Chapter 5
ECONOMIC IMPACTS DUE TO THE ADHS

The travel efficiencies of Chapter 4 are one of the key components for documenting and measuring the economic gains attributable to the ADHS and provide critical data for estimating the economic development benefits of the ADHS. The ADHS as envisaged by Congress was intended to stimulate economic development in the Appalachian Region by making the Region more accessible, and better able to compete with other regions of the US. This chapter develops an estimate of the economic development impacts on Appalachian Region believed attributable to the completed portions of the ADHS. Specifically, this section of the report analyzes the jobs, wages and value-added from new production that can be quantified as impacts of the ADHS.

In order to measure how the ADHS has helped promote economic development in the Appalachian Region, this chapter implements the methods that were explained in Chapter 2 for estimating the job creation, wages and value-added that are attributable to the ADHS. The value-added estimates are then divided by the ADHS life cycle costs, and an economic impact/cost ratio is thereby derived.

ECONOMIC DEVELOPMENT OVERVIEW

The effectiveness of the ADHS in creating economic opportunity in the Appalachian Region is quantified by the use of the REMI regional economic model. The direct efficiency benefits that arise from shorter travel times, reduced vehicle operating costs for business and non-business uses, and improved safety of the ADHS provide the data input into REMI model. In turn, the REMI model generates detailed, regionally specific, estimates of the economic development impacts, as measured by jobs, wages and value-added by industries within the impact region.

Do Not Add Economic Benefits and Economic Impacts

A note of caution: the economic benefits (efficiencies) of Chapter 4 should not be added to the economic development impacts of Chapter 5. The limited extent to which some of the benefits and impacts can be properly added together is already done in the Chapter 5 impact/cost analysis. No further adding of benefits and impacts should be made—any such summation would be to double count the implications of the ADHS.

Four Indicators of Economic Development Impact

The economic development impacts of the ADHS investments are measured in four ways. Use of these four measures allows ADHS diverse impacts to be documented in a consistent fashion. The following "impact indicators" are used. These should not in any way be added together.

- **Value Added** – The dollar value of increased economic production in the Appalachian Region because of the ADHS. It is the value of the region firms' output minus the value of the inputs they purchase from other firms. In this study it is the value added by firms located in the defined impact region(s), including employee compensation, proprietary income, indirect business taxes, and other property income. This value can be thought of as the net increase in gross regional product (GRP) for the Appalachian Region.

- **Wages** – Total increases in payroll costs (wages, salaries, and benefits) paid by local industries to employees who owe their jobs, directly or indirectly, to the ADHS.

- **Employment** – Employment impacts are net changes in number of jobs due to the ADHS expressed as "full-time equivalents" (FTE's). These FTE's include the number of jobs directly attributable to ADHS highway use, plus the share of those employed in sectors that indirectly support the road users, and the firms that might expand in or locate to the Appalachian Region. In addition, the people in the new jobs will spend much of their income in the Region and this respending will in turn create additional jobs, which are also included in the study.

- **Population** – Total population dependent on the new jobs created by the ADHS.

These four statistics are the best available measures for the economic impact derived from the improved corridors. Each of the impact statistics is presented based on the impact the corridors have had or will have on the Appalachian economy in the past, present, and in the future. In order to do so, the economic impact statistics are presented for the years 1975, 1995, and 2015. All monetary calculations are expressed in constant 1995 price levels. The full results for each of the tables are presented in Appendix C.

ECONOMIC DEVELOPMENT IMPACTS

The economic development impacts are calculated for each year 1965-2025, by impact type and cause. For impact/cost evaluation purposes, the impacts are discounted by seven percent per year, and summed. The total sum of the discounted economic impacts are shown on **Exhibit 5-1**.

Exhibit 5-1
ADHS TOTAL LIFE CYCLE ECONOMIC DEVELOPMENT IMPACT
Discounted at 7%
1965-2025

	Economic Impact on Appalachian Region
Competitive Advantage	$2,699,500,000
Roadside Services	253,070,000
Tourism	235,968,000
Total ADHS Operations Impacts	$3,188,538,000
Construction Impacts [a]	1,457,585,000
Total Appalachian Region Impacts	$4,646,123,000[b]

[a] The Region impacts due to the act of spending the federal construction funds in the Region should be excluded from any analysis that attempts to justify the use of these funds.

[b] Excludes accident savings and some other travel efficiencies.

The total net life cycle economic development impacts discounted at 7 percent per year indicate that the completed sections of the ADHS as operating is worth $3.2 billion to the Appalachian economy (excluding the impacts attributable to the expenditure of the federal funds). When the

state and federal fund expenditures are included, the impacts total an estimated $4.6 billion. Clearly the ADHS has created sizable economic value for the Appalachian Region. A summary of these impacts by type and year follows.

Estimated Competitive Advantage Impacts

A major ARC objective is to create economic development for the Appalachian Region by expanding existing businesses, by attracting new businesses, and by diversifying the area's economic base. To expand and attract businesses, the Region must be competitive with other areas of the US and the world. It has been clear in recent years that there is a high level of competition among regions of the US for economic development. Keeping transportation costs as low as possible is one way that the ARC can help the Appalachian Region to be more competitive and to strengthen its business climate. Facilitating faster and more efficient travel along the corridors represents a logical means for increasing the competitive advantage of communities along the corridors. These lower transportation costs may be passed on to consumers as lower prices for consumer goods, to workers as higher wages, or to owners of businesses and firms as higher net income. Therefore, individuals can benefit from the improved corridors without even traveling on them.

To estimate the economic impact attributable to making the Region more competitive, the efficiencies are distributed across a number of industries within REMI as cost savings based on the importance of each of the industries to the total Appalachia Region. The importance of each industry is based upon the number of employees each industry has as a percentage of the total employees of the Appalachia Region. Once the values are placed into REMI as an input, the REMI model calculates the effect of reinvestment of these savings into the corridor region and estimates the amount of new business in the region attributable to the increased competitive position of the industries within the region.

The estimated annual economic impact from an improved competitive position for the Appalachian Region is listed in **Exhibit 5-2**. The exhibit suggests that the improved competitive position has led to significant economic impacts in the past, and is likely to lead to significant impacts in the future. The table lists the annual dollar economic impact for three different years (1975, 1995, and 2015) and the net total jobs and resident population for the specific year. While **Exhibit 5-2** displays the growth of economic development resulting from an improved competitive position for selected years, **Exhibit 5-3** displays the growth over time.

Exhibit 5-2
COMPETITIVE ADVANTAGE ECONOMIC IMPACT
(All dollar values expressed in 1995 dollars, not discounted)

Year	Employment	Population	Wages	Value Added
1975	1,790	2,317	$15,560,000	$54,840,000
1995	12,200	22,750	$324,800,000	$444,830,000
2015	35,800	73,900	$1,001,050,000	$1,752,250,000

While the economic impact of the improved competitive position is rather modest in the initial years, about 1,800 new permanent jobs and valued added of nearly $55 million in 1975, the

economic impact grows substantially over time. In 1995, the improved competitive position of the twelve corridors is estimated to have created over 12,000 new permanent jobs and over $444 million of value added. By year 2015, these values are expected to grow to over 35,000 new jobs with a value added of $1.75 billion by the Year 2015. On average, this would mean that each improved corridor would create about 3,000 permanent jobs by year 2015.

Exhibit 5-3
ECONOMIC IMPACT FROM COMPETITIVE ADVANTAGE
(In Terms of Value Added)
1995 $

In Millions of $
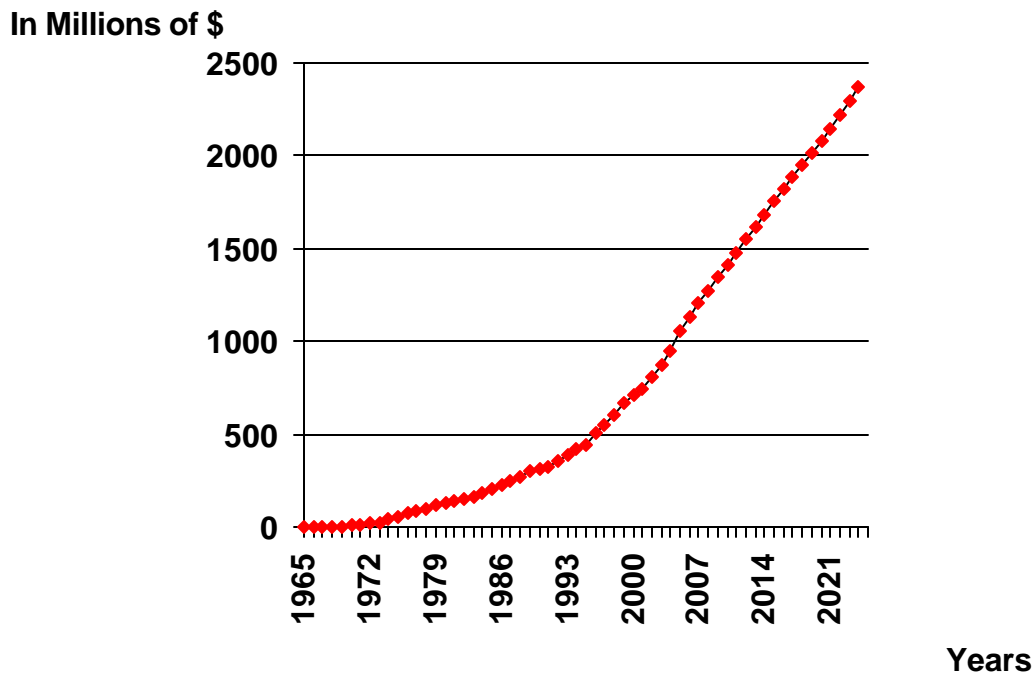
Years

This substantial economic impact growth is largely due to the increased volume of traffic over time. In the initial years, only a few of the corridors had been developed and therefore the travel time and VOC savings for the initial years was rather modest. As more and more corridors are developed, the travel time savings and VOC savings grow and, as a result, the economic impact grows.

The sheer magnitude of the competitive position economic impact that these roads are having currently, and are likely to have in the future, highlights the importance of good transportation network for the businesses in a region. This is especially true for a region like Appalachia, which has historically lagged the rest of the U.S in economic growth.

Roadside Services Impact

The second economic development impact component is the economic impact attributable to Roadside Services. Roadside Services comprise those firms which sell goods and services that cater to the traffic along a highway. As described in Chapter 3, these roadside services include gasoline stations, hotels/motels, restaurants, gift shops, and other businesses that are typically located near the highways. As traffic volumes increase, so do the number of roadside service establishments. The economic impact estimates from the increased number of establishments are based on estimates of dollars spent on roadside services per vehicle mile of travel (VMT). The increase in roadside service expenditures is entered into REMI model, which traces the respending of the expenditures through the regional economy and forecasts the future repercussions of such expenditures.

Exhibit 5-4 lists the annual roadside expenditure economic development impacts for the twelve corridors combined. The wages and value added numbers are annual impacts in the stated years; the employment and population numbers represent the net change that exists, by year. Like the competitive advantage impacts, the economic impact created from roadside expenditures is relatively small in the initial years, but the impact grows as the traffic volumes increase and as the number of ADHS segments that are open to traffic increases.

Exhibit 5-4
ROADSIDE EXPENDITURE ECONOMIC IMPACT
(All dollar values expressed in 1995 dollars, not discounted)

Year	Employment	Population	Wages	Value Added
1975 [a]	320	270	$2,970,000	$8,190,000
1995	1,390	1,980	$33,220,000	$54,870,000
2015	2,960	4,790	$81,500,000	$118,410,000

(a) In the early years (1975) the ADHS effect is greater on employment than on population. The reason is higher labor force participation rates due to the ADHS, and the ability to commute further distances to work.

This growth is also shown in **Exhibit 5-5**. By the Year 2015, the impact is quite substantial as nearly 3,000 permanent jobs are created with a value added to the Appalachian Region of over $118 million. To give some perspective, this translates into an additional 250 permanent jobs (on average) per corridor by the year 2015.

Exhibit 5-5
ECONOMIC IMPACT FROM ROADSIDE SERVICES
(In Terms of Value Added)
1995 $

In Millions of $

Years
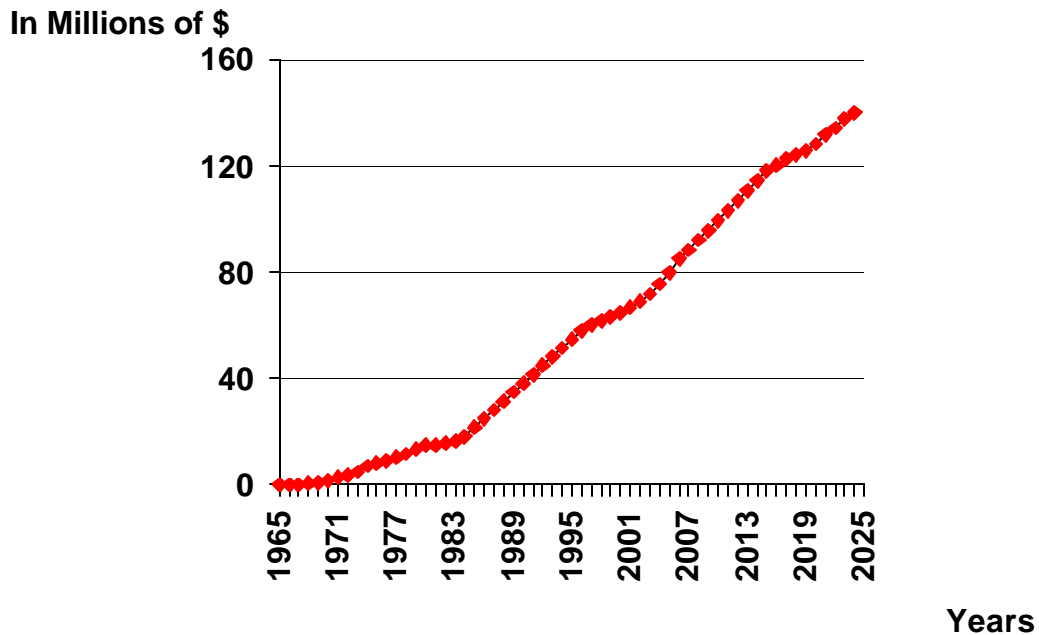
Tourism Impact

The ADHS corridors also have the opportunity to influence tourism, to the advantage of the Appalachian Region. Tourists spent considerable sums while traveling, and if additional tourists find their way to Appalachia due to the ADHS, that is good for the economy. A number of the study corridors serve tourist facilities and locations and, as access is improved due to the ADHS, tourists are influenced. The economic impacts believed attributable to these tourism effects are estimated in the study.

A typical family vacationing in the area spends substantially more money than a person who is just passing through the area. These visitors create economic activity through money they spend shopping, staying at hotels, eating at restaurants, and visiting amusement and recreation centers. A vacationing family could inject hundreds of dollars per day into the local economy and create a substantial economic impact through the multiplier effect of these dollars. This multiplier effect is estimated by REMI for the Appalachian Region.

Exhibit 5-6 lists this estimated impact for the three example years. Similar to the economic impact from improved competitive position and increased expenditures in roadside services, the economic impact that results from tourism is rather modest in the initial years (only 320 new jobs and a value added of $7.35 million created by 1975), but this impact grows substantially over time (almost 2,900 new jobs and a value added of over $100 million by the Year 2015) and its growth is shown in **Exhibit 5-7**. The impact per corridor is slightly less than economic impact from the expenditures of the roadside services as nearly 250 permanent jobs will be created on average per corridor.

Exhibit 5-6
ECONOMIC IMPACT FROM TOURISM
(All dollar values expressed in 1995 dollars, not discounted)

Year	Employment	Population	Wages	Value Added
1975	320	280	$2,430,000	$7,350,000
1995	1,290	1,930	$33,440,000	$52,850,000
2015	2,920	4,880	$75,250,000	$108,110,000

Exhibit 5-7
ECONOMIC IMPACT FROM TOURISM
(In terms of Value Added)
$1995

In Millions of $

Years
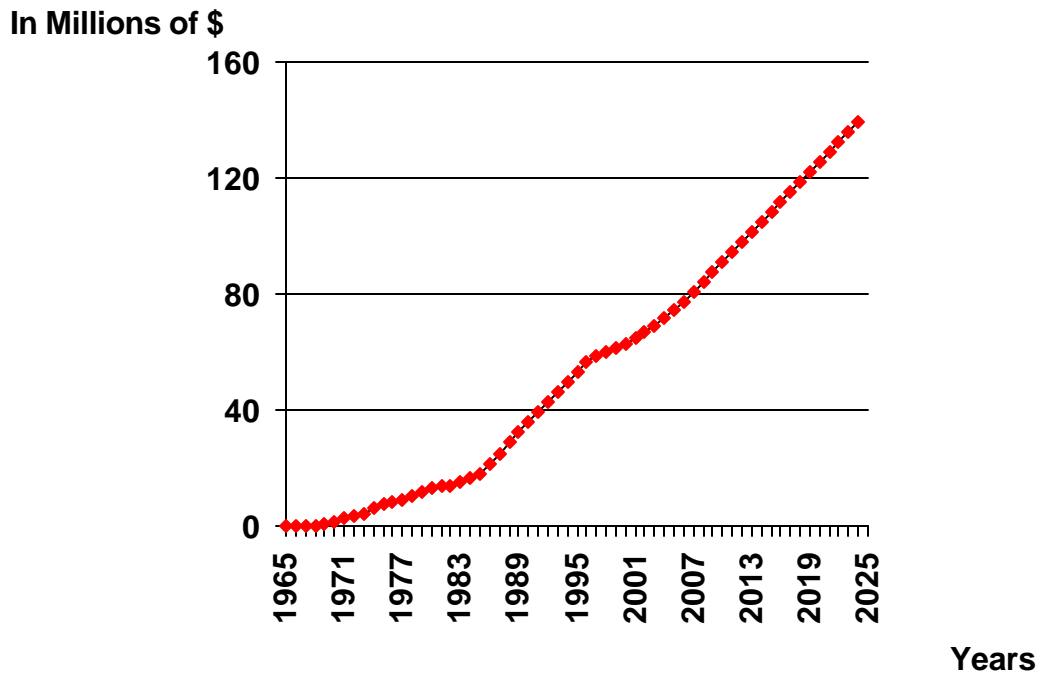
Construction Economic Impact

The fact that federal dollars are imported into the Region to build the ADHS is of economic value to the Region. The economic impact value of these expenditures to the Region is calculated by the REMI model. The construction cost of designing and building the highways is treated as a positive economic shock to the economy in the REMI model. The model determines the amount of materials, labor, etc., that can be supplied locally and then estimates the total economic development impacts to the region created by highway construction. This impact includes money that is respent through a multiplier effect in the area. While this is a tremendous impact for any one region of the country, it is viewed as a zero net gain to the nation as a whole. The funding for the construction project may result in economic gain for the Appalachian Region can be viewed as a lost opportunity of economic development for another region of the country that did not get a project funded; therefore, from the national perspective there is a zero net gain.

Over $4.6 billion (current dollars) has been spent in the Appalachian Region on the construction of the improved corridors of the ADHS. **Exhibit 5-8** displays the estimated economic impact directly due to the act of making these construction expenditures. Most of the expenditures occurred in the years between 1965-1995 with only maintenance expenditure occurring after Year 1995. In 1975, it is estimated that the money spent on building the ADHS accounted for 3,600 new full time equivalent jobs and a value added impact of over $109 million. This translates into 300 new permanent jobs, on average, per corridor. By 2015, only lingering effects from the initial construction expenditures coupled with the effects from the maintenance expenditure is occurring. It is projected that the capital projects will account for 500 new permanent jobs with a value added of nearly $23 million by year 2015.

Exhibit 5-8
ECONOMIC IMPACT FROM CONSTRUCTION
(All dollar values expressed in 1995 dollars, not discounted)

Year	Employment	Population	Wages	Value Added
1975	3,680	11,820	$47,110,000	$109,900,000
1995	1,390	3,760	$34,620,000	$58,200,000
2015	509	910	$19,960,000	$22,990,000

Exhibit 5-9 presents these impacts over time. The key point is that the construction impacts are large during the construction period, and small after the money is spent and the highway is open. After the year 1995, there is no construction on these completed highway sections and the impact that then occurs is due to the increased highway maintenance expenditures.

Exhibit 5-9
ECONOMIC IMPACT FROM CONSTRUCTION EXPENDITURES
(In Terms of Value Added)
1995$

In Millions of $

Years
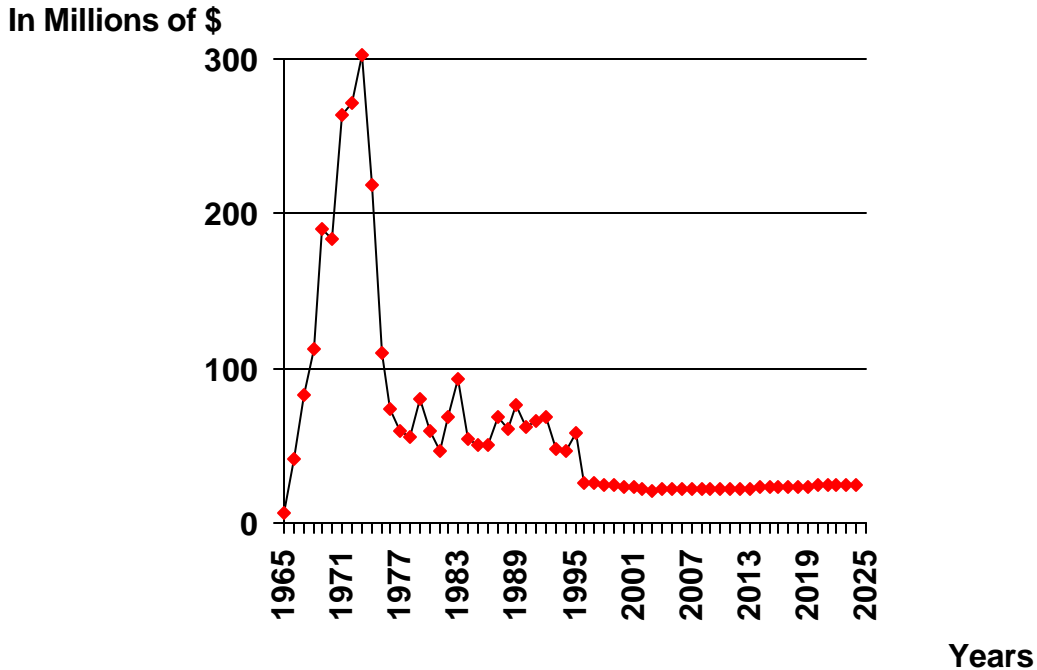
Economic Development Impact Summary

A summary of the total estimated economic impact on the Appalachian Region from the improved corridors is displayed in **Exhibit 5-10**. This is a summary of the economic impacts from the competitive advantage, roadside services, tourism, and the construction expenditure. In examining the table, it is evident that twelve improved corridors have had, and will continue to have, a significant positive impact for the Region. The impact these corridors is having on the economy has grown over time and is projected to create over 42,000 new jobs and over $2 billion of value added impact by the year 2015. Examining the average impact per corridor indicates that over 3,500 permanent jobs are estimated to be created per corridor by the year 2015.

Exhibit 5-10
TOTAL ECONOMIC IMPACT
(All dollar values expressed in 1995 dollars, not discounted)

Year	Employment	Population	Wages	Value Added
1975	6,100	14,700	$68,070,000	$180,280,000
1995	16,260	30,420	$426,080,000	$610,750,000
2015	42,190	84,480	$1,177,770,000	$2,001,760,000

Exhibit 5-11
TOTAL ECONOMIC IMPACT
(In Terms of Value Added)
1995 $
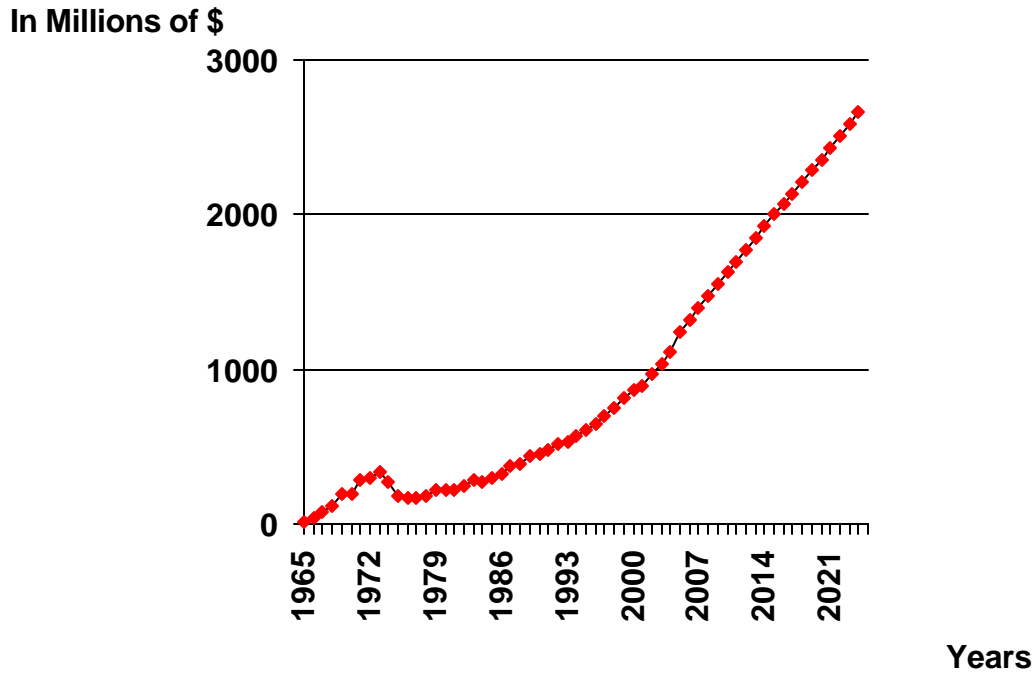
Impacts by Industry Type

A wide variety of firms and economic sectors have benefited from the ADHS. These include firms and industries that use the highways, as well as firms and industries that supply goods and services to those who build the highways, and use the highways.

Exhibit 5-12 lists ten economic sectors, and indicates the estimated number of jobs within each sector that is attributable to the ADHS.

Exhibit 5-12
EMPLOYMENT IMPACTS BY ECONOMIC SECTOR
Three Example Years

Economic Sector	1975		1995		2015	
	Employ	Percent	Employ	Percent	Employ	Percent
Manufacturing	195	3.20%	1,003	6.13%	3,348	7.94%
Mining	34	0.56%	68	0.42%	201	0.48%
Construction	3,059	50.24%	1,010	6.17%	2,479	5.88%
Trans and Pub Utilities	120	1.97%	380	2.32%	1,174	2.78%
Finance and Insurance	112	1.84%	550	3.36%	1,548	3.67%
Retail Trade	899	14.76%	4,378	26.75%	12,078	28.63%
Wholesale Trade	89	1.46%	338	2.07%	1,091	2.59%
Services	835	13.71%	6,339	38.73%	14,832	35.16%
Agr/Forestry/Fish Srv	23	0.38%	371	2.27%	656	1.56%
Government	723	11.87%	1,931	11.80%	4,778	11.33%
TOTAL	6,089		16,368		42,185	

These statistics indicate that the construction industries are the first to benefit but then, later when the highways are open to traffic, the services and retail trade sectors benefit the most. These statistics also suggest that all of the economic sectors are estimated to benefit from the ADHS.

Economic Development Conclusions

Clearly the 12 completed ADHS highway corridors have had a significant positive impact on the people of the Appalachian Region. For example:

- By the year 2015 it is estimated that 42,000 jobs will exist in the Region that, without the ADHS, would not have existed in the Region.

- The net increase in annual value added will be over $2 million by 2015. The total present value of the life cycle net increase in value added is $3.2 billion excluding construction impacts ($4.6 billion including construction impacts).

- The total life cycle economic impact of the 12 ADHS corridors, including the value added plus the portion of the travel efficiency benefits then can properly be added, is $5.5 billion in discounted 1995 price levels.

ECONOMIC DEVELOPMENT IMPACT/COST RESULTS

In Chapter 4 an economic benefit/cost comparison was developed, and the benefit/cost result was a 1.18, indicating that the ADHS significantly contributed to the economic efficiency of the Appalachian Region. Chapter 5 indicates that the ADHS does more than merely increase efficiency; it also creates economic development opportunities for the Appalachian Region (jobs, wages, value added).

To gauge the magnitude of this economic development relative to the costs incurred, an "Impact/Cost Ratio" is also developed. This ratio divides the total life cycle value added impact accruing to the Appalachian Region by the total life cycle costs incurred by the ADHS program (the state and federal dollars).

Impact/Cost Results

The results of this economic development/cost calculation are presented on **Exhibit 5-13**. The impacts used in this calculation include those due to:

- Competitive position
- Roadside expenditures
- Tourism
- Accident savings
- Other efficiencies

Excluded are the impacts attributable to the actual expenditure of federal funds in the Region.

Exhibit 5-13
ECONOMIC IMPACT/COST RESULTS

	Net Present Value ($000)	Internal Rate of Return	Benefit/Cost Ratio
Economic Development Results [a]	$1,344,376	8.2%	1.32

(a) These impacts exclude the impacts directly attributable to the expenditure of the federal funds to build the ADHS.

According to **Exhibit 5-13**:

- The economic values accruing to the Appalachian Region are greater than the federal costs of creating those Regional impacts.

- For each $1.00 invested, $1.32 is generated in economic impact value.

- The Appalachian Region is better off by $1.3 billion more than the cost of building the ADHS.

- With a positive Net Present Value, an Internal Rate of Return of 8.29%, and a Benefit/Cost Ratio of 1.32, the 12 ADHS corridors evaluated in this study are found to have had a positive impact on the Region, and a positive impact that exceeds the costs of the ADHS.

According to these statistics, the completed portions of the Appalachian Development Highway System have clearly had a very significant economic development impact on the Appalachian Region. The ADHS highways have caused places in the Region to be more accessible, and have created significant perceived efficiencies. These in turn have made the Region to be a better place to live, work, and invest, which in turn have created economic opportunity. The results are:

1. **Enhanced Economic Growth** – job opportunities, resident population, increased wages, and increased economic prediction (value added).

2. **Economically Viable Highway Investments** – the economic development impact values exceed the costs, implying feasible projects.

Costs in the Impact/Cost Calculation

The costs of the twelve corridors included in the impact/cost calculation include the cost of purchasing the right-of-way, designing, constructing, and maintaining the facility. **Exhibit 5-14** shows the construction and maintenance costs of the twelve corridors combined over the study period. The construction costs include the cost of designing the roads, constructing the major structures, relocating utilities, purchasing the right-of-way, and the constructing of the actual road.

As shown in the exhibit, highway construction costs end in the Year 1995, with only maintenance expenditures remaining for the rest of the study period. The largest outlay of construction expenditures occurs in 1973 when over $850 million (in 1995 dollars) was spent on the various corridors. Over time, the expenditures gradually decreased until 1995 when $34 million was spent. From 1996 to the end of the study period, it is estimated that the net increase in highway maintenance costs will be about $30 million per year, or $2.5 million per corridor per year.

Impacts in the Impact/Cost Calculation

The impacts from the improved corridors may be realized in a number of ways, including improved traffic safety, decreases in fuel and other vehicle operation costs, increased tourism, attraction of new industry, and an increase in roadside businesses. These impacts not only accrue to individuals who use the roads, but can be passed on to others in the Appalachian Region through lower prices for consumers, higher wages for workers, and increased profits for businesses.

Exhibit 5-14
ADHS COSTS BY YEAR IN IMPACT/COST CALCULATION
(Thousands of 1995 $, Not Discounted)

| Year	Construction Costs	Maintenance Costs	Total Costs	Year	Construction Costs	Maintenance Costs	Total Costs
1965	19,909.17	0.00	19,909.17	1996	0	29,840.35	29,840.35
1966	117,537.62	0.00	117,537.62	1997	0	30,010.16	30,010.16
1967	235,723.29	-29.90	235,693.39	1998	0	30,135.53	30,135.53
1968	335,328.64	-245.98	335,082.67	1999	0	30,135.53	30,135.53
1969	539,689.93	146.43	539,836.36	2000	0	30,135.53	30,135.53
1970	551,169.13	568.53	551,737.65	2001	0	30,135.53	30,135.53
1971	775,138.19	2,021.84	777,160.03	2002	0	30,135.53	30,135.53
1972	775,403.32	3,266.79	778,670.10	2003	0	30,135.53	30,135.53
1973	848,293.45	4,742.13	853,035.58	2004	0	30,135.53	30,135.53
1974	658,781.88	6,862.97	665,644.85	2005	0	30,135.53	30,135.53
1975	392,227.75	8,595.57	400,823.32	2006	0	30,135.53	30,135.53
1976	288,077.65	10,938.39	299,016.03	2007	0	30,135.53	30,135.53
1977	239,776.97	13,071.29	252,848.26	2008	0	30,135.53	30,135.53
1978	198,702.43	14,239.57	212,942.00	2009	0	30,135.53	30,135.53
1979	232,395.91	16,047.11	248,443.02	2010	0	30,135.53	30,135.53
1980	180,917.07	17,483.04	198,400.11	2011	0	30,135.53	30,135.53
1981	137,288.78	19,099.60	156,388.38	2012	0	30,135.53	30,135.53
1982	174,858.95	20,526.69	195,385.64	2013	0	30,135.53	30,135.53
1983	217,589.03	21,412.51	239,001.54	2014	0	30,135.53	30,135.53
1984	111,262.23	22,442.54	133,704.77	2015	0	30,135.53	30,135.53
1985	87,355.88	23,330.84	110,686.72	2016	0	30,135.53	30,135.53
1986	77,072.95	24,166.09	101,239.04	2017	0	30,135.53	30,135.53
1987	99,511.97	24,866.60	124,378.56	2018	0	30,135.53	30,135.53
1988	74,047.16	25,162.71	99,209.87	2019	0	30,135.53	30,135.53
1989	94,384.55	25,560.73	119,945.28	2020	0	30,135.53	30,135.53
1990	65,354.81	25,893.20	91,248.01	2021	0	30,135.53	30,135.53
1991	65,859.41	26,324.39	92,183.81	2022	0	30,135.53	30,135.53
1992	61,637.56	27,294.46	88,932.02	2023	0	30,135.53	30,135.53
1993	19,278.90	28,119.92	47,398.82	2024	0	30,135.53	30,135.53
1994	9,813.27	28,840.12	38,653.39	2025	-1,317,796.54	0.00	-1,317,796.54
1995	4,888.89	29,655.08	34,543.97				
				Discounted Present Value	**3,978,268.05**	**160,530.34**	**4,138,798.39**

Note: This exhibit presents statistics that are not discounted. In the economic analysis, the construction costs are later discounted at 7 percent per year and summed. The total present values are shown on the bottom of each column of the exhibit.

Therefore, the impacts include not only the economic development impacts, but also the direct benefits of an improved travel efficiency on the corridors. The direct travel efficiency benefits include the non-business travel efficiencies of travel time savings and vehicle operating savings along with the savings from a reduced number of accidents. The total impacts of the twelve corridors experience steady growth over the study period and reach $1 billion by year 1997. By the end of the study period (2025), the value of the annual impacts is estimated to total almost $4 billion.

The total discounted impact types are shown in **Exhibit 5-15**. In the exhibit, the improved competitive advantage of businesses creates over 49 percent of the total impact derived. Non-Business Benefits in the form of travel time and vehicle operating cost savings represents the next largest impact.[1] The remaining impacts (Roadside Services, Tourism Impacts, and Accident Savings) each represent 4 to 5 percent of the total benefits.

Exhibit 5-15
BREAKDOWN OF TOTAL DISCOUNTED IMPACTS BY TYPE [a]
(1965-2025)

Non-business Savings 37%

Accident Savings 5%

Tourism 4%

Roadside Services 5%

Competitive Advantage 49%
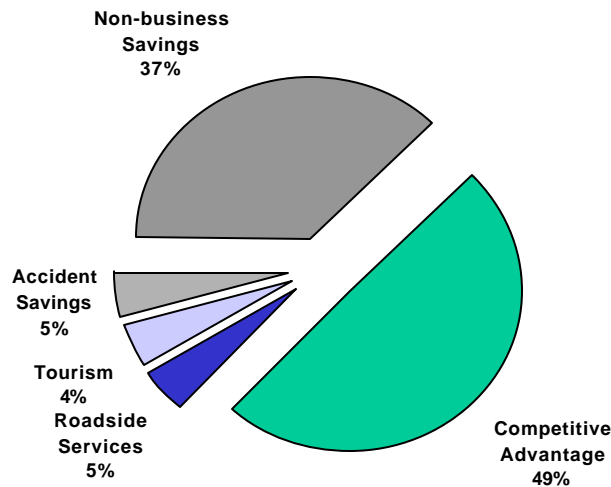
(a) This exhibit summarizes the total impacts, of all types, used in the impact/cost calculations.

In Exhibit 5-16, these impacts and benefits are shown per year. In the exhibit, columns **B**, **C**, and **D** are the economic development impacts (the value added impacts) of competitive advantage, roadside services, and tourism per year. Columns **E** and **F** are the travel efficiency impacts of Non-business savings (auto travel time and VOC savings) and Accident Savings. Column **G** represents the sum of the total economic development impacts and the relevant portion of the travel efficiency benefits.

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[1] The reason the Non-Business Benefits represent such a large percentage of the total benefits is that over 85 percent of all traffic is non-business related. This large portion of the traffic creates substantial benefits.

Exhibit 5-16
TOTAL IMPACTS IN IMPACT/COST CALCULATION
(All Values in thousands of 1995 $)

A	B	C	D	E	F	G
Year	Competitive Advantage	Roadside/ Impact	Tourism Impact	Accidents Benefit	N-bus auto Savings	Total Benefit
1965	0	0	0	0	0	0
1966	0	0	0	0	0	0
1967	100	50	50	-271	333	262
1968	2,180	610	220	1,017	6,711	10,738
1969	3,430	860	790	831	9,163	15,073
1970	5,740	1,640	1,480	1,560	13,945	24,365
1971	11,690	2,800	2,550	2,516	26,542	46,098
1972	17,160	3,650	3,300	4,946	34,128	63,184
1973	24,480	4,860	4,380	7,108	43,049	83,876
1974	40,240	7,070	6,370	9,804	66,247	129,730
1975	54,840	8,190	7,350	10,853	79,583	160,815
1976	71,090	9,130	8,200	14,028	94,306	196,754
1977	83,790	10,340	9,290	14,465	101,801	219,686
1978	99,300	11,540	10,390	17,624	115,616	254,470
1979	115,240	13,290	11,950	20,535	131,315	292,330
1980	126,110	14,790	13,290	23,089	143,743	321,022
1981	139,690	14,970	13,460	24,227	153,247	345,594
1982	145,870	15,650	14,100	25,885	161,691	363,196
1983	162,670	16,450	14,850	27,966	179,343	401,279
1984	188,360	18,220	16,420	28,010	194,936	445,946
1985	205,320	21,550	18,240	29,497	205,377	479,985
1986	225,780	24,880	21,710	32,753	220,265	525,388
1987	246,790	28,210	25,170	36,722	234,058	570,950
1988	271,250	31,550	28,630	37,256	248,557	617,243
1989	297,690	34,880	32,090	38,020	259,360	662,039
1990	316,480	38,210	35,550	38,414	270,901	699,555
1991	327,180	41,540	39,010	39,078	280,331	727,139
1992	359,160	44,880	42,470	40,564	299,309	786,383
1993	385,610	48,210	45,930	41,479	309,629	830,858
1994	417,980	51,540	49,390	43,070	326,188	888,168
1995	444,830	54,870	52,850	47,449	343,459	943,458
1996	502,790	58,200	56,310	48,579	371,421	1,037,300
1997	549,740	60,270	58,380	49,709	399,384	1,117,483
1998	605,810	61,790	59,860	50,839	427,346	1,205,645
1999	667,590	63,320	61,270	51,969	455,309	1,299,458
2000	713,120	64,910	62,820	53,099	483,271	1,377,221
2001	744,520	66,770	64,550	54,229	511,234	1,441,303
2002	810,210	68,980	66,670	55,359	539,196	1,540,416
2003	873,940	71,890	69,100	56,489	567,159	1,638,578
2004	944,240	75,690	71,790	57,619	595,121	1,744,461
2005	1,059,200	79,900	74,390	58,749	623,084	1,895,323
2006	1,129,920	85,190	77,350	59,879	651,046	2,003,386
2007	1,202,030	88,590	80,560	61,009	679,009	2,111,198
2008	1,272,240	92,140	83,820	62,139	706,972	2,217,311
2009	1,342,310	95,840	87,250	63,269	734,934	2,323,604
2010	1,411,400	99,560	90,740	64,400	762,897	2,428,996
2011	1,480,740	103,290	94,190	65,530	790,859	2,534,609
2012	1,549,810	107,000	97,650	66,660	818,822	2,639,941
2013	1,617,190	110,790	101,080	67,790	846,784	2,743,634
2014	1,686,020	114,600	104,560	68,920	874,747	2,848,846
2015	1,752,250	118,410	108,110	70,050	902,709	2,951,529
2016	1,817,360	110,430	111,620	71,180	930,672	3,041,261
2017	1,885,710	113,930	115,160	72,310	958,634	3,145,744
2018	1,951,270	117,460	118,610	73,440	986,597	3,247,377
2019	2,017,210	121,030	122,070	74,570	1,014,559	3,349,439
2020	2,082,250	124,490	125,520	75,700	1,042,522	3,450,482
2021	2,148,830	127,910	128,960	76,830	1,070,484	3,553,014
2022	2,220,060	131,450	132,370	77,960	1,098,447	3,660,287
2023	2,292,760	134,910	135,730	79,090	1,126,410	3,768,899
2024	2,366,390	138,340	139,140	80,220	1,154,372	3,878,462
2025	0	0	0	0	0	0
Discounted present value	2,699,500	253,070	235,968	247,680	2,175,020	5,483,175

Note: Columns B, C, and D represent the "value added" impacts. Columns E and F are the portion of the efficiencies that are independent of the value added impact. Together they constitute the total ADHS impact.

The Impact/Cost Calculation

In order to place the economic impacts into perspective (relative to the cost outlays which generated the impacts), an impact/cost calculation is made. In this calculation, the net economic impacts accruing to the Appalachian Region are divided by the ADHS costs paid by the Nation.

The complete impact/cost calculation is shown on **Exhibit 5-17**. On this exhibit:

Columns

B, C, D, E, F, G, I are at 1995 price levels, not discounted

K, L are discounted at 7% per year

B, C, D, E, F, G are all economic impacts which can properly be added together

J is the present worth factor at 7% per year

Year 2025 cost is the residual value of the highways in that year

PV at the bottom of each column is the present value sum of each column, discounted at 7% per year

The **Exhibit 5-17** conclusion is that the economic impact/cost comparison indicates that the ADHS positive impact on the Appalachian Region is greater than the total ADHS cost. The key conclusions are:

1. The total economic return on investment is an attractive constant dollar return of 8.29% per year.

2. The Appalachian Region is better off by an estimated $1.3 billion more than the total cost of building and maintaining the ADHS.

3. Each $1.00 invested yields $1.32 in economic development benefit for the Appalachian Region.

4. While the efficiency benefit/cost analysis indicated an economically feasible ADHS (benefit/cost of 1.18), the ADHS from an economic development perspective is even more attractive (impact/cost ratio of 1.32).

Exhibit 5-17
IMPACT-COST ANALYSIS
7 Percent Discount Rate
(All values in 1995 dollars not discounted)

A	B	C	D	E	F	G	I	J	K	L
	Competitive	Roadside/	Tourism	Accidents	N-bus auto	Total	N et Benefit -	Present-Worth	Discounted	Discounted
Year	Advantage	Impact	Impact	Benefit	Savings	Benefit	Costs	Factor	Costs	Benefits
1965	0	0	0	0	0	0	-19,909	1.0000	19,909	0
1966	0	0	0	0	0	0	-117,538	0.9346	109,848	0
1967	100	50	50	-271	333	262	-235,432	0.8734	205,864	229
1968	2,180	610	220	1,017	6,711	10,738	-324,344	0.8163	273,527	8,766
1969	3,430	860	790	831	9,163	15,073	-524,763	0.7629	411,839	11,499
1970	5,740	1,640	1,480	1,560	13,945	24,365	-527,372	0.7130	393,381	17,372
1971	11,690	2,800	2,550	2,516	26,542	46,098	-731,062	0.6663	517,855	30,717
1972	17,160	3,650	3,300	4,946	34,128	63,184	-715,486	0.6227	484,917	39,348
1973	24,480	4,860	4,380	7,108	43,049	83,876	-769,159	0.5820	496,474	48,817
1974	40,240	7,070	6,370	9,804	66,247	129,730	-535,915	0.5439	362,067	70,565
1975	54,840	8,190	7,350	10,853	79,583	160,815	-240,008	0.5083	203,758	81,750
1976	71,090	9,130	8,200	14,028	94,306	196,754	-102,262	0.4751	142,060	93,477
1977	83,790	10,340	9,290	14,465	101,801	219,686	-33,162	0.4440	112,268	97,543
1978	99,300	11,540	10,390	17,624	115,616	254,470	41,528	0.4150	88,363	105,596
1979	115,240	13,290	11,950	20,535	131,315	292,330	43,887	0.3878	96,350	113,371
1980	126,110	14,790	13,290	23,089	143,743	321,022	122,622	0.3624	71,909	116,353
1981	139,690	14,970	13,460	24,227	153,247	345,594	189,206	0.3387	52,974	117,065
1982	145,870	15,650	14,100	25,885	161,691	363,196	167,811	0.3166	61,854	114,979
1983	162,670	16,450	14,850	27,966	179,343	401,279	162,278	0.2959	70,712	118,724
1984	188,360	18,220	16,420	28,010	194,936	445,946	312,241	0.2765	36,970	123,308
1985	205,320	21,550	18,240	29,497	205,377	479,985	369,298	0.2584	28,604	124,037
1986	225,780	24,880	21,710	32,753	220,265	525,388	424,149	0.2415	24,451	126,888
1987	246,790	28,210	25,170	36,722	234,058	570,950	446,572	0.2257	28,074	128,871
1988	271,250	31,550	28,630	37,256	248,557	617,243	518,033	0.2109	20,928	130,205
1989	297,690	34,880	32,090	38,020	259,360	662,039	542,094	0.1971	23,647	130,519
1990	316,480	38,210	35,550	38,414	270,901	699,555	608,307	0.1842	16,812	128,892
1991	327,180	41,540	39,010	39,078	280,331	727,139	634,955	0.1722	15,874	125,210
1992	359,160	44,880	42,470	40,564	299,309	786,383	697,451	0.1609	14,312	126,553
1993	385,610	48,210	45,930	41,479	309,629	830,858	783,459	0.1504	7,129	124,963
1994	417,980	51,540	49,390	43,070	326,188	888,168	849,514	0.1406	5,433	124,843
1995	444,830	54,870	52,850	47,449	343,459	943,458	908,914	0.1314	4,538	123,939
1996	502,790	58,200	56,310	48,579	371,421	1,037,300	1,007,460	0.1228	3,664	127,352
1997	549,740	60,270	58,380	49,709	399,384	1,117,483	1,087,473	0.1147	3,443	128,221
1998	605,810	61,790	59,860	50,839	427,346	1,205,645	1,175,510	0.1072	3,232	129,287
1999	667,590	63,320	61,270	51,969	455,309	1,299,458	1,269,322	0.1002	3,020	130,231
2000	713,120	64,910	62,820	53,099	483,271	1,377,221	1,347,085	0.0937	2,823	128,995
2001	744,520	66,770	64,550	54,229	511,234	1,441,303	1,411,168	0.0875	2,638	126,165
2002	810,210	68,980	66,670	55,359	539,196	1,540,416	1,510,280	0.0818	2,465	126,020
2003	873,940	71,890	69,100	56,489	567,159	1,638,578	1,608,443	0.0765	2,304	125,281
2004	944,240	75,690	71,790	57,619	595,121	1,744,461	1,714,325	0.0715	2,153	124,650
2005	1,059,200	79,900	74,390	58,749	623,084	1,895,323	1,865,188	0.0668	2,012	126,570
2006	1,129,920	85,190	77,350	59,879	651,046	2,003,386	1,973,250	0.0624	1,881	125,034
2007	1,202,030	88,590	80,560	61,009	679,009	2,111,198	2,081,063	0.0583	1,758	123,143
2008	1,272,240	92,140	83,820	62,139	706,972	2,217,311	2,187,175	0.0545	1,643	120,872
2009	1,342,310	95,840	87,250	63,269	734,934	2,323,604	2,293,468	0.0509	1,535	118,379
2010	1,411,400	99,560	90,740	64,400	762,897	2,428,996	2,398,861	0.0476	1,435	115,653
2011	1,480,740	103,290	94,190	65,530	790,859	2,534,609	2,504,473	0.0445	1,341	112,787
2012	1,549,810	107,000	97,650	66,660	818,822	2,639,941	2,609,806	0.0416	1,253	109,788
2013	1,617,190	110,790	101,080	67,790	846,784	2,743,634	2,713,498	0.0389	1,171	106,636
2014	1,686,020	114,600	104,560	68,920	874,747	2,848,846	2,818,711	0.0363	1,095	103,482
2015	1,752,250	118,410	108,110	70,050	902,709	2,951,529	2,921,393	0.0339	1,023	100,198
2016	1,817,360	110,430	111,620	71,180	930,672	3,041,261	3,011,126	0.0317	956	96,490
2017	1,885,710	113,930	115,160	72,310	958,634	3,145,744	3,115,609	0.0297	894	93,275
2018	1,951,270	117,460	118,610	73,440	986,597	3,247,377	3,217,242	0.0277	835	89,990
2019	2,017,210	121,030	122,070	74,570	1,014,559	3,349,439	3,319,304	0.0259	780	86,746
2020	2,082,250	124,490	125,520	75,700	1,042,522	3,450,482	3,420,346	0.0242	729	83,516
2021	2,148,830	127,910	128,960	76,830	1,070,484	3,553,014	3,522,879	0.0226	682	80,372
2022	2,220,060	131,450	132,370	77,960	1,098,447	3,660,287	3,630,151	0.0211	637	77,382
2023	2,292,760	134,910	135,730	79,090	1,126,410	3,768,899	3,738,764	0.0198	595	74,466
2024	2,366,390	138,340	139,140	80,220	1,154,372	3,878,462	3,848,326	0.0185	556	71,617
2025	0	0	0	0	0	0	1,317,797	0.0173	-22,742	0
Discounted Present Value	2,699,500	253,070	235,968	247,680	2,175,020	5,483,175	1,344,376		4,138,798	5,483,175

	7.00%	IRR =	8.29%
	1.32	NPV =	1,344,376.32

Sensitivity Tests

The economic development impacts and impact/cost results, while valid, are nevertheless sensitive to certain key assumptions and other uncertainties. To depict this, three sensitivity tests were conducted. The first added the construction impacts to the economic development impacts. The second used a constant dollar discount rate of 4%, and the third used a discount rate of 10%.

The results of the sensitivity tests are shown on **Exhibit 5-18**. As shown, only at the unrealistically high discount rate of 10% does the ADHS become infeasible.

Exhibit 5-18
ECONOMIC DEVELOPMENT IMPACT/COST SENSITIVITY RESULTS

	Net Present Value ($000)	Internal Rate of Return	Benefit/Cost Ratio
Feasibility Test [a]	$1,344,376	8.29%	1.32
Including Construction [b]	$2,801,961	10.55%	1.68
Excluding Construction, 4% [c]	$9,971,179	8.29%	2.84
Excluding Construction, 10% [d]	($897,072)	8.29%	.72

(a) The basic test of highway feasibility, suggesting that the ADHS has a legitimate economic rationale.
(b) A sensitivity test wherein the impacts of spending the federal funds in the Region are included as economic impacts. ADHS economic feasibility is enhanced when the construction expenditures are included.
(c) A sensitivity test using a 4% discount rate. ADHS economic feasibility is enhanced.
(d) A sensitivity test using a 10% discount rate. ADHS feasibility is questioned -- but 10% is an unrealistically high constant dollar (excluding inflation) discount rate.

ECONOMIC DEVELOPMENT CONCLUSIONS

From the beginning, the ARC has strived to generate and support economic development in the Appalachian Region. An important method has been the investment in new and improved highways. ARC's investments have created economic activity in the form of jobs, increased income, increased wages, increased production, and an overall improvement in living standard. Both the Impact/Cost and the Benefit/Cost analyses have shown that this investment has resulted in a feasibility ratio of greater than 1.0. This means that the people, businesses, and communities of the Appalachian Region have gained considerably from the highway investments. The results of the analysis provide strong support for the past investment in ADHS highways.