



Appalachian Development Highway System Economic Analysis Study: Synthesis of Findings to Date



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Appalachian Regional Commission

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EXECUTIVE SUMMARY

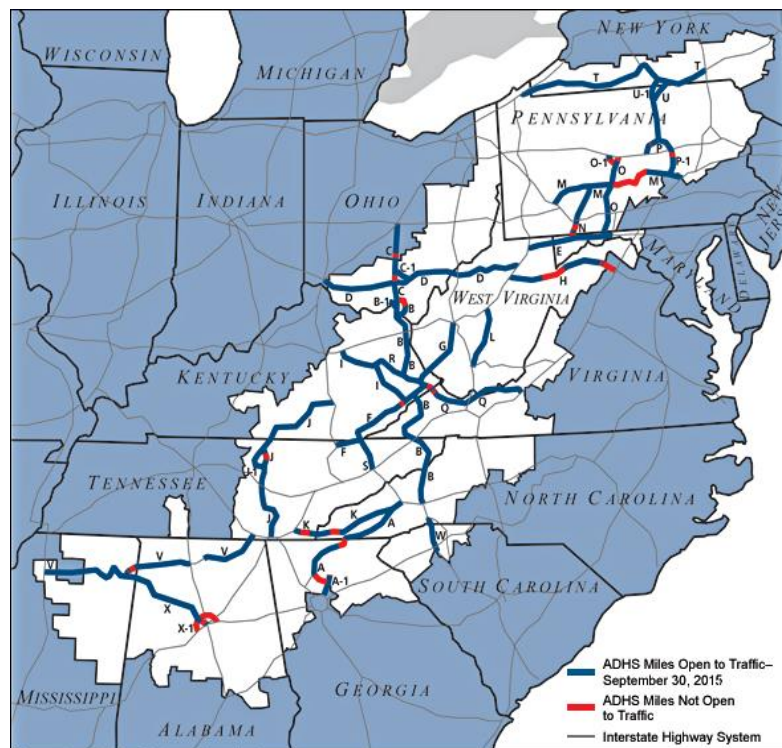
Overview. This report reviews and summarizes the findings of previously published studies on the impacts of the Appalachian Development Highway System (ADHS) on economic growth and transportation connectivity in Appalachia. The collective findings of these reports cover a wide-range of topics including: (a) research on the ADHS role in regional economic growth and development, (b) case studies of impacts associated with specific ADHS corridor projects and their connection to multi-modal transportation facilities, and (c) emerging issues concerning the role of the ADHS network in enabling national highway connectivity and an emerging intermodal freight system.

This is the first volume in an ongoing study that more broadly analyzes the ways that ADHS development has affected economic growth in Appalachia, and the future economic benefits and costs of completing the ADHS.

Background. The ADHS is a federally designated 3,090-mile network of modern highways, comprising 32 highway corridors spread across 13 states. It is designed to link isolated and economically distressed areas of Appalachia to the Interstate Highway System and major economic markets. Development of this network was originally authorized by a broad bipartisan majority of Congress in 1965, under the Appalachian Regional Development Act of 1965. This legislation set up the Appalachian Regional Commission (ARC), and it also designated the ADHS as a key element of ARC's strategy to grow and diversify economic opportunities in a region underserved by transportation.

Research Importance. Today, fifty years after its authorization by Congress, almost 88 percent of eligible ADHS mileage has been built (open to traffic) with another 76.7 miles under construction.¹ The process of completing the entire ADHS has been slow, in part because of the high cost and environmental sensitivity of completing highways in a region marked by mountainous terrain. At the same time, the extent of long-term poverty in this region and the implications of improved accessibility enabled by ADHS corridors are of a large scale. As a result, both the potential costs and benefits for completion of the ADHS system are large and very meaningful for both the Appalachia Region and the U.S. That is the reason why research findings on the

Appalachian Development Highway System



¹ As of September 30, 2015: <http://www.arc.gov/images/programs/transp/ADHSFY2015StatusReport.pdf>

actual ADHS economic and transportation impacts to date are so important, and relevant to the Region's plans to complete the ADHS.

Key Findings

- 1) ***The role of the ADHS in enabling economic development is well documented.*** Several historical studies have traced the processes whereby ADHS corridor completion to date has had a clearly observable effect on diversifying the economy of many parts of Appalachia, and played a pivotal role (along with other ARC programs) in helping to reduce poverty in the Region. However, the ADHS network is not complete and significant pockets of poverty still remain.
- 2) ***There is strong evidence of a positive relationship between completion of ADHS segments and subsequent economic activity growth at a county level.*** A series of statistical studies have shown that these impacts are statistically significant and particularly large for economically distressed counties. These are statistical relationships across all Appalachian counties, which means that not every distressed county will automatically grow just because ADHS segments are complete.
- 3) ***Different parts of Appalachia benefit from ADHS corridor completion in different ways.*** A series of case studies show that some areas have been able to boost tourism, others have seen industrial activity grow, and yet others have seen commercial/retail activity expand. Some areas have seen strong economic growth and others are still waiting for major economic growth to occur. The effects depend on the nature of the specific corridor, its population and workforce, its current economic profile and its location relative to surrounding business centers and markets.
- 4) ***The importance of ADHS network connectivity is receiving increased attention as businesses move towards more dependence on national and global markets.*** Public and private organizations are actively working to invest in intermodal transfer facilities and global gateways both within and surrounding the Region, and this is increasing attention to the issue of how Appalachian communities connect not only to the interstate highway network, but also to intermodal rail, air and marine transportation facilities.
- 5) ***Completion of remaining elements of the ADHS depends on complex issues, requiring more attention to the costs and stakes involved.*** Future research, grounded in the findings of ADHS impacts to date, should help to provide more information concerning the economic consequences of ADHS project acceleration or delay.

1. INTRODUCTION

Overview. This report reviews and summarizes the findings of previously published studies on the impacts of the Appalachian Development Highway System (ADHS) on economic growth and transportation connectivity in Appalachia. It reviews the collective findings of previously published reports. This is the first volume in an ongoing study that more broadly analyzes the ways that ADHS development has affected economic growth in Appalachia, and the future economic benefits and costs of completing the ADHS.

Background: ADHS Development. The ADHS is a designated 3,090-mile network of modern highways, comprising 32 highway corridors spread across 13 states. It is designed to link isolated and economically depressed areas of Appalachia to the Interstate Highway System and major economic markets. Development of this network was originally authorized by a broad bipartisan majority of Congress in 1965, under the Appalachian Regional Development Act of 1965.² This legislation set up the Appalachian Regional Commission (ARC) to address persistent poverty and economic isolation in the Region. It also designated the ADHS as a key element of ARC's strategy to grow and diversify economic opportunities for a region underserved by transportation:

"In order to provide a highway system which, in conjunction with the Interstate System and other Federal-aid highways in the Appalachian region, will open up an area or areas with a developmental potential where commerce and communication have been inhibited by lack of adequate access, the Secretary of Transportation... is authorized to assist in the construction of an Appalachian development highway system and local access roads serving the Appalachian region... Construction of local access roads... will serve specific recreational, residential, educational, commercial, industrial, or other like facilities or will facilitate a school consolidation program." (Appalachian Regional Development Act of 1965)

Economic Development Goals. ARC staff and economic developers in the Region recognized that the process of opening up access to isolated areas, as referenced in the legislation establishing the ADHS, would help increase job and income opportunities for residents of the Region in several distinct ways by: a) expanding labor market opportunities, b) expanding access to broader domestic and international business markets, and c) expanding connectivity to intermodal terminals. Residents would also benefit from increased access to education and health care facilities.

The need for a separate Appalachian highway system was established in an earlier 1964 report to Congress, which noted that "the Interstate Highway System has largely bypassed the Appalachian Region, going through or around the Region's rugged terrain as cost-effectively as possible."³ At the same time, the Region required better access to diversify away from its extractive, resource-based economy, particularly given its historic dependency on coal mining and its persistent concentration of poverty. This required the development of new access routes that could connect the Region to wider markets, though these new routes did not necessarily have to be up to the full freeway design standard of the Interstate Highway System.

² Appalachian Development Act of 1965, as Amended; see <https://www.fhwa.dot.gov/federalaid/0633bsu1.cfm>

³ PARC. 1964. Appalachia: A Report by the President's Appalachian Regional Commission (PARC).

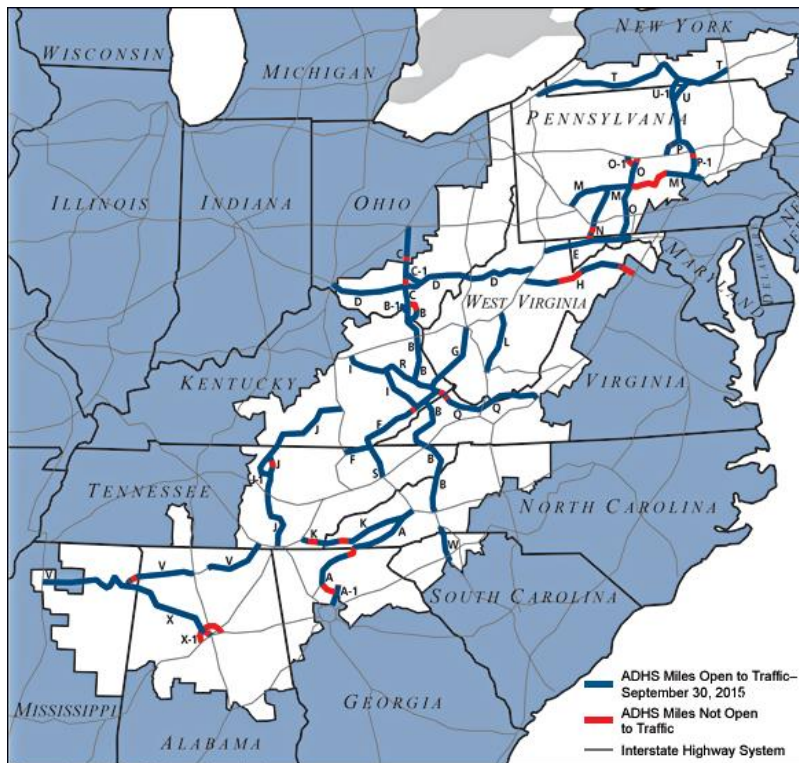
Research Importance. Even with a lower highway design standard for the ADHS (e.g., not requiring limited access freeways), the breadth of the Region and its rugged, mountainous terrain has meant that highway development is still often difficult and costly. As a result, the ADHS completion process has taken a long time; fifty years after its authorization by Congress, about 88 percent of the ADHS is now open to traffic (see Figure 1). At the same time, the extent of long-term poverty in this region and the implications of improved accessibility enabled by ADHS corridors are of a large scale. As a result, both the potential costs and benefits for completion of the ADHS system are very meaningful for both the Appalachia Region and the U.S. That is the reason why research findings on the actual ADHS economic and transportation impacts to date are so important, and relevant to the Region’s plans to complete the ADHS.

This report summarizes the findings of research studies that have examined realized and estimated economic and transportation impacts of ADHS completion to date. Further analysis of these issues will be forthcoming.

Report Organization. The remainder of this report is organized into five sections. They discuss:

- The role of ADHS within the economic context of the Appalachian Region;
- Overall benefits of the ADHS network at a regionwide level;
- Impacts of individual ADHS corridor projects;
- Multimodal connectivity and trade effects; and
- Forward-looking estimates of ADHS completion and key funding and implementation issues.

Figure 1. Appalachian Development Highway System

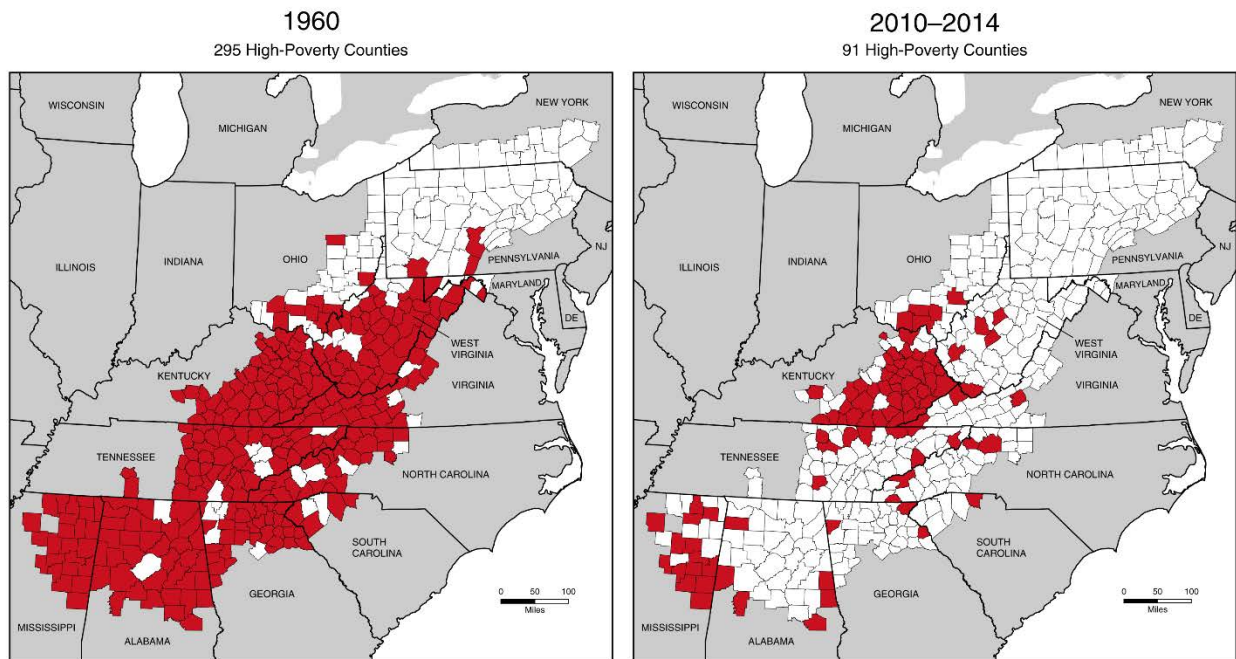


2. THE REGIONAL ECONOMIC CONTEXT

Prior to isolating the specific impact of ADHS highways, it is important recognize the broader context in which ADHS investments have been made. This historical regionwide context includes both the challenge of economic distress in the Region and the role of ADHS as a pivotal part of a broader Appalachian economic development strategy that is clearly producing results.

Appalachian Poverty. The Appalachian Region extends from the Southern Tier of New York State to northern Mississippi (see Figure 1). The Region covers 205,000 square miles and is home to approximately 25 million people, 42 percent of whom reside in rural areas. The Region today includes 420 counties in 13 states; when ARC was originally established it included 360 counties in 11 states (portions of New York and Mississippi were added later). Figure 2 shows the Appalachian Region and the extent of poverty in 1960 and in 2010-2014. It shows that since the start of ARC infrastructure investments, areas of high poverty have been substantially reduced over time, though significant pockets of poverty still remain.

Figure 2. High Poverty Counties in the Appalachian Region
(Counties with poverty rates at least 1.5 times the U.S. average)



Data Source: Office of Economic Opportunity data from U.S. Dept. of Agriculture, Economic Research Service, 1960.

Data Source: U.S. Census Bureau, American Community Survey, 5-Year Estimates, 2010-2014.

ADHS Role. The motivation for the ADHS was, from the beginning, to be part of a multi-pronged ARC-led effort to reduce poverty and enable greater economic development by improving accessibility, workforce skills and community infrastructure (including water, sewer, telecom and industrial park facilities). The intended role of the ADHS was to address the need for accessibility by reducing the isolation of many Appalachian communities, bringing mobility options and highway connectivity up to levels available elsewhere in the nation, and expanding access to markets. Such improvements would enable the

economy to become more diversified and raise income levels while reducing dependence on stagnant or declining resource-based (mining and agriculture) industries.

Economic Shifts over Time. Overall economic indicators show that the intended movement towards economic diversification of the Region’s economic base has indeed been occurring, though at a pace that still lags the rest of the nation. Changes in the economic sectors, needs, and conditions for the Region are described in a 2015 ARC-commissioned report: *Appalachia Then and Now: Examining Changes to the Appalachian Region Since 1965*.⁴ Notable trends include a shift to a more service-oriented economy and the increased importance of access to educational and health care resources. Further evidence of shifts towards service sectors dependent on labor market accessibility are described in *Appalachian Legacy: Economic Opportunity after the War on Poverty*.⁵

These reports describe how Appalachia’s economy today is more diversified, with growth in sectors of the economy that are dependent on market connectivity enabled by the ADHS, such as wholesale and retail trade, transportation, and utilities; information; financial services; business and professional services; and health and education services.

Closing the Economic Development Gap. While the Region’s economy has generally improved over the past 30 years, its job growth rate is still below the national average. Table 1 shows that over the past decade, the number of workers in Appalachia grew by an average annual rate of 0.41 percent, less than half the rate at which employment grew nationally (0.96 percent) during the same period. Private industry sectors (apart from agriculture and mining) experienced stronger employment growth in both Appalachia and the United States with flat growth in government sector jobs from 2004 to 2014. Per capita income in the Region is now around 81 percent of the national average, compared to 77 percent in 1960.⁶ Altogether, these findings appear to be evidence that the strategy of investment in Appalachian economic development is making progress, though there is a clear need for further improvement to close income and job creation gaps.

Table 1. Employment in Appalachia and the United States by Sector 2004-2014

Industry Sector	Employment, 2014		Appalachia Share, 2014	Average Annual Growth, 2004-2014	
	Appalachia	US		Appalachia	US
Agriculture & Mining	339,192	2,910,179	11.7%	-0.29%	0.12%
Mfg., Trade, Utilities, Services, Other	10,961,943	158,858,621	6.9%	0.11%	0.53%
Government	1,728,593	24,030,000	7.2%	0.01%	0.12%
Total	13,029,728	185,798,800	7%	0.41%	0.96%

Source: US Bureau of Economic Analysis; Moody’s Analytics data used to estimate mining employment

⁴ Center for Regional Economic Competitiveness (CREC) and West Virginia University. 2015. *Appalachia Then and Now: Examining Changes to the Appalachian Region since 1965*. Appalachian Regional Commission.

⁵ Ziliak, James P. 2012. *Appalachian Legacy: Economic Opportunity after the War on Poverty*. Brookings Press.

⁶ Jacobsen, Linda A. et al. (Population Reference Bureau). 2013. *Household Wealth and Financial Security in Appalachia*. Appalachian Regional Commission.

3. REGION-WIDE IMPACTS OF THE ADHS TO DATE

Economic developers recognize that highway access is a necessary but not sufficient condition to foster economic development. In other words, highway access can help enable economic development, but only when local labor force and community infrastructure assets are also in place for economic development. When those local factors are in place, then highway access can be the critical factor needed to enable economic development. That is why ADHS investments are typically most effective when accompanied by other complementary ARC community investment programs and a range of local/regional economic development initiatives.

This recognition of the interrelationship between highway investment and other economic development factors is embodied in a series of research studies that have been conducted to examine and isolate the role of ADHS development in facilitating economic development across the Region. This section focuses on regionwide effects of ADHS investment; subsequent sections examine more localized connectivity and corridor development effects.

Empirical Research. There has been a continuing series of empirical research on the economic impacts of ADHS development which examined how economic development has varied over time and over locations within Appalachia. These studies fall into three categories: (1) descriptive analyses of the processes whereby highway access affects economic opportunity, (2) rigorous statistical analysis exercises, and (3) use of economic simulation models to calculate impact. *All three types of studies have come to the same general conclusion -- that investment in ADHS development has led to clearly evident improvements in mobility and connectivity, and has helped grow and diversify the economic base of areas where highway network links have been completed.*

Descriptive Studies of Economic Change. The book *Uneven Ground* provides a history of postwar Appalachia and describes how the ADHS helped connect “larger towns in the mountains and the foothills with external markets, increased access to the mountains for tourists, and facilitated the transportation of coal to electric power plants outside the region.”⁷ Communities within close proximity to the ADHS benefited the most economically, especially those located at the intersections of ADHS corridors and Interstate highways which became either trade centers or sites for new manufacturing. Tourism destinations also gained from access to broader markets.

These descriptive findings of ADHS impacts match the findings of another study, *Sources of Economic Growth in Non-Metro Appalachia*, which examined the processes by which rural, distressed Appalachian communities have subsequently developed economically.⁸ That study noted the major “economic growth paths” for Appalachian communities, each of which depends on highway accessibility in a different way:

- *Trade center development* – retail and service business centers that are dependent on access to a broad population (customer) base in surrounding areas;
- *Tourism (natural amenity or cultural asset) development* – visitor destination activities that are

⁷ Eller, Ronald D. 2008. *Uneven Ground: Appalachia since 1945*. The University Press of Kentucky. (see p.202)

⁸ Economic Development Research Group, Regional Technology Strategies and MIT Dept of Urban Studies and Planning, 2007. *Sources of Regional Growth in Non-Metro Appalachia*, vol. 1, Appalachian Regional Commission.

also dependent on access to a broad population (customer) base in surrounding areas;

- *Supply chain cluster development* – assembly and distribution activities that locate in areas with same-day access to parts suppliers, manufacturers and business customer markets;
- *Agglomeration cluster development* – specialized concentrations of related activities that benefit from access to each other and access to a labor force base with specialized worker skills; these include technology R&D, medical research and educational (learning) clusters.

Distributional Consequences. ADHS implementation over time has reduced access travel times for rural residents, allowing them to reach shopping and employment opportunities in larger trade centers and business clusters. However, this consequently means that some of the trade center and cluster growth enabled by better network access may have been at the expense of more remote establishments not connected to the ADHS by secondary local road networks. The net impact on business productivity and business output growth was nonetheless clearly positive. This was illustrated in a statistical study that tracked the economies of all Appalachian counties from 1977 to 1992.⁹ The study had two key findings:

- 1) *Highway investment aids the growth of economically distressed counties.* Higher levels of capital investment in highways were associated with increased growth in business output for distressed counties.¹⁰ The study also found that this was real economic growth, as there was no significant evidence that highway investment in distressed counties had detracted from the growth of adjacent counties.
- 2) *Highway investment supports a wider rebalancing of economic activity between distressed and non-distressed Appalachian counties.* Overall, highway capital investment in non-distressed counties (e.g., economic attainment based on ARC’s categorization of economic status) did not increase output in those same counties, but actually led to a spreading of economic output from the developed counties to elsewhere in the Region.

Statistical Analysis of Economic Change. The gold standard in statistical impact analysis are studies that control for changes over time and differences among counties. Quasi-experimental method (QEM) studies match each county receiving ADHS highway improvements with a carefully selected “control group” of otherwise similar counties that did not receive highway improvements. The first of these studies was a widely published 1995 journal article by Isserman and Rephann; it compared population, per capita income, and earnings growth rates among ARC counties over the 1969-1991 period with a sample of similar (“twin”) counties matched across geographic and socioeconomic variables.¹¹ The study found that “counties on the Appalachian highway system (having at least three miles of highway) grew faster than their twins.”¹² The study also included a multivariate regression analysis which found that counties having an ADHS or Interstate highway had its strongest positive impact on manufacturing growth.

⁹ Islam, Samia. 2010. “An Examination of the Differential Impact of Highway Capital Investment on Economically Disparate Appalachian Counties in the USA.” *Transportation Planning and Technology* 33 (5): 453-464.

¹⁰ The study examined impacts for all highway investment and not just ADHS segments. The results indicated that every dollar of highway investment was generating an increase in worker income growth in those counties.

¹¹ Isserman, Andrew, and Terance Rephann. 1995. “The Economic Effects of the Appalachian Regional Commission: An Empirical Assessment of 26 Years of Regional Development Planning.” *Journal of the American Planning Association* 61 (3): 345-364.

¹² Counties with ADHS miles had 68 percent more income growth after 22 years, equivalent to 2.2 percent per year, compounded.

An update of the QEM approach was published in the 2007 *Sources of Economic Growth* study.¹³ It used enhanced state department of transportation (DOT) data on county-level highway lane-miles of investment. It found that lane-miles of ADHS highways “*significantly contribute[d] to the differential income and earnings growth experienced from 1969 to 2000 for ARC counties relative to their twins’ performance,*” as well as growth in population and employment in the retail trade and service sectors. Interstate highways, by contrast, contributed to growth in per capita income and service sector employment only, but not job and population growth. The study also showed that new ADHS lane-miles had a positive and statistically significant effect on income and earnings growth, while replaced or widened lane-miles of highway did not create such an effect.

The most recent use of the QEM approach was published in the 2015 *Appalachia Then and Now* report¹⁴ and covered the period of 1965-2012. This study concluded that “*Employment and per capita income grew significantly faster in Appalachian counties compared to the control counties for most of the study period.*” However, differences related specifically to ADHS investment were not covered in that study.

Simulation Modeling. A final method for calculating region-wide impacts of the ADHS is to apply regional transportation and economic models to estimate what today’s economy would be if ADHS investments had not been made (compared to today’s economy with ADHS investments in place).

This method, sometimes referred to as “backcasting” (as opposed to forecasting the future), was used in a 1998 ARC-commissioned report.¹⁵ The study used a transportation network model to calculate the added travel time and travel costs that would have incurred if completed ADHS segments had not been built over the 1965-1995 period. This information was used to calculate the economic value of the travel improvements and served as input to a regional economic model to estimate the effect on regional economic growth over that same period, as well as implications for the future. The study concluded that the addition of ADHS investment led to 16,270 more jobs in the Region as of 1995.

A 2016 National Bureau of Economic Research (NBER) working paper accounted for additional investments in the ADHS through 2010. That updated study applied an economic model to derive an estimate of how the region would have evolved between 1960 and 2010 if there had never been any development of the ADHS system. This study compared two scenarios, both assuming the development of interstate highways over the time period, but one assuming that there was no ADHS. The study computed the difference in inter-county travel times among the two scenarios and applied a statistical model of inter-regional trade to capture the effect of greater inter-county connectivity enabled by the ADHS. The study found that without the ADHS, there would be \$46 billion/year of less income generated, as well as a smaller population in the region. The study provides evidence that the ADHS has made a difference in regional economic development, though it likely understates the full impact as it did not address the effects of ADHS investment on intermodal connectivity (with rail, air and sea ports) and export trade growth.

¹³ Lynch, Teresa. 2007. “The Impact of Highway Investments on Economic Growth in the Appalachian Region, 1969-2000: An Update and Extension of the Twin County Study”, v. 3, ch.3 of the *Sources of Growth* study (footnote 7).

¹⁴ See footnote 4

¹⁵ Wilbur Smith Associates. 1998. *Appalachian Development Highways Economic Impact Studies*. Appalachian Regional Commission.

4. IMPACTS OF INDIVIDUAL ADHS PROJECTS

The regional impact studies have all documented that the ADHS has had a measurable impact on growth of the Region's economy. However, aggregate studies of regional economic growth alone do not reveal the multitude of ways in which local economies can be affected, which is why this section turns to case studies of local impacts for specific ADHS corridors.

The economic impacts of some individual ADHS corridor projects have been documented through published case studies. Individual corridor case studies are important because they can “tell the story” in ways that cannot be accomplished by regional statistical studies. “The story” refers to the behavioral consequences of improving local access and network connectivity – affecting business investment, location, and growth patterns. In general, these case studies provide real world examples of how ADHS corridor projects have enabled counties and communities to follow the economic growth paths identified in the prior section: (a) trade center development, (b) tourism development, (c) manufacturing and supply chain development, and/or (d) specialized technology and education cluster development. Additional ADHS effects of intermodal freight accessibility are covered in Section 5.

Overview of Case Studies. Several case studies of the economic impact of ADHS highway projects were developed as part of larger ARC and U.S. DOT research studies (cited below). Several more were developed under the federally-funded Strategic Highway Research Program (SHRP2) and are now part of the national EconWorks database of transportation project impact case studies.¹⁶

In general, all of these case studies provide a narrative of how the projects have affected the economies of corridor communities. They also attempt to distinguish impacts on new versus retained jobs, and impacts attributable to the highway versus impacts associated with other (non-highway) factors occurring at the same time. A map showing the location of these ADHS corridors is provided in Section 1 of this report (Figure 1). Case study findings for five ADHS projects are summarized below; more detailed information is available in the documents referenced by footnotes at the end of each summary.

- **Corridor E Project (Maryland).** Originally designated as Appalachian Corridor E, this project is an 82-mile highway in western Maryland, and was upgraded in 1991 to become part of I-68. This region has historically relied on manufacturing, natural resource extraction, and tourism to drive its economy. During the middle of the 20th century, these industry sectors experienced employment decline. Completion of this highway link enabled the area to offset those losses by attracting: (1) new tourism drawing residents of the Washington, DC and Baltimore metropolitan areas, and (2) new manufacturing and distribution (supply chain) activities as well as back office uses that rely on improved transportation access from those areas. It is estimated that this highway project enabled a net direct increase of around 900 jobs to the corridor region.¹⁷
- **Corridor D Project (West Virginia).** This corridor connects I-275 in the Cincinnati metro area with Bridgeport, West Virginia, a community located approximately 35 miles south of Morgantown along

¹⁶ EconWorks is a web site containing a searchable database of over 100 transportation project impact case studies. See <https://planningtools.transportation.org/13/econworks.html>

¹⁷ Corridor E sources: EconWorks case study (see footnote 14) and FHWA *Economic Development History of Interstate 68 in Maryland* (http://www.fhwa.dot.gov/planning/economic_development/studies/i68md.cfm)

I-79. The case study focused on a 70-mile segment of Appalachian Corridor D completed in 1977, which connects interstates 77 and 79 and is also known as US-50. The case study found that this segment “supported the transition of the study area away from heavy industry and toward services,” with jobs created in “healthcare, education, government, and education.” Authors of this case study estimate that it helped to retain “indigenous manufacturing activities,” and had a direct impact of around 1,000 new jobs.¹⁸

- **Corridor Q Project (Kentucky and Virginia).** Appalachian Corridor Q passes through the mountains to connect eastern Kentucky with the Roanoke, Virginia area. Research findings indicate that Corridor Q has “improved connectivity, as exemplified by increased commuting distances along the corridor, and facilitated commercial development in rural areas.” Highway improvements have stimulated new retail development in several communities, as well as development of a new industrial park and small business incubator between Tazewell and Bluefield, Virginia. Overall, the project’s direct impact has been an increase of around 6,250 jobs along the corridor.¹⁹
- **Corridor T Project (New York State).** This project is a 180-mile stretch of highway along New York State’s rural Southern Tier, not far from the Pennsylvania border. Originally designated as Appalachian Corridor T, it was upgraded in 1998 to become I-86. The project upgrades took place over a 30-year period, over which time the project was credited with generating over 3,200 jobs in the region. Economic development gains includes manufacturing jobs at several industrial parks, as well as jobs at a ski resort, a casino and a call center. The project is considered a particularly critical factor behind the location and expansion of manufacturing facilities for diesel engines, furniture and advanced ceramics – all driven by the need for connectivity to the interstate system for national truck access.²⁰
- **Corridor B Project (North Carolina and Tennessee).** This corridor connects Asheville, North Carolina with Portsmouth, Ohio, a small city situated on the border with Kentucky. The case study focused on an 88-mile segment of Appalachian Corridor B that was completed in 2003. It passes through the Blue Ridge Mountains to connect western North Carolina with northeastern Tennessee. Through its conversion from a winding 2-lane road to a four-lane highway with passing lanes by 2003, this project enabled “improved connections between major centers, and improved access to the Port of Charleston,” enabling a direct increase of around 4,600 new jobs in the area. A significant element of this impact has been new residential and commercial in the area of Weaverville, North Carolina.²¹

Interpretation of Case Study Literature. Considered together, these five cases reinforce the finding that completing or upgrading of ADHS segments can make a demonstrable difference for the growth of local economies. However, the magnitude of impacts on the economic development of surrounding areas, and the mix of economic activities that result, are very much dependent on the nature of the local area’s economic base, workforce and location relative to wider population and business markets. Another related factor is connectivity to intermodal terminals and international gateways.

¹⁸ Corridor D source: EconWorks case study (see footnote 14).

¹⁹ Corridor Q source: EconWorks case study (see footnote 14).

²⁰ Corridor T sources: EconWorks case study (see footnote 14), plus FHWA *Economic Impact Study of the I-86 Corridor* (http://www.fhwa.dot.gov/planning/economic_development/studies/new_york_86/index.cfm), and “Detailed Corridor Analysis Summaries,” Ch.3 in *Economic Impact Study of Completing the Appalachian Development Highway System* (http://www.arc.gov/research/researchreportdetails.asp?REPORT_ID=69).

²¹ Corridor B source: EconWorks case study (see footnote 14).

5. IMPACT OF THE ADHS ON FREIGHT ACCESSIBILITY

The economic development impacts of the ADHS go well beyond the regionwide and localized economic growth effects covered in the previous sections. The ADHS also has an important impact on both the Appalachian economy and the larger U.S. economy by providing highway access to intermodal rail terminals, barge terminals, airports and marine ports that exist both within and outside of the Region. By connecting the Region to these broader multi-modal transportation facilities, the ADHS also becomes important as an enabler of regional export growth and global economic competitiveness. This section summarizes ARC-commissioned research concerning freight accessibility and its dependence on the ADHS.

Development of Intermodal Rail Network Connections ARC has commissioned a continuing series of research studies that have examined the role of the ADHS in supporting broader freight movements that require transfers to intermodal rail, air, and marine terminals.

A 1999 study, *An Assessment of Intermodal Transportation Plans, Systems, and Activities in Appalachia*, examined the limited extent of intermodal (truck-rail) container transfer facilities in the Region. It noted that “While ADHS has served as the centerpiece of ARC’s economic development program, highways alone are no longer sufficient to help Appalachia’s communities compete in the global marketplace.”²²

The 2004 study, *Meeting the Transportation Challenges of the 21st Century, Intermodal Opportunities in the Appalachian Region*, examined opportunities for increasing connectivity to intermodal (truck-rail) transfer facilities, so that Appalachia’s freight system could be positioned as a link from eastern coastal ports to business markets in the Midwest and South.²³

A 2010 report, *Network Appalachia: Access to Global Opportunity*, documented the broader multimodal network that connects Appalachia to global markets.²⁴ This network consists of freight railroad corridors and intermodal (rail, marine and air freight transfer) facilities; each is summarized below.

Freight Railroad Corridors. Two Class I railroads serve the region: CSX and Norfolk Southern. While early freight rail in the Region consisted mostly of logging and mining products, emerging corridors increasingly carry a variety of mixed commodities destined for both domestic and international markets. In more recent years, both railroads have made significant investment in modern, long-distance freight rail corridors that cross through Appalachia and link to an increasing number of intermodal terminals. These corridors are intended to handle a mix of goods, including double-stack intermodal containers which is one of the biggest growth markets for private railroads. The corridors are shown in Figure 3 and include:

- *CSX National Gateway*, a corridor connecting Northeastern Ohio with Wilmington, NC;
- *Norfolk Southern (NS) Heartland Corridor*, connecting Chicago with Norfolk, VA; and
- *Norfolk Southern Crescent Corridor*, connecting the Eastern Seaboard with the Gulf of Mexico.

²² Appalachian Regional Commission. 1999. *An Assessment of Intermodal Transportation Plans, Systems, and Activities in Appalachia*.

²³ Rahall Transportation Institute and Wilbur Smith Associates. 2004. *Meeting the Transportation Challenges of the 21st Century, Intermodal Opportunities in the Appalachian Region*, Appalachian Regional Commission.

²⁴ Moffatt & Nichol. 2010. *Network Appalachia: Access to Global Opportunity*. Appalachian Regional Commission.

Each of these rail corridors represents significant private investment and supportive public sector partnerships that helped to add rail capacity and allow for double-stacking throughout the route.

Figure 3. Intermodal Freight Corridors and Intermodal “Inland Port” Facilities



Source: *Network Appalachia: Access to Global Opportunity, 2010.*

Intermodal Terminals. Within the past ten years, Appalachia has also benefitted from a significant growth in what are now often labeled “inland ports”. These are intermodal rail facilities that enable the transfer of containers from trucks to rail lines, airports or inland waterways (or often, to marine ports via rail lines). They effectively provide access to the global supply chain, helping to strengthen business links to both customers and suppliers across American and around the world.

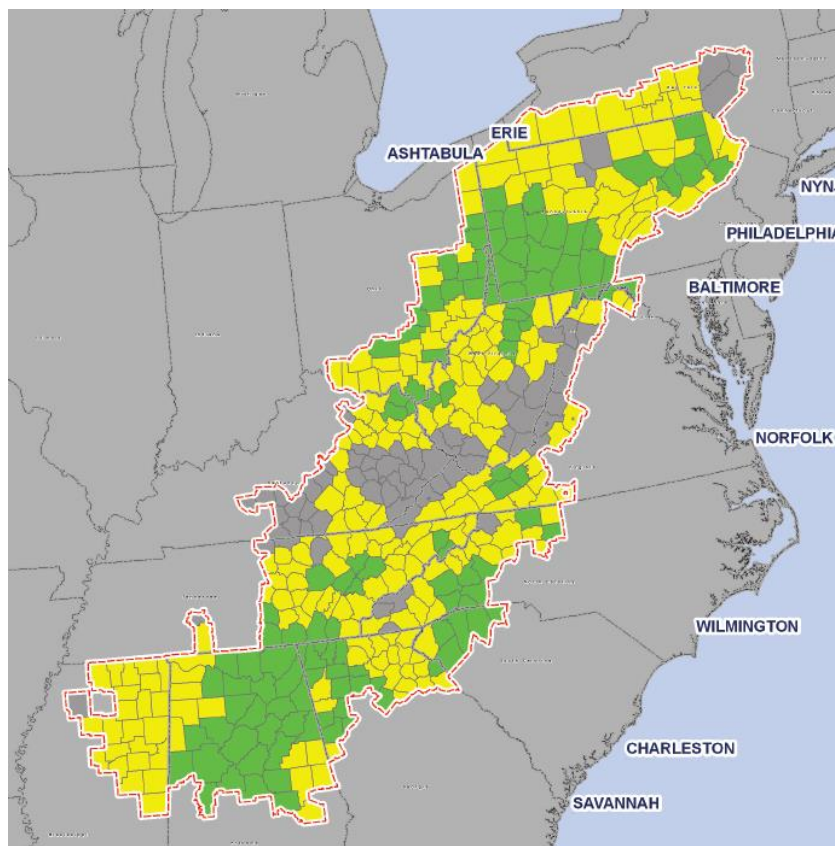
Figure 3 also shows the location of existing coastal ports, and inland ports that are either located in Appalachia, or connected to the Appalachian Region via rail. Critically, the ADHS provides many of the connections to these port and rail facilities. For example, Corridor V of the ADHS connects northern Mississippi with the region surrounding Chattanooga, Tennessee. By passing through Huntsville, Alabama, the ADHS opens access to and from the Alabama International Intermodal Center (IIC), an inland port complex with both rail (Norfolk Southern) and air (Huntsville International Airport) connections. It has been estimated that approximately 90 percent of the volume passing through IIC is international

containers enabling economic transactions between American business and either suppliers or markets abroad.

Other examples of these new inland port centers include facilities in Spartanburg/Greenville, South Carolina; multiple intermodal terminals in Birmingham, Alabama; CSX National Gateway facilities being developed in Pittsburgh and in-operations in Chambersburg, Pennsylvania; and Norfolk Southern facilities in Greencastle, Pennsylvania and the West Virginia/Ohio/Kentucky Tri-State area (Pritchard, West Virginia). Each Appalachian inland port is linked to the ADHS highway network, expanding access from businesses across the region to and from these important new centers of global commerce.

Overall Freight Accessibility. Inland ports and other freight terminals are not ubiquitous throughout the Region, nor is the ADHS fully complete. As a result, there are significant disparities among Appalachian counties in terms of their level of freight access to outside markets. Figure 4 shows a rating of freight access among Appalachian counties, which was based on a composite scoring system laid out in the *Network Appalachia* study. (Green colored counties have the strongest freight system access, followed by yellow-shaded counties, while those shaded gray have the worst freight system access.)

Figure 4. Appalachian Freight Accessibility Evaluation Map



Source: *Network Appalachia: Access to Global Opportunity, 2010*

6. COMPLETING THE ADHS

Challenges for ADHS Completion. The ADHS is currently authorized at 3,090 miles. As of early 2016, 2,577 miles of highway were complete and open, and 206 miles of highway were under construction. That leaves 307 miles (10 percent of the total) remaining to be built. ARC and the states have documented the latest plans to complete the ADHS, but the challenges for completion are: (a) high costs, (b) limited state funds, (c) changes in federal contributions, and (d) varying state-level prioritization given to completion of the ADHS. There are several reasons for these challenges:

- a) The *high costs* come from the fact that the many remaining miles of ADHS highway corridor involve rugged and/or environmentally sensitive areas, and will thus be expensive to complete.
- b) The *state funding* challenges come from the fact that state gas tax revenues are not keeping up with rising highway funding needs, and states are no longer receiving separate federal funds designated specifically for ADHS use.
- c) The *federal funding* process has changed. Until 2012, Congress provided the Appalachian states with dedicated funds for ADHS construction. Now, ADHS funding is pooled with other highway funding that Congress apportions to the states. However, states can apply their federal funds to cover 100 percent of the cost of ADHS construction (compared to 80 percent of the cost of other eligible highways).
- d) The *prioritization* challenge is complex, and concerns how public, business and civic leaders view the economic stakes and social importance of completing remaining ADHS segments, often in competition with other statewide priorities.

For all of these reasons, it is now important is to take a fresh look at the expected economic impacts, benefits and costs of completing the ADHS, and to better understand their implications.

Research Studies on ADHS Completion Impacts. There have been two past studies of the economic benefits and impacts of ADHS completion (in 1998 and 2008), and a new study is currently underway. All of these studies involve the same basic approach:

- Transportation network analysis is used to identify: (a) the number of cars and trucks that will be affected by ADHS completion, and (b) the extent to which travel characteristics (travel distances, speeds, congestion delays, collisions and vehicle operating expenses) will be changed by ADHS completion.
- These travel characteristics are translated into changes (over time) in economic factors, such as commuting costs, freight delivery costs, business reliability and logistics costs, safety effects, labor market access, and connectivity to intermodal terminals. Costs of highway completion are also itemized.
- An economic model is applied to calculate how spending patterns, business productivity and competitiveness will be affected, and to forecast (given the economic base of the region) the extent to which the changes will generate future jobs, wages and business sales in the Region. A separate benefit-cost analysis is also conducted.

The 1998 study estimated the long-term implications of 12 ADHS corridors, representing 1,417 miles of highway that were already completed. It was estimated that completion of those ADHS segments had led to 16,270 more jobs in the Region as of 1995, which would rise to 42,190 jobs as of 2015. The study

projected a GDP increase of \$4.62 billion (in 2016 dollars) and a travel efficiency gain rising to \$3.20 billion (in today's dollars) by the year 2015.²⁵

The 2008 study estimated the long-term implications of completing the entire ADHS system, which then meant completing the final 453 miles of the system at a cost of \$12.1 billion (2016 dollars). It was estimated that completion of the remainder of the system will lead to 80,491 more jobs in the region as of 2035. The study projected a year 2035 GDP increase of \$5.69 billion (2016 dollars), and a travel efficiency gain rising to \$5.77 billion/year (2016 dollars).²⁶

Both of those studies also calculated a benefit/cost ratio based on updated project costs and updated estimates of transportation system efficiency gains. The 1998 study considered corridor benefits and showed a regional benefit-cost ratio (BCR) of 1.2. The 2008 study had more inclusive (network-based) measurements of efficiency gains and placed the BCR at 1.9 for the Region and 2.9 for the nation. The new 2016 study is expected to provide updated benefit and economic impact numbers based on completion of the 307 remaining miles of ADHS, and it will also be tailored to address broader issues of intermodal connectivity and export growth that have arisen in recent years.

Issues to Consider in Assessing ADHS Completion Impacts. The challenges for completing the ADHS include consideration of funding allocation decisions and relative priorities for public investment in transportation projects. These topics can be more effectively addressed if there is better information available to inform decision-making, helping to answer the following questions:

To what extent will completion of remaining ADHS segments:

- Help those parts of Appalachia that still suffer from high poverty and high unemployment rates?
- Help those parts of Appalachia that currently suffer from the poorest freight accessibility?
- Enhance intermodal freight movements to and from the Region (increasing competitiveness)?
- Address goals of supporting corridors that are of regional and national significance?
- Help to relieve congestion on other parts the national highway system?
- Expand access to broader job opportunities for area residents?
- Expand the region's export base (i.e., economic activities that sell to outsiders and hence bring more money flowing into the Region)?
- Enable further diversification of the regional economy towards those industry sectors that are projected to have the greatest future growth and highest paying jobs?
- Ultimately increase jobs and household incomes for residents of affected states, and increase tax and fee revenues for states that need to fund the ADHS completion?

Current research can and will address these questions.

²⁵ Wilbur Smith Associates. 1998. *Appalachian Development Highways Economic Impact Studies*. Appalachian Regional Commission. All dollar values in that report were in 1995 dollars, and this text inflates them to 2016 dollars.

²⁶ Cambridge Systematics, Economic Development Research Group, and HDR Decision Economics. 2008. *Economic Impact Study of Completing the Appalachian Development Highway System*. Appalachian Regional Commission. All dollar values in that report were in 2007 dollars, and this text inflates them to 2016 dollars.

7. SUMMARY OF FINDINGS

This report summarizes research to date on the impact that the Appalachian Development Highway System (ADHS) has on economic activity and economic growth in Appalachia. There are six major categories of overall findings:

- 1) ***The ADHS was designed to reduce isolation and enhance access for Appalachian communities,*** including access to jobs, business markets and more diverse economic opportunities. Most of the research on ADHS impacts has accordingly focused on achievement of those goals and ultimate economic outcomes (in terms of jobs and income growth).
- 2) ***The role of the ADHS in helping to facilitate economic development is well documented.*** Several prior studies have traced the processes whereby ADHS corridor completion to date has had a clearly observable effect on diversifying the economy of many parts of Appalachia, and played a pivotal role (along with other ARC programs) in helping to reduce poverty in the Region. However, the ADHS network is not complete and significant pockets of poverty still remain.
- 3) ***There is strong evidence of a positive relationship between completion of ADHS segments and subsequent economic activity growth at a county level.*** A series of statistical studies have shown that these impacts are statistically significant and particularly large for economically distressed counties. These are statistical relationships across all Appalachian counties, which means that not every distressed county will automatically grow just because ADHS segments are complete.
- 4) ***Different parts of Appalachia benefit from ADHS corridor completion in different ways.*** A series of case studies show that some areas have been able to grow tourism, others have seen industrial activity grow, and yet others have seen commercial activity grow. Since highways are one aspect of the multiple assets needed for economic development, some communities have seen large economic growth and others are still waiting for major economic growth to occur. The effects depend on the nature of the specific corridor, its population and workforce, its current economic profile and its location relative to surrounding business centers and markets.
- 5) ***The importance of ADHS network connectivity is receiving increased attention as businesses move towards more dependence on national and global markets.*** Public and private organizations are activity working to invest in intermodal transfer facilities and global gateways within and surrounding the Region, and this is increasing attention to the issue of how Appalachian communities connect to the interstate highway network, and to intermodal rail, air and marine transportation facilities. Current research will more carefully examine how ADHS network completion addresses these needs.
- 6) ***Completion of remaining elements of the ADHS depend on complex issues, requiring more attention to the costs and stakes involved.*** Current research should help to provide more information concerning the economic consequences of accelerating or delaying ADHS completion.

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