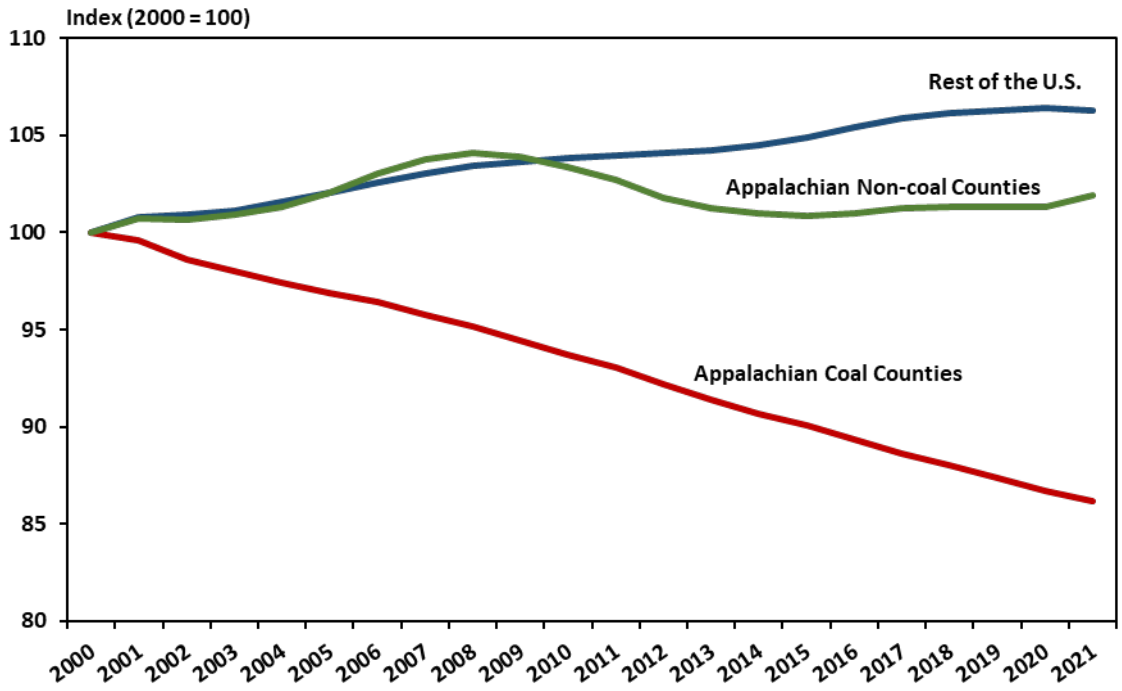


Source: 2000-2009 Intercensal and 2022 Population Estimates, U.S. Census Bureau and 2010-2019 Intercensal, Authors' calculations.

PRIME WORKING-AGE POPULATON: In Figure 24 we report trends in the prime working population (people ages 25 to 54) for Appalachian coal counties, Appalachian non-coal counties, and the rest of the United States. Declines in the coal industry that lead to population losses will likely affect the prime working-age population more so than the older segments of the population. As shown, the loss of the prime-age population for Appalachia coal counties started as early as 2000 and intensified over the last decade. Between 2000 and 2021, the prime working population in Appalachian coal counties declined by around 14 percent, much bigger than the approximately 2 percent decline in total population depicted in Figure 22 above.

The Appalachian non-coal counties, on the other hand, did not see a decline in prime working-age population until 2009. The loss was also much more moderate than in the Appalachian coal counties. The rest of the United States saw a continued increase of its prime working-age population over the past two decades.

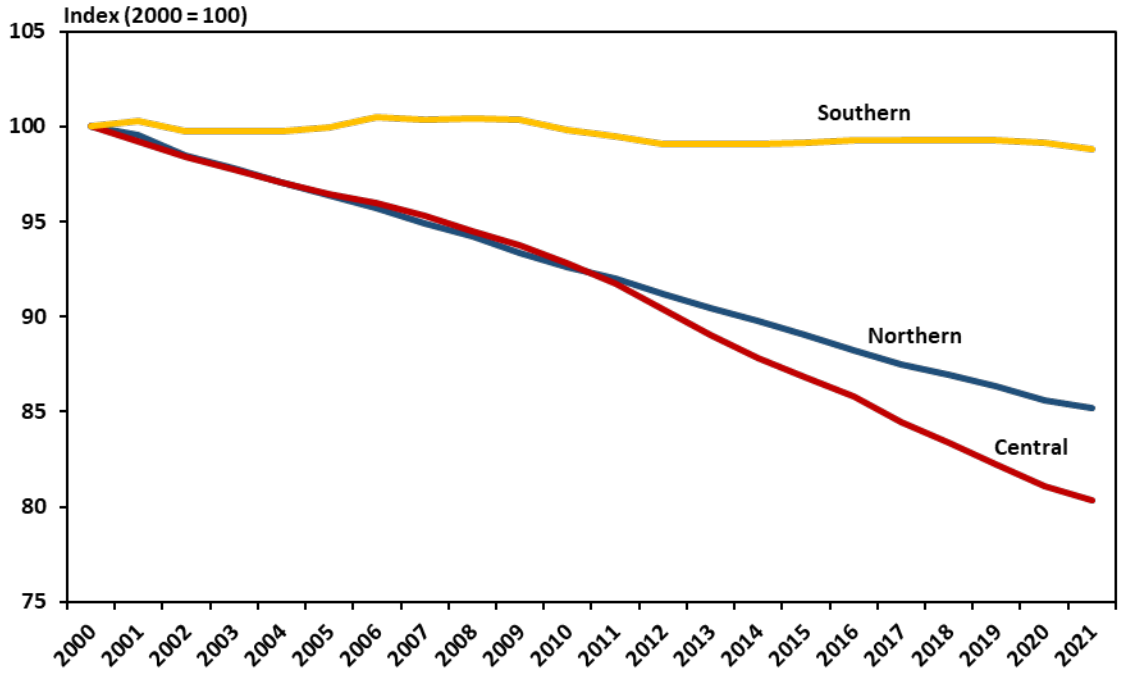
Figure 24: Population 25-54 Years Old, Appalachian Coal Counties, Appalachian Non-coal Counties, and the Rest of the United States



Source: 2000-2009 Intercensal and 2021 Population Estimates, U.S. Census Bureau and 2010-2019 Intercensal, Authors' calculations.

In Figure 25 we report trends in the prime working-age population for three Appalachian coal-producing subregions. As shown, the prime working-age population in the three coal producing subregions dropped sharply in the last decade. The loss has been more pronounced in Central Appalachia than in the Northern Appalachia and Southern Appalachia coal-producing subregions.

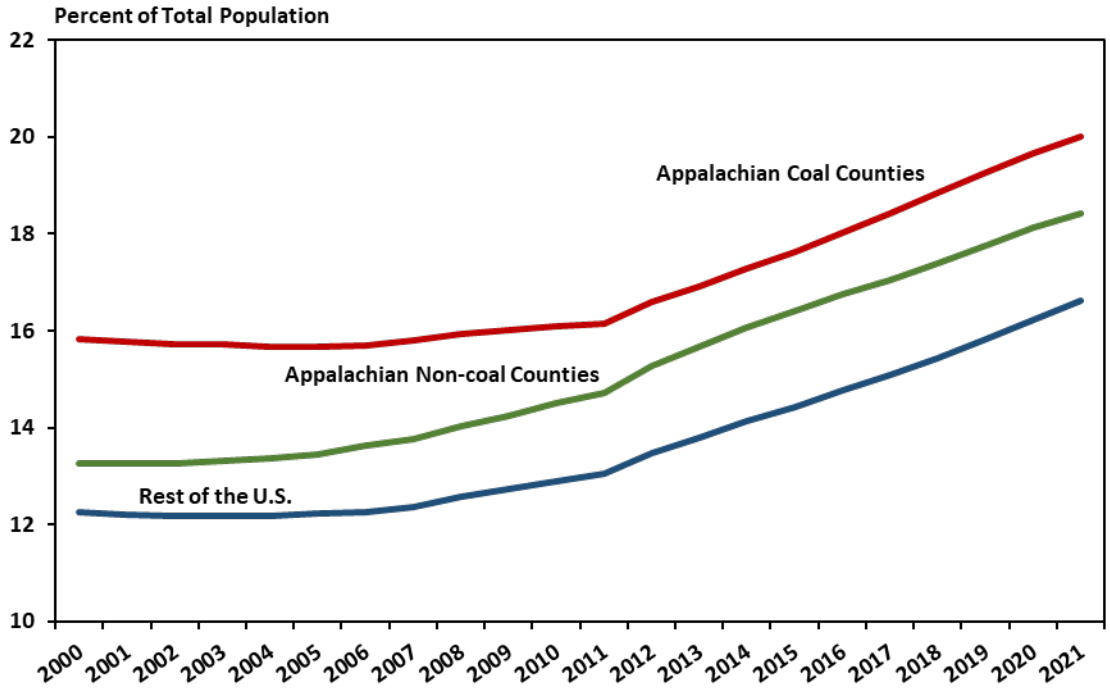
Figure 25: Population 25-54 Years Old, Appalachian Coal-producing Subregions



Source: 2000-2009 Intercensal and 2021 Population Estimates, U.S. Census Bureau and 2010-2019 Intercensal, Authors' calculations.

POPULATION 65 YEARS OR OLDER: In light of the losses among the prime working population, it stands to reason that population in the Appalachian coal-producing counties is getting older on average. Figure 26 shows the share of the population that is 65 years old or older, which we also refer to as the retirement-aged population, in the Appalachian coal counties, Appalachian non-coal counties, and the rest of the United States. As illustrated, the shares for all the three geographies have increased over the last two decades, but particularly so over the most recent ten-year period. Appalachian coal counties have consistently had a higher share of its population 65 years or older, increasing from nearly 16 percent in 2000 to 20 percent in 2021.

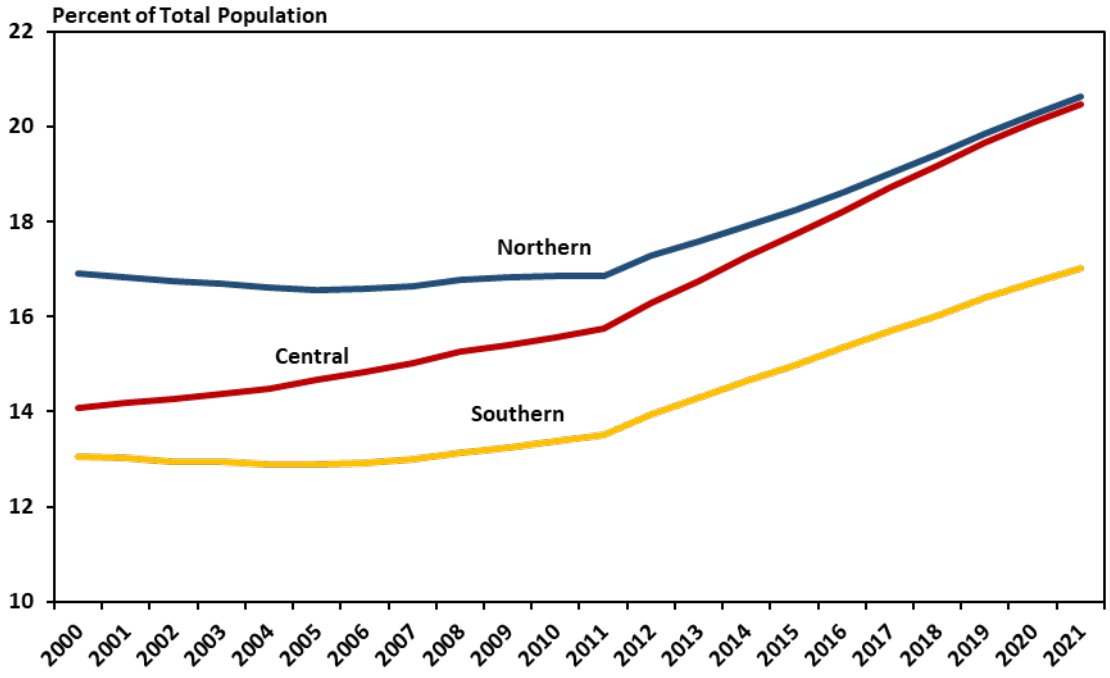
Figure 26: Share of Population 65 Years or Older, Appalachian Coal Counties, Appalachian Non-coal Counties, and the Rest of the United States



Source: 2000-2009 Intercensal and 2021 Population Estimates, U.S. Census Bureau and 2010-2019 Intercensal, Authors' calculations.

In Figure 27 we report the retirement-age population share for the three Appalachian coal-producing subregions. Similarly, the shares of the retirement-age population in the three subregions have increased over the last two decades, and they all increased faster over the last decade. More specifically, from 2011 through 2021 the share for Central Appalachia subregion rose by 4.7 percentage points, faster than Northern Appalachia, which increased by 3.8 percentage points, and Southern Appalachia, which increased by 3.5 percentage points.

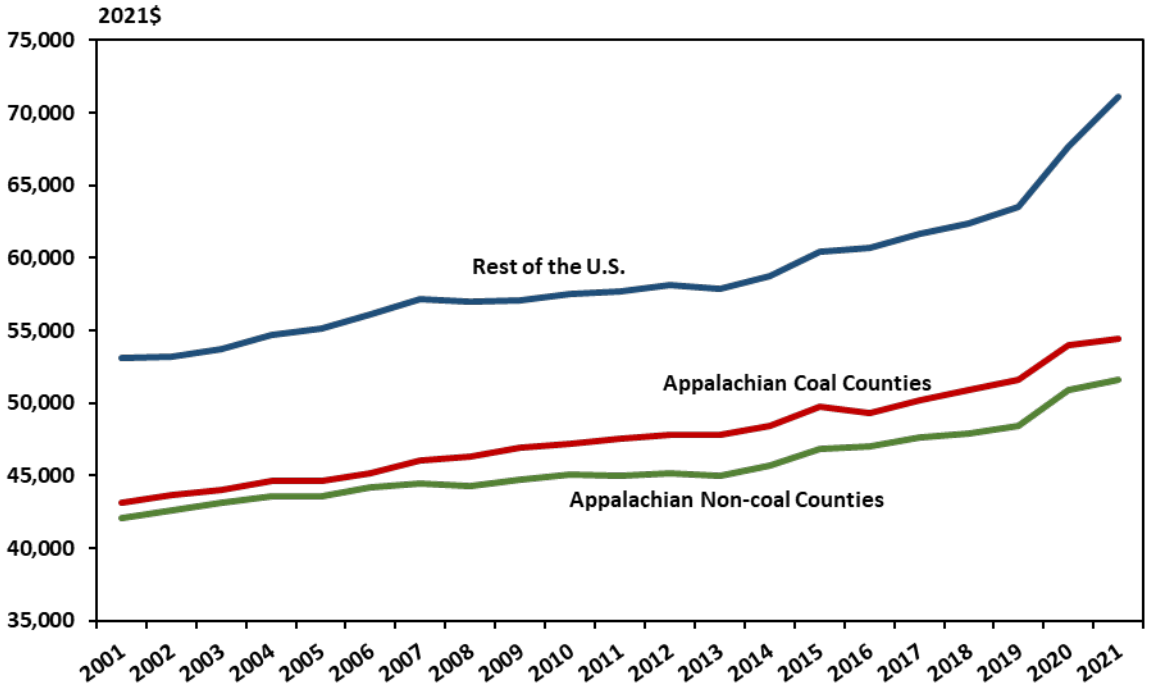
Figure 27: Share of Population 65 Years or Older, Appalachian Coal-producing Subregions



Source: 2000-2009 Intercensal and 2021 Population Estimates, U.S. Census Bureau and 2010-2019 Intercensal, Authors' calculations.

WAGE AND SALARY INCOME: In this section we turn to income earned in the Appalachian coal counties, Appalachian non-coal counties, and the rest of the United States. Figure 28 shows that wages and salaries per job are higher in Appalachian coal counties compared to Appalachian non-coal counties. This is likely the result of two conditions. First, wages and salaries for coal mining jobs in Appalachia are significantly higher than the average wages and salaries in the Region, and second, Appalachian coal counties have a substantially larger share of coal mining jobs than Appalachian non-coal counties. However, wages and salaries in both Appalachian coal counties and Appalachian non-coal counties stand well below wages and salaries in the rest of the United States.

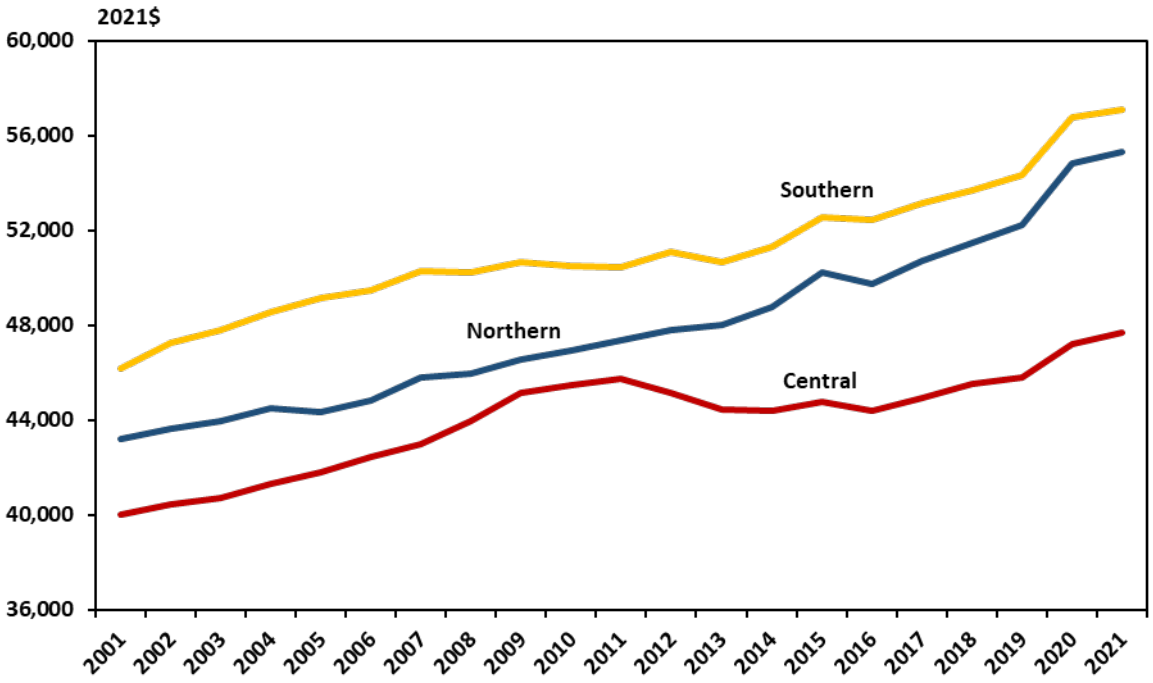
Figure 28: Wage and Salary per Job, Appalachian Coal Counties, Appalachian Non-coal Counties, and the Rest of the United States



Source: U.S. Bureau of Economic Analysis

Figure 29 shows wages and salaries per job across three Appalachian coal-producing subregions. Here we see that wages and salaries have been substantially lower in Central Appalachia since 2001. More importantly, while wages and salaries constantly increased from 2001 through 2021 in Northern Appalachia and Southern Appalachia, there's been little growth in Central Appalachia since 2012. After 2012, wages and salaries in Northern Appalachia and Southern Appalachia increased much faster than that in Central Appalachia. As a result, the gap in wages and salaries between Central Appalachia and the other two subregions has grown larger since 2012.

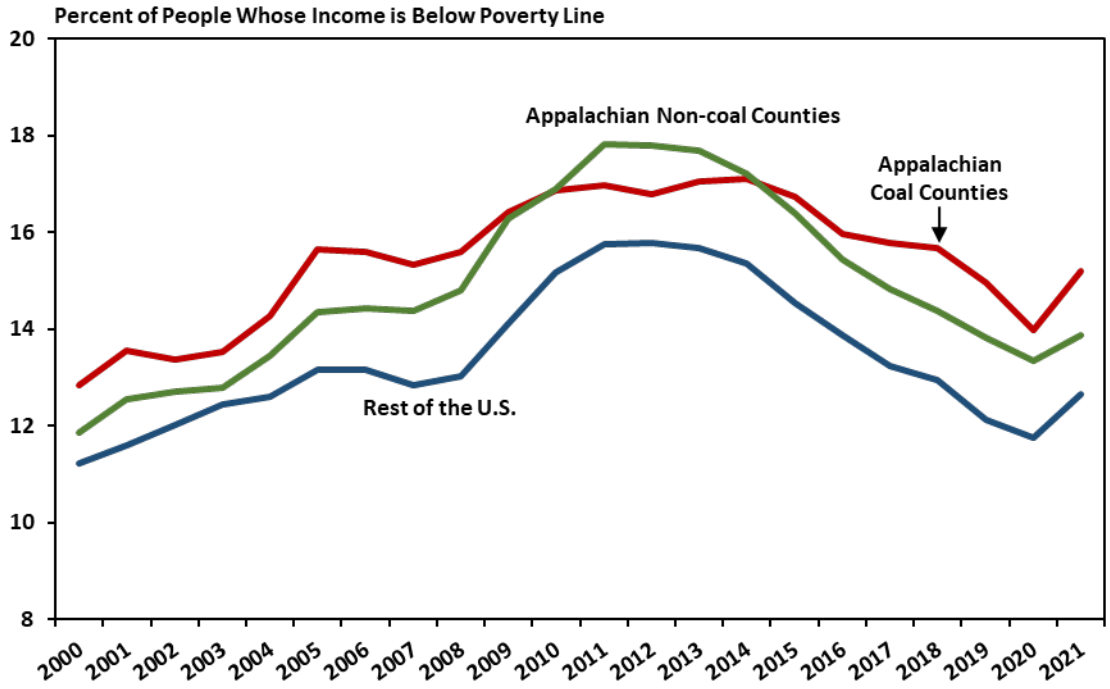
Figure 29: Wage and Salary per Job, Appalachian Coal-producing Subregions



Source: U.S. Bureau of Economic Analysis

POVERTY: In this section we compare the poverty rate in Appalachian coal counties, Appalachian non-coal counties, and the rest of the United States. As shown in Figure 30, the poverty rate is consistently higher in both Appalachian coal counties and Appalachian non-coal counties than the rest of the nation. Poverty rates for the three geographies increased substantially from 2000 to 2012 before gradually improving over the past decade. The improvement, however, was slower in Appalachian coal counties than the other two geographies. Among the three geographies, the poverty rate has been highest in Appalachian coal counties since 2015. Poverty rate increased sharply in 2021 in the three geographies, which likely showed the lingering effects of the COVID-19 pandemic on the economy.

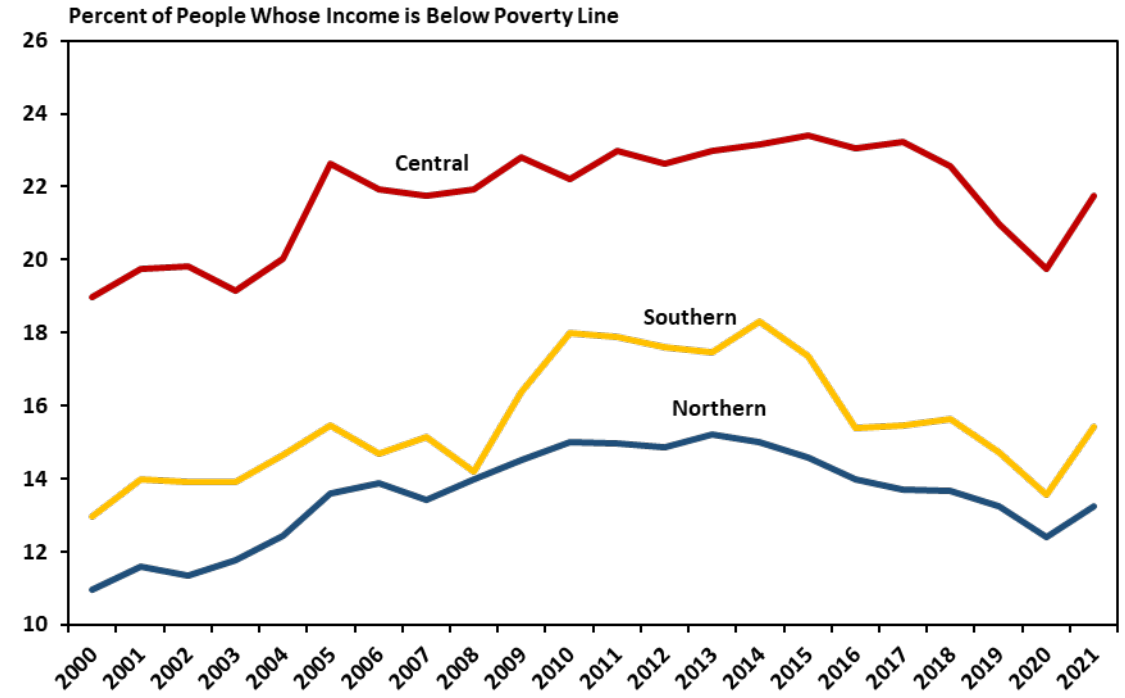
Figure 30: Poverty Rate, Appalachian Coal Counties, Appalachian Non-coal Counties, and the Rest of the United States



Source: Small Area Income and Poverty Estimates, U.S. Census Bureau

In Figure 31 we report the poverty rate for the three Appalachian coal-producing subregions. Consistent with many of the socioeconomic performances noted above, the poverty rate is substantially higher in Central Appalachia than in the Northern and Southern Appalachia subregions.

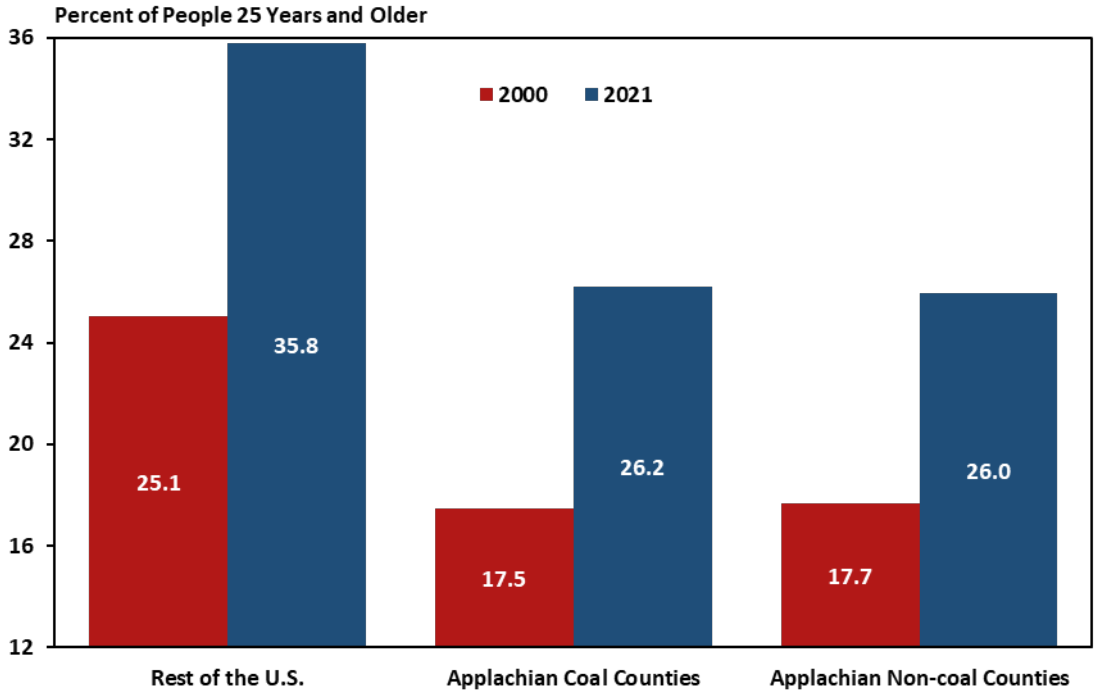
Figure 31: Poverty Rate, Appalachian Coal-producing Subregions



Source: Small Area Income and Poverty Estimates, U.S. Census Bureau

EDUCATION: Figure 32 shows that the overall educational attainment is lower in Appalachia—both the Appalachia coal counties and Appalachian non-coal counties—compared to the rest of the United States. However, like the rest of the nation, Appalachia has made a significant improvement in education over the last two decades. The share of people 25 years of age or older that has at least a bachelor's degree in both Appalachian coal counties and non-coal counties have increased from around 17 percent in 2000 to around 26 percent in 2021.

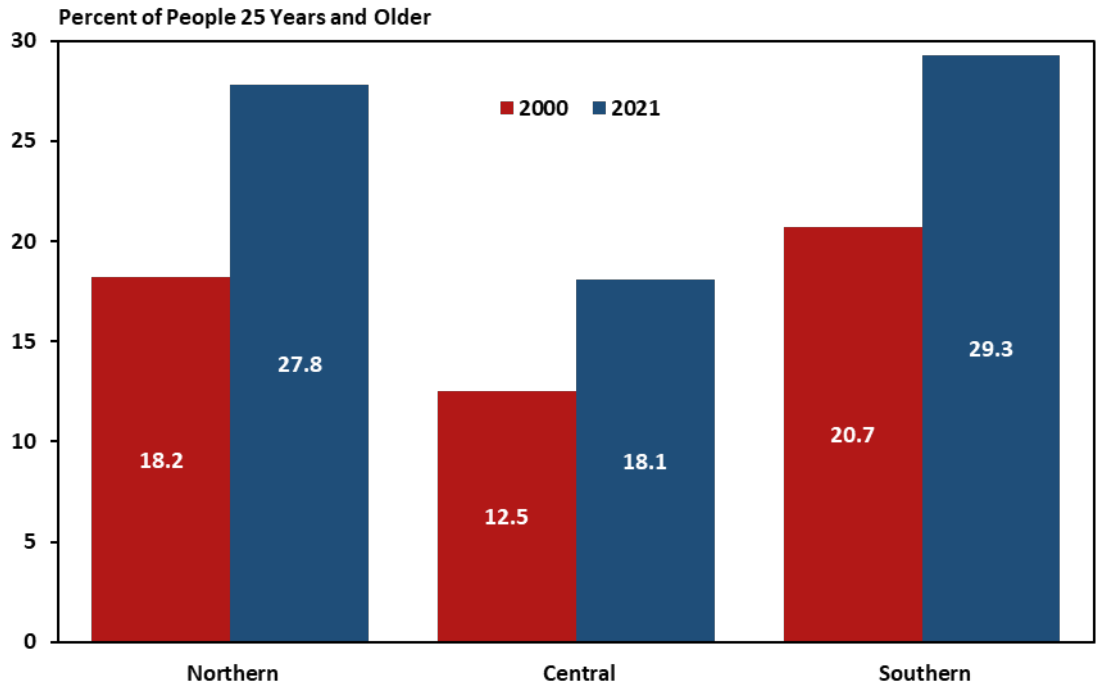
Figure 32: Attainment of a Bachelor's Degree or Higher, Appalachian Coal Counties, Appalachian Non-coal Counties, and the Rest of the United States



Sources: SF-3 2000 Census and 2021 American Community Survey 5-Year Estimates, U.S. Census Bureau

Rates of educational attainment among the three Appalachian coal-producing subregions vary. In Figure 29 we observe that the Central Appalachia subregion has a much lower share of its population that has at least a bachelor's degree than the other two coal-producing subregions. While all three coal-producing subregions have made significant improvement in educational attainment between 2000 and 2021, the share of those with a bachelor's degree or higher has remained the lowest in Central Appalachia.

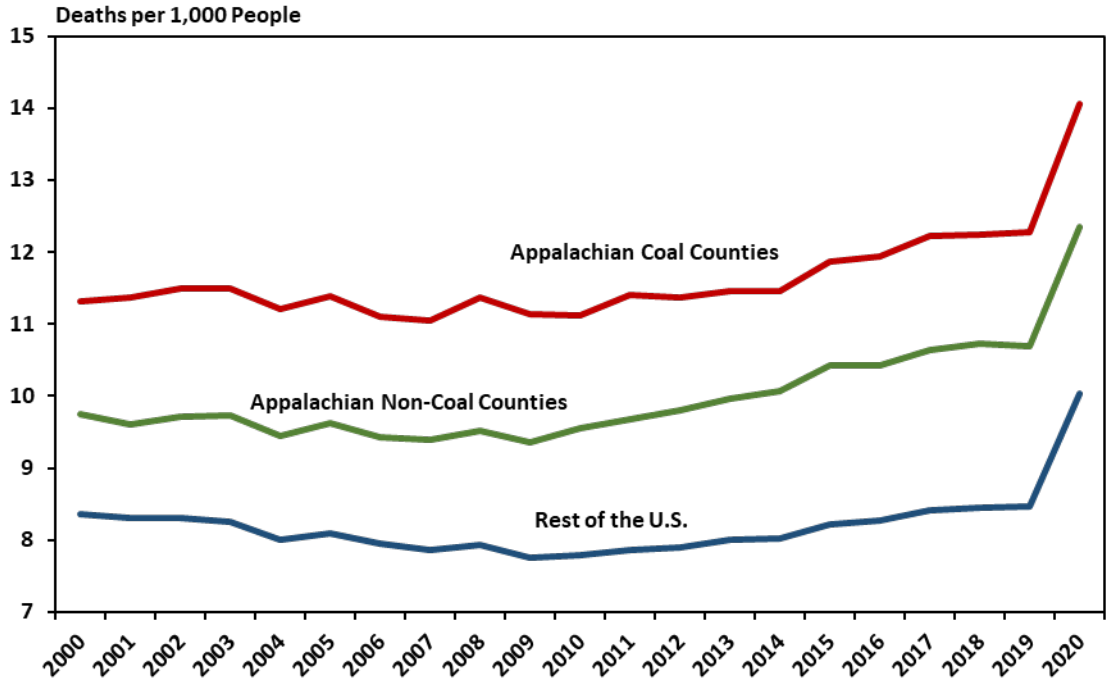
Figure 33: Attainment of a Bachelor's Degree or Higher, Appalachian Coal-producing Subregions



Sources: SF-3 2000 Census and 2021 American Community Survey 5-Year Estimates, U.S. Census Bureau

HEALTH: We close with a brief examination of health outcomes in Appalachia. Figure 34 shows that Appalachian coal counties have substantially higher mortality rates than Appalachian non-coal counties and the rest of the nation. Mortality rates in the three geographies have started increasing since 2011. The rates increased sharply in 2020 because of the COVID-19 pandemic. As these mortality rates reflect deaths from all causes and are not age-adjusted, these rates are likely influenced in part by higher levels of population 65 years or older, but there are likely other factors at play, as well.

Figure 34: Mortality Rate, Appalachian Coal Counties, Appalachian Non-Coal Counties, and the Rest of the United States

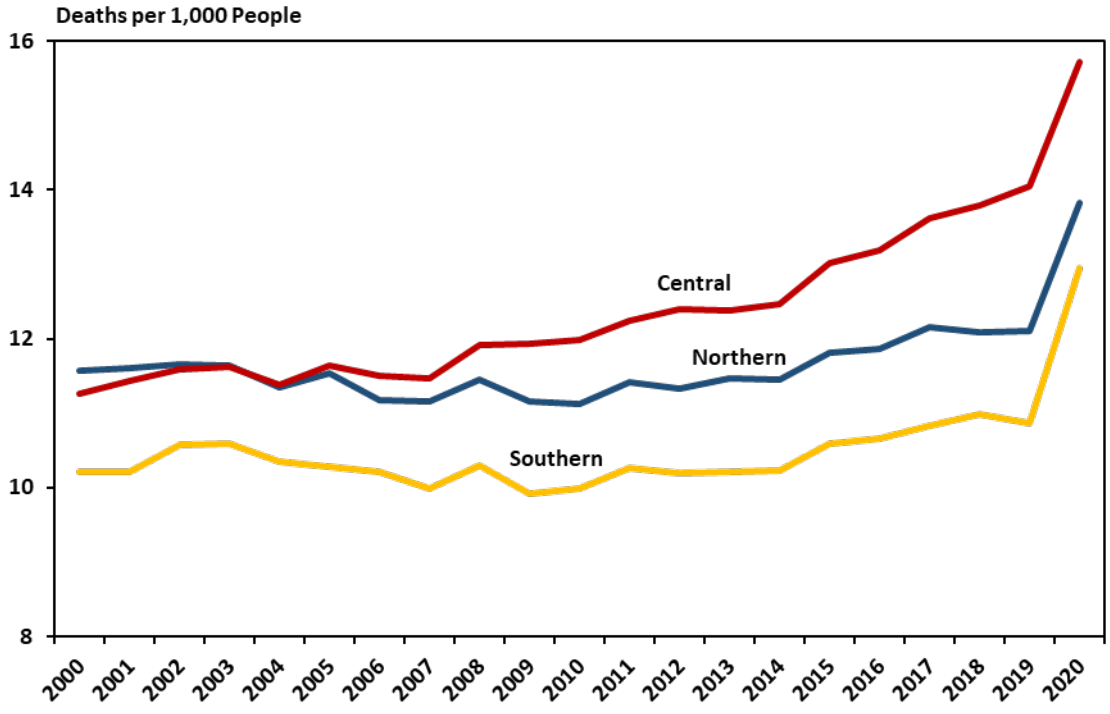


Source: U.S. Centers for Disease Control and Prevention
Note: Rates are not age-adjusted.

Figure 35 shows that Central Appalachia has had a higher mortality rate than the other two coal-producing subregions since 2005. Mortality rates have risen in all three subregions since around 2010, but the increase has been larger in Central Appalachia than the other two subregions. As a result, the gap in mortality rate between Central Appalachia and the other two subregions has increased over time.

In 2020, mortality rates in the three subregions increased sharply because of the COVID-19 pandemic. In that year, Central Appalachia recorded a mortality rate of nearly 16 deaths per 1,000 people, which was higher than Northern Appalachia and Southern Appalachia, with nearly 14 and 13 deaths per 1,000 people, respectively.

Figure 35: Mortality Rate, Appalachian Coal-producing Subregions



Source: U.S. Centers for Disease Control and Prevention
Note: Rates are not age-adjusted.