

Chapter 2

DESCRIPTION OF THE ECONOMIC EVALUATION METHODOLOGY

This is not a typical economic study of a highway. In a typical study, the road is not yet built, the economic impacts are estimated based on a planned highway, and the question being addressed is whether or not the highway should be built. In this study, the highways that are being studied are already built and are already open to traffic. The study measures what economic impacts and benefits have occurred as a result of the completion of the highway corridors that were studied.

This study focuses on the portions of the ADHS that have already been built (12 of the 26 corridors). Those ADHS highway segments that are not yet funded and/or not yet built are excluded from the analysis. Because the highways being studied are already built, the study analyses are much more certain than is typically the case with other highway studies. For example:

- The actual construction costs are known; they need not be estimated.
- The highway locations and alignments are known; they need not be planned.
- The highways are open to traffic and the traffic volumes are known; traffic need not be estimated.

Therefore, this study is conducted with much greater certainty than is the case with most other, more traditional studies.

The challenge in this study, in terms of estimating the economic contribution the highways make to the Appalachian Region, is to estimate what would have occurred in the areas of the Region impacted if these Appalachian Development Highway System (ADHS) corridors had not been built. The economic benefits and impacts analyzed in the study represent the economic differences between:

- The Appalachian economy with the ADHS highways having been built, compared with
- The Appalachian economy that would have existed if the ADHS highways had not been built.

The differences between these two scenarios comprise the net quantifiable economic contribution, which the completed portions of the ADHS highways have made to the Appalachian Region economy.

THE ECONOMIC ASSESSMENT PROCESS

A public investment in a series of highway corridors such as the ADHS is “economically feasible” if the economy is better off with the investment than without it. Without question highways are significant assets to the people who live and work along the corridors. But the key issues addressed in this study are (1) the magnitude of overall transportation efficiency benefits believed attributable to the highway improvements, and (2) whether such efficiencies induce economic development and/or economic productivity within the Appalachian Region.

Overall Economic Analysis Approach

Great care was taken in the selection of an economic impact methodology. Alternative methods were considered, but the one that was selected has been supported by FHWA.

Optional Approaches – A number of different approaches have been attempted in various studies, all with the goal of quantifying or otherwise depicting the economic gains believed attributable to highway construction. Some of these have been applied previously to the Appalachian Development Highway System.¹ Others have been applied nationally, to the national system of highways.² In addition, there are a number of technical approaches that are available to address the economic questions.³

Travel Efficiency/Economic Development Approach – What was ultimately decided was to use an economic approach that is described in two places.⁴ FHWA in 1996 examined alternative approaches to highway corridor economic analysis, and developed its “Good Practices” report. That FHWA report states that the FHWA “...report is intended to supplement the Federal Highway Administration’s (FHWA’s) Procedural Guidelines for Highway Feasibility Studies to serve as a reference document on good practice. It provides a set of principles drawn from the best of recent highway and multimodal corridor studies, and directs attention to sources for more information on examples of good practice.”⁴

“The audience for this (FHWA Good Practices) report is intended to be all persons involved in highway corridor feasibility studies, including those who are developing work programs or proposals, those who are performing the studies, and those who are overseeing the work as members of review committees. The primary audience is intended to be those involved in feasibility studies initiated as a result of Congressional action and administered by the FHWA. However, this report should also be useful to a secondary audience; namely, those involved in other highway corridor studies.”⁴

¹ “The Economic Effects of the Appalachian Regional Commission,” Andrew Isserman and Terance Rephann, 1995.

² “Economic Impacts of Federal-Aid Highway Investment: Productivity Impacts of Highway Investment,” 1996; and “Highway Infrastructure Investment and Job Generation,” U.S. Department of Transportation, 1996; and “Productivity and the Highway Network: A Look at the Economic Benefits to Industry of the Highway Network,” Federal Highway Administration, 1996.

³ “AASHTO Red Book”—American Association of State Highway and Transportation Officials: *A Manual on User Benefit Analysis of Highway and Bus Transit Improvements*, 1977.

“HERS Manual”—Jack Faucett Associates, *The Highway Economic Requirements System*, Federal Highway Administration, US DOT, July 1991. (an update is scheduled for 1996-7.)

“Indiana Guide”—*Major Corridor Investment-Benefit Analysis System*, Cambridge Systematics and Bernardin Lochmueller for Indiana Dept. of Transportation, 1996.

“NCHRP 342”—D. Lewis: *Primer on Transportation, Productivity and Economic Development*, National Cooperative Highway Research Program, Transportation Research Board, August 1996.

“Road Investment to Foster Local Economic Development,” University of Iowa Public Policy Center, 1990.

“NCHRP 7-12”—Texas Transportation Institute: *Microcomputer Evaluation of Highway User Benefits*, National Cooperative Highway Research Program, Report 7-12, Transportation Research Board, 1993.

⁴ “Examples of Good Practice: Highway Corridor Feasibility Studies,” Planning Programs Branch, FHWA, June 1996; and “Iowa Guide”—*Guide to the Economic Evaluation of Highway Projects*, Wilbur Smith Associates for the Iowa Dept. of Transportation, 1993.

Economic Methodology

“Most of the substance of this (FHWA Good Practices) report is drawn from five corridor feasibility studies which were selected by FHWA staff because portions of each of the studies include examples of the best of current practice. The five corridors and the reference documents, all of which were underway prior to development of FHWA’s guidelines, are:⁴

1. Chicago to Kansas City: *Chicago/Kansas City Tollway Feasibility Study: Overview Report and Engineering Analysis*; Howard Needles Tammen & Bergendorff, et al.; January 1990; and *Financial Analysis*; Price Waterhouse, et al., March 1990; for Federal Highway Administration, Illinois Department of Transportation, and Missouri Highway and Transportation Department.⁴
2. St. Louis to St. Paul: *St. Louis to St. Paul Corridor Feasibility and Necessity Study; Consultant’s Report to the States and Executive Summary*; Wilbur Smith Associates; March 1990; for Federal Highway Administration, Iowa Department of Transportation, Illinois Department of Transportation, Minnesota Department of Transportation, and Wisconsin Department of Transportation.⁴
3. U.S. Highway 20 in Iowa, from Sioux City to Fort Dodge: *U.S. Highway 20 Corridor Development Study; Final Report and Executive Summary*; Wilbur Smith Associates, et al.; December 1992; for Iowa Department of Transportation.⁴
4. Transamerica Transportation Corridor, from California to the Chesapeake Bay area: *Transamerica Transportation Corridor – Transportation Options for the 21st Century Feasibility Study – Final Report*; Wilbur Smith Associates and Howard Needles Tammen & Bergendorff; September 1994.⁴
5. Corridor 18, from Indianapolis to Houston: *Corridor 18 Feasibility Study; Final Report and Executive Summary*; Wilbur Smith Associates and HNTB Corporation; November 1995; for Arkansas State Highway and Transportation Department.”⁴

The economic evaluation methodology described in the FHWA “Best Practices” study of 1996 was used in this assessment of the completed portions of the Appalachian Development Highway System.

Economic Principles

Government is often asked to make highway investments for "economic development" purposes. The rationale is that the area served by the highway will be better off due to greater transport efficiency, the possible attraction of new businesses, and the overall improved ability of the corridor(s) region to compete (with the rest of the country) for economic activity.

This study analyzes the completed portions of the ADHS, to determine what impact the improvements to the highways have had on the Appalachian Region.

Definition of Economic Development - For purposes of this study, economic development is defined as "an increase in the prosperity and incomes of people and institutions." Economic development of this nature in the Appalachian Region occurs when the incomes and products

generated in the Region increase. Improved highways can cause such increases to occur in either of two ways: more resources and/or greater efficiency.

- **More Resources** - If goods and services produced in the Appalachian Region (output) increase, more resources (land, labor, materials, capital) will be required which means that more people are employed, more incomes are earned and more profits are made. If the ADHS investment enables the retention of existing firms or the attraction of additional business to the Appalachian Region (new firms, or expanded firms), then the highway has aided the Region's economic development process.
- **Greater Efficiency** - Even if the improved highway does not help to create increased output (more resources) in the Appalachian Region, it can still help economic development by causing the Region's (and the Nation's) output to be achieved at less total cost. Reduced transportation costs due to the highway improvement in this way yields increased prosperity and income.

The study finds that the completed portions of the ADHS (the 12 corridors) have accomplished both: the federally funded highways have enabled the attraction of "more resources" and they have created greater "efficiency." As a result, the highway improvements have enabled/created some "economic development."

Economic Development Basis for a Feasible Highway Project - Highways are essentially "tools" used in transporting goods and people from one place to another. Investments in highways contribute to economic development in that they lower transportation and/or logistics costs and/or improve people's perceptions of the corridor thereby causing them to want to settle/invest there, and/or divert and induce traffic. Such changes may be realized in numerous ways, including improved safety, decreases in fuel and other vehicle operation costs, revised logistics or agricultural or mining patterns, and reductions in noise or air pollution.

Such changes that result from the ADHS may not only accrue to persons and businesses that use the highways. 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 as higher net income. Persons may thus benefit from the ADHS highways without traveling on them.

It is important to keep in mind that for any of these benefits to occur, the highway must either have enabled significant reductions in transportation costs or cause revised perceptions of the region served by the highway. If the amount of these savings is small for each trip, if the number of vehicles using the highway is not sufficiently large, or if peoples' perceptions do not change significantly, the investment will not produce sufficient economic development impacts to make the investment worthwhile.

Treatment of "Transfer" Impacts - This study recognizes only "net" changes within the portion of the Appalachian Region impacted by the 12 study corridors. Transfers of economic value from one part of the Region to another part (from one group of people or firms to another group of people or firms within the Appalachian Region) are excluded from the calculations.

Under Investment vs. Over Investment - There are economic consequences of either under investing or over investing in highways. If the states or the Appalachian Regional Commission

under invest in highways, economic development will be inhibited because real and perceived travel costs will be greater; tourism and competitive position will be retarded, etc. There is, therefore, an economic cost associated with under investment in highways. If the states or ARC over-invest in highways, overall efficiency will suffer because those funds could have been put to better (more efficient) use elsewhere. There is therefore a net cost to society of either underinvesting, or overinvesting, in highways

Economic Model - The Regional Economic Models Incorporated (REMI) econometric model is used in this study to ascertain the magnitude of the economic development impacts believed attributable to the ADHS. Inputs into the model comprise cost savings to area businesses, increases in disposable income to area residents, increased roadside business revenues, increased tourism revenues and construction cost expenditures.

Travel Efficiency and Economic Development

The two ways that a highway can impact an area economically (greater efficiency and more resources) are both analyzed in this study. Greater efficiency is calculated as travel efficiency benefits, and more resources are calculated in the form of economic development impacts.

- **Travel Efficiency** - Automobile users benefit from better highways due to faster average travel speeds (time savings), reduced accident rates (safety), and improved traffic flow (vehicle operating costs). Truck travel similarly may be faster, cheaper and more reliable. These types of travel efficiency benefits are estimated in this study for the completed segments on each of the 12 ADHS study corridors.
- **Economic Development** – This impact type depicts how the highway improvements impact the region's economy in terms of creating economic opportunity, creating/retaining jobs, and creating value added. These are caused by:

Improved Competitive Position - Highway improvements sometimes remove an impediment to economic development. Reduced transportation costs and/or better access can enable a region to better compete for economic activities, meaning that business activity is expanded in, or otherwise attracted to, the corridor's economy.

Non-Business Travel – Vehicle operating cost savings for private personal travel result in an increase in disposable income (less spent on travel, more available to spend on other things).

Roadside Service Industries - The highway improvements may induce traffic (trips that otherwise would not be made), which will increase local revenues of roadside businesses such as gasoline stations, motels, restaurants and others.

Tourism - If the highway improvements cause additional visitors to be attracted to the region, the area's income and general prosperity will rise (over and above the Roadside Service Industries' impacts).

These types of economic development impact are presented for all 12 studied corridors combined. The economic development impacts are not presented on a corridor-specific basis.

The overall economic evaluation process as applied in this study is depicted in **Exhibit 2-1**. The chart shows that the traffic volumes and travel costs are tabulated both with and without the ADHS highways. For purposes of clarification, the travel efficiency improvements that result from the ADHS are referred to as *benefits*, and economic development improvements are referred to as *impacts*. The chart indicates that all the net highway improvements costs are compared with all quantifiable "net" travel efficiency benefits. These benefits and the overall traffic analysis provide the foundation for assessing the magnitude of economic development impacts that accrue to the Appalachian Region.

Another important distinction between the benefits and impacts is that the travel efficiency benefits are calculated from the national perspective, while the economic development impacts that are calculated from the Appalachian Region's perspective. The rationale for this distinction is that the travel efficiency gains are net gains to society (no one loses, there is no transfer effect) while the economic development impacts accrue to businesses and residents in the impacted portions of the Appalachian Region and may be transfers from elsewhere in the U.S.A. (not necessarily a net gain to the entire U.S.A.).

Life Cycle Analysis Time Period

To ensure evaluation consistency, a life cycle approach is used in this study. In most studies, travel efficiency benefit/cost analyses evaluate the project over a period of 20 to 30 years, which is a suitable period of time over which to cover the construction and use of the road. Since the various segments of the 12 ADHS study corridors were authorized and built between 1965 and 1995, a single 30-year analysis period is not acceptable. To ensure that the benefits of each segment of the 12 corridors is evaluated over a period of at least 30 years, the study period was extended through 2025. All ADHS corridor segments are evaluated through the year 2025, regardless of when they were built, 1965, 1980 or 1995.

For these reasons, the analysis of the completed segments of the 12 study corridors begins in the year of funding authorization (between 1965 and 1992) and continues through the year 2025, which results in a 60-year analysis period, 1965 to 2025, for some highways.

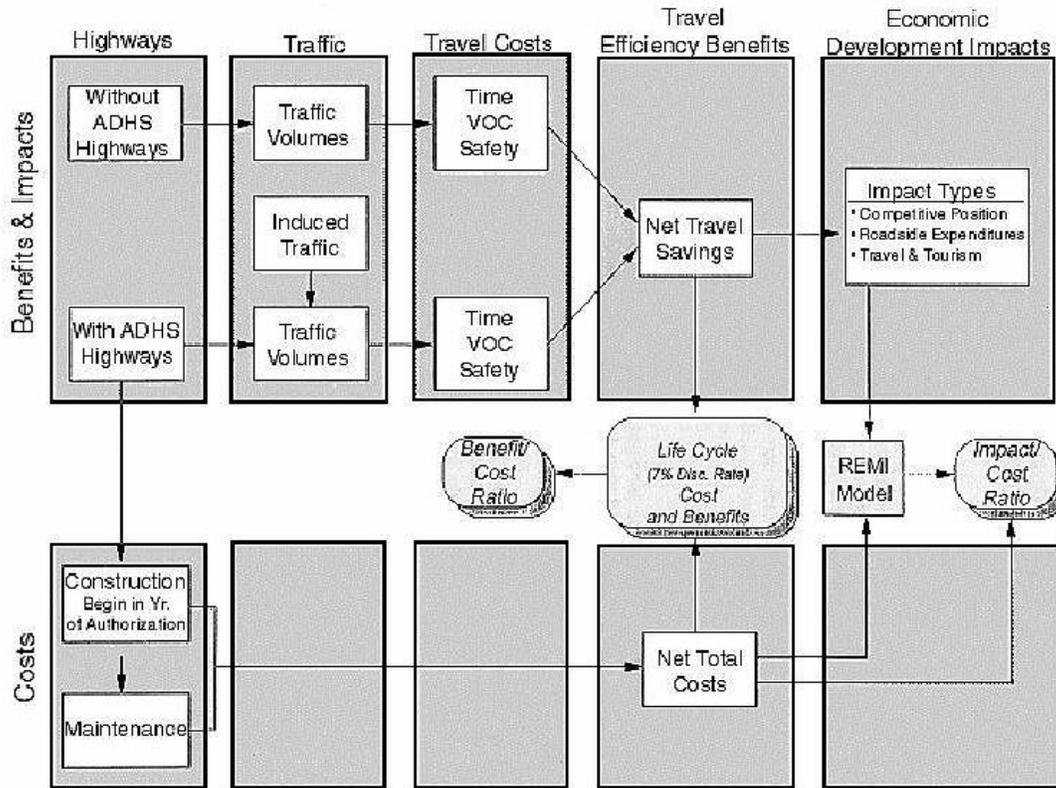
Quantifiable Economic Implications Only

It is important to stress that this study, in its estimates of benefits and impacts, only includes:

- Those implications that can be quantified, and
- Those implications that are economic in nature.

Therefore, this study examines only the quantifiable economic implications of the ADHS; it does not address the social, quality of life or other non-quantifiable impacts. There are likely many social and other positive ADHS impacts that are not included in this study.

Exhibit 2-1
ADHS ECONOMIC EVALUATION PROCESS



Social Benefits Not Examined – For example, the ADHS likely has increased access to health care, education, cultural amenities and otherwise improved access to other social needs. These types of access benefits cannot be measured in economic terms and therefore are not included in this study.

Import Substitution Effects Not Included – This study methodology assumes that travel efficiency is the only net gain to the USA, and that the economic development impact for the Appalachian Region is a transfer effect nationally. But this is not necessarily the case. There may be economic development impacts to the U.S.A. that are not included. For example, better access to tourist destinations in Appalachia might cause a net increase in tourism nationally, or better access to Appalachian hardwood products might create a net gain for American hardwoods (a benefit to the USA).

These are examples of ADHS implications that are not included as quantifiable economic benefits or impacts believed attributable to the ADHS. In this sense the benefit and impact estimates in this study could be viewed as conservative.

TRAVEL EFFICIENCY ECONOMIC BENEFITS

Transportation efficiency is a legitimate local corridor, regional, state and even national goal. If a road improvement creates road user cost savings that, over time, exceed the cost of the road improvement, then that road improvement should be implemented. Therefore, travel efficiency is relevant to the funding decision for Congress, the FHWA, the Appalachian Regional Commission, the individual state departments of transportation, and local agencies.

The highway travel efficiency benefits due to ADHS improvements are of three types: value of travel time savings, vehicle operating cost savings, and accident cost savings. Such benefits are calculated for two vehicle types: cars and trucks. Travel efficiency benefits are calculated by corridor beginning in the year the segment was opened to traffic through the year 2025.

The calculation itself compares travel costs in the built scenario (with the ADHS in place) with travel cost in the non-built scenario (if the ADHS were not built). For this reason, comparable road data were needed for both scenarios.

Travel Time Savings

Most highway investments enable motorists to travel more quickly. There are potentially three different ways to reduce travel time: (1) Reducing mileage to reach one's destination by offering a shorter route, (2) Increasing the speed at which one can travel by providing facilities with higher design standards, and (3) Reducing congestion by providing additional high capacity facilities. A methodology to take into account all three elements of time savings was developed. It uses the results of the corridor surveys, which describe the ADHS corridors the way they are today, and the way they were before the ADHS was implemented. In effect, for each vehicle using one of the ADHS segments, travel times with and without the new improved highway are calculated and summarized. Travel times are calculated for each segment using the Highway Performance Monitoring System (HPMS)⁵ model methodology and data developed by FHWA. This methodology recognizes that travel time varies due to the design of the road, the speed limits in effect, and the level of congestion (expressed in terms of volume/capacity ratios). Travel

time also varies by type of vehicle (it takes longer for a truck to climb an upward grade or resume original speed when slowed down by congestion).

To include time savings in the transportation efficiency evaluation, it is necessary that a purposes of this study, values of time based on average hourly wage rates, average occupancy and cargo values were developed using the FHWA methodology outlined in the Highway Economic Requirements System (HERS)⁵. The resulting values of time are:

- \$16.59 per on-the-clock auto hour (travel while on business);
- \$7.64 per off-the-clock auto hour (commuter and non-business travel);
- \$21.48 to \$28.95 per truck hour depending on the type of truck.⁶

These values are used in this study, and sensitivity analyses are also conducted.

Vehicle Operating Cost Savings

The costs of operating motor vehicles are a significant portion of the total cost of transportation. Vehicle operating costs include a number of components, some of which are variable costs (use related), and others are fixed costs (insurance and license fees which typically do not vary with use). Only use-related costs -- engine oil, gasoline, maintenance, and tires -- are directly affected by an improved highway. Vehicle operating costs, like travel time, vary with the characteristics of the trip being made including trip length, running speeds, and speed change cycles. Using the same data as for the travel time, vehicle operating costs with and without the ADHS were calculated. HPMS model data was used to develop the costs.⁶ With this methodology, vehicle operating costs vary with the length of the segments, the various speeds on different portion of the segments, and the type of vehicle. Excess vehicle operating costs due to speed change cycles are also calculated by type of vehicle.

Accident Reduction Cost Savings

Improvements in highway safety comprise another reason for building highways with higher design standards. Because a higher standard 4-lane roadway is safer than an older 2-lane lower standard road, many of the ADHS roadways reduce accident risk. National average injury rates by type of accident (fatal, injury, property damage only) and by type of highway facility were used to calculate accidents savings in the various corridors under study.⁷ These accident rates are shown on Exhibit 2-2.

⁵ "Highway Performance Monitoring System (HPMS)," FHWA, 1994

⁶ "Highway Performance Monitoring Systems Analytical Process (HPMS)," FHWA, 1987

⁷ "Highway Statistics," FHWA, 1994 and 1995

Economic Methodology

Exhibit 2-2 ACCIDENT RATES BY HIGHWAY TYPE Rate Per 100 Million Vehicle Miles of Travel

Accident Types: Highway Lanes:	Fatalities		Serious Injuries		Other Injuries	
	<u>2</u>	<u>4</u>	<u>2</u>	<u>4</u>	<u>2</u>	<u>4</u>
Rural Interstate	1.209	1.209	5.151	5.151	30.733	30.733
Rural Other Principal Arterial	2.458	2.300	12.211	10.990	73.822	66.439
Rural Minor Arterial	2.915	2.727	14.917	13.425	102.579	92.321
Rural Collector	3.285	3.038	17.367	15.338	135.354	121.305
Rural Local	3.855	3.607	19.331	17.398	198.845	178.960
Urban Interstate	0.626	0.626	4.858	4.858	67.177	67.177
Urban Other Freeway/Expressway	1.170	1.095	5.552	4.997	86.844	78.160
Urban Other Principal Arterial	1.494	1.397	17.281	15.553	214.497	193.048
Urban Minor Arterial	1.260	1.179	14.863	13.376	179.640	161.676
Urban Collector	1.070	1.001	14.334	12.901	142.775	128.497
Urban Local	1.741	1.628	18.198	16.378	286.084	257.431

Source: FHWA Highway Statistics and Consultant Calculations

To include the accident reduction benefits in the transportation efficiency evaluation, a monetary value was assigned to each type of accident. The accident monetary values used for this study are based on "The Economic Cost of Motor Vehicle Crashes," National Highway Traffic Safety Administration (NHTSA) 1994 data.⁸

- \$2,854,000 per fatality.
- \$654,000 per seriously injured person.
- \$20,600 per other injured person
- \$1,600 per property damage only (PDO) vehicle

Total Travel Efficiency Benefits

The total efficiency benefits quantified in this study comprise the sum of the travel time savings, vehicle operating cost savings, and accident savings. Under the efficiency category, economic development impacts (job creation, etc.) are excluded.

ECONOMIC DEVELOPMENT IMPACTS ON APPALACHIAN REGION

Highway improvements of the ADHS type make travel faster, easier and more efficient. These improvements divert traffic from other highways; they also generate traffic. Such events are most welcome, not only because of the travel efficiencies and the improved perception of the area served by the highway, but also because of what these travel efficiencies and perceptions could mean to the local economy that is served by the highway. Whereas the previous section explained the methodology behind the estimation of travel efficiencies, this section explains the methods used to estimate the economic development impacts that are of value to the Appalachian Region.

⁸ "The Economic Cost of Motor Vehicle Crashes," National Highway Traffic Safety Administration (NHTSA), 1994

The REMI Economic Model

The economic development impact portion of the study relies on an inter-regional model of the US and the Appalachian Region referred to as “REMI.” REMI is a private sector model owned by Regional Economic Models, Inc. of Amherst, Massachusetts. This model package, which has previously been applied to a number of corridor evaluations, has the advantage that it is dynamic in the sense that it allows the primary impact region to interact with the rest of the United States.

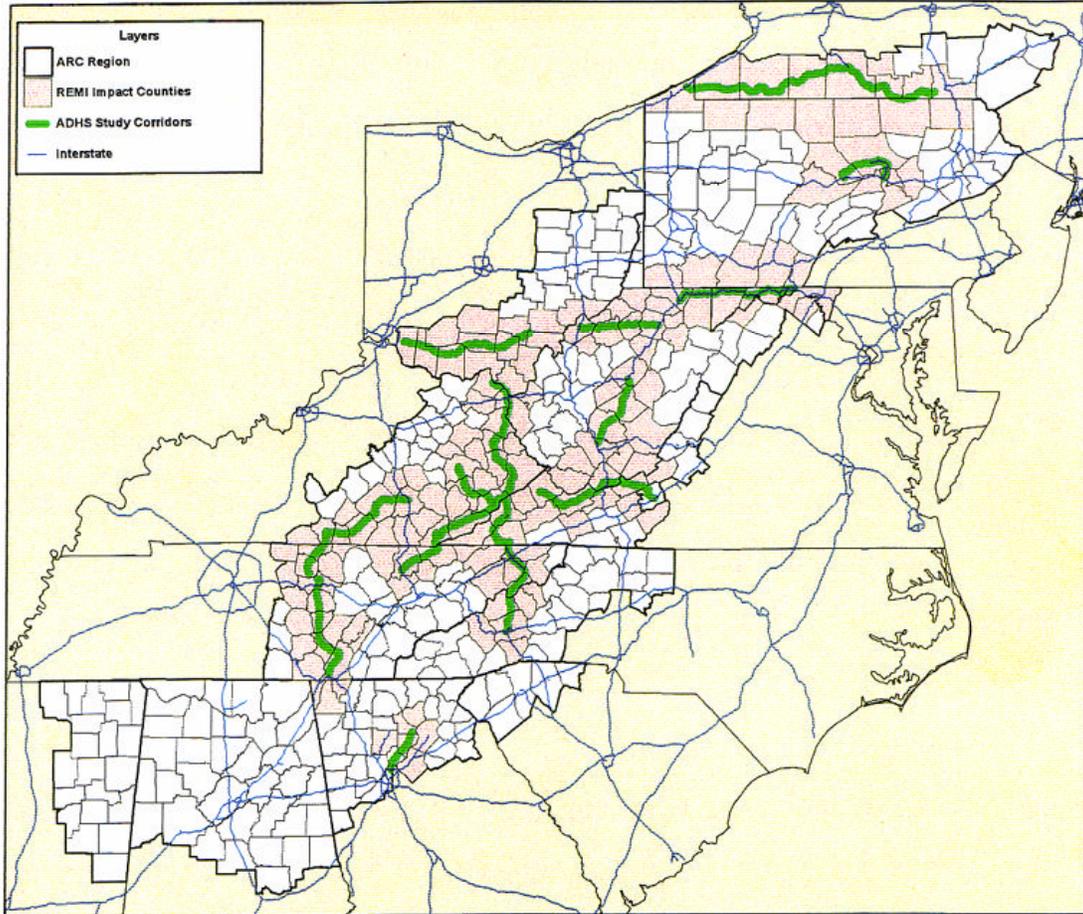
The REMI model is a comprehensive forecasting and simulation system useful for policy and investment analysis of a wide array of issues. While it does have some similarities to Input-Output models, it allows greater interaction of industries and it has the ability to estimate the proportion of an increase in demand for goods and services from a shock to the system that can be met by businesses within the region. Within the model, wages are responsive to changes in labor market conditions, migration is responsive to changes in expected income, and the share of local and export markets responds to changes in regional profitability and export costs.

From a highway investment feasibility perspective, the study was interested in the extent of economic development that has occurred as a result of the highway improvement. Moreover, the degree of economic development, which may result from the highway, varies depending on the stage of total socioeconomic development for the impact region. That is, a remote small rural community with a relatively undeveloped labor pool may not have the full range of socioeconomic conditions required to fully benefit from the economic development potential of a highway improvement. REMI accounts for this phenomenon in its estimates of economic impact.

Modifications to REMI Model - Simulations with the model can be used to estimate the economic and demographic effects of policy and investment interventions such as economic development programs, infrastructure investments such as new highway construction, energy and natural resource conservation programs, state and local tax changes, and other policies. The policy simulation compares the performance of the corridor region after a policy intervention with the projected performance of the region based on national forecasts of industry growth and estimates of the shifting competitive position of each industry in the corridor region compared to that industry elsewhere in the country and elsewhere in the primary impact area. Because REMI is primarily an economic forecasting model, alterations to the inputs and the outputs had to be made in order to reflect the historical nature of this study. A description of these alterations is discussed in **Appendix A**.

Primary Economic Impact Areas - The REMI model is compiled by county, which requires a clearly defined impact area. Although the ADHS spans a large geographic area, each study corridor is perceived to principally serve a primary impact area near the highway. For analysis purposes, the “principal impact” areas were defined as those counties through which one of the corridors passes plus those that lie within a ten-mile buffer of the new highways. These are included in the REMI primary impact study areas as shown in **Exhibit 2-3**. The selected impact area is mostly rural and excludes many of the major urban areas (Atlanta, Pittsburgh, and Cincinnati). Any area within the Appalachian Region that was not included in the primary impact area was considered a second region of non-primary impact counties. The REMI primary impact area includes 165 of the total 399 counties in the Appalachian Region. The other 234 counties comprise non-primary Appalachian Region counties.

Exhibit 2-3
REMI MODEL IMPACT REGIONS
Primary Impact Counties and Rest of Appalachian Region



REMI Model Inputs - In the following pages, the method in which the economic impacts are estimated is described. The impacts derived from an improved competitive position, increased roadside services, and additional dollars spent on tourist related businesses are based upon travel estimates derived from the traffic forecast model used in the study. The method used in the calculation of REMI model outputs for the ADHS system is displayed in **Exhibit 2-4**.

Indicators of Economic Development Impact

The ADHS investments are believed to impact the Appalachian Region economy in numerous “economic development” ways. In order to recognize these impacts in a consistent fashion, a single set of "impact indicators" were used. These are all produced by the REMI model, and are as follows:

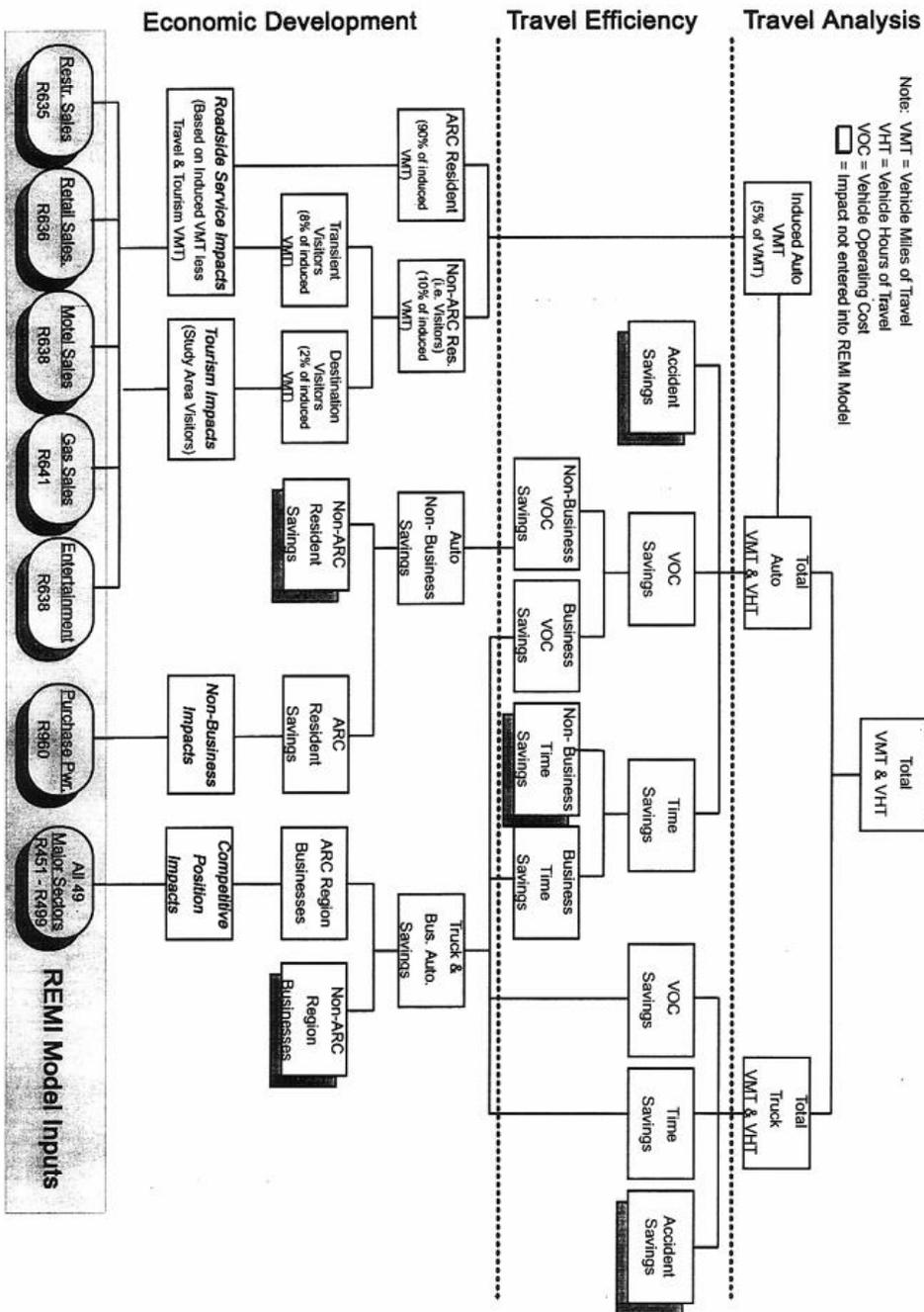
- **Value Added** – Dollar value of increased Regional product believed attributable to the completed portions of the ADHS.
- **Employment** – Net change in Appalachian Region jobs believed attributable to the completed portions of the ADHS.
- **Wages** - Total increases in payroll costs (wages and salaries and benefits) paid to those increased jobs.
- **Population** - Total population dependent on the new jobs created by the completed portions of the ADHS.

All monetary calculations are expressed at constant 1995 price levels (unless otherwise stated).

Direct Measures of ADHS Economic Development Impact

The fact that the study’s 12 ADHS corridors have been built and are operational has caused a number of “direct impacts” to have occurred. These direct impacts include those items that can be measured using available information. It is these direct impacts which are input into the REMI model to estimate the total economic development impacts believed attributable to the ADHS. Four such direct impacts were estimated in this study. These are:

- **Competitive Position** – Improved access, revised perceptions of an area, and reductions in transportation time and cost make the corridor areas more attractive, and can lead to reduced costs of production, which in turn lead to marginally reduced prices and/or increased profits, which can lead to increased production (firm expansion and/or attraction of new firms), which in turn generates economic impact value. Efficiencies of this type are input into the REMI model.
- **Roadside Service Industries** – Increased traffic due to the highway improvements generally increases local sales at roadside businesses (restaurants, gasoline stations, motels, and other businesses that cater to highway users). These increased sales are input into the REMI model, to the extent that they exist.



- **Tourism** - Highway improvements of the scale of the ADHS help to attract additional visitors to the area over and above the Roadside Service Industry impacts. Such travel and tourism impacts pertain to visitors who choose to visit the area after the road improvement because of the improved access. This direct increase in tourism expenditures is also input into the REMI model.
- **Highway Construction** - The act of spending money to build the highway is of immediate economic impact to the region. These impacts are temporary in nature, since they primarily exist during the construction period and dissipate after road construction (when the highway is open to traffic). These "direct" impacts of highway construction are calculated and are run through the REMI model, but they should not be used as evidence that the highway improvements are feasible. Therefore, these impacts are not included in the calculation of the impact/expenditure ratio.

All four of the above identified "direct impacts" are estimated in the study for each of the 12 corridors, based on the traffic models and on secondary data. However, they are not presented on a corridor-specific basis. Each is described in greater detail below.

Competitive Position Impacts

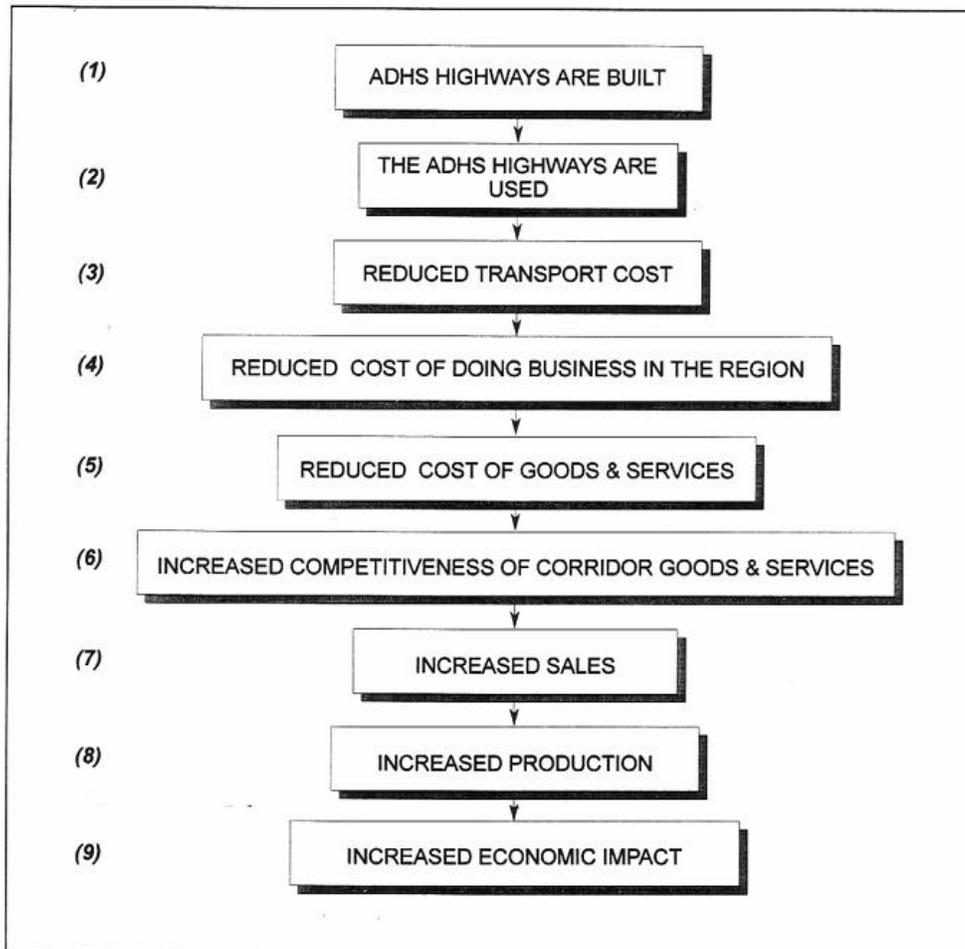
There is a desire for the Appalachian Region, and its individual corridor regions, to expand existing businesses, to attract new businesses, and to diversify the area's economic base. To attract business activity to the Appalachian Region, the Region must be competitive with other areas of the USA.

The question arises as to what extent the ADHS investments impact the businesses already in the Region. A related question is what the highways could do to help foster growth of other, emerging industries. It is clear that competition is great among regions of the USA to maintain as high a level of economic activity as possible and to attract activities demonstrating growth potential nationally. Keeping transportation costs as low as possible is one action government can take to make a region more competitive.

Exhibit 2-5 presents a sequential flow of activities involved in moving from the ADHS highway improvements to the associated economic impact in terms of what they do for competitive position. The activities are described as follows:

1. **The ADHS Highways Are Built** - The act of building the improved highways has a short-term economic impact; that impact is assessed in this study.
2. **The ADHS Is Used** - The improved highway is used by existing and induced traffic. Because the highways are already built, the extent of ADHS use is known.
3. **Reduced Transportation Cost** - The highway improvements lead to increased travel efficiency in the form of reduced travel time, increased travel reliability, reduced accidents and revised vehicle operating costs. The efficiencies themselves are quantified in the "Travel Efficiency Analyses" for cars and trucks.

Exhibit 2 - 5
COMPETITIVE POSITION PRINCIPLES



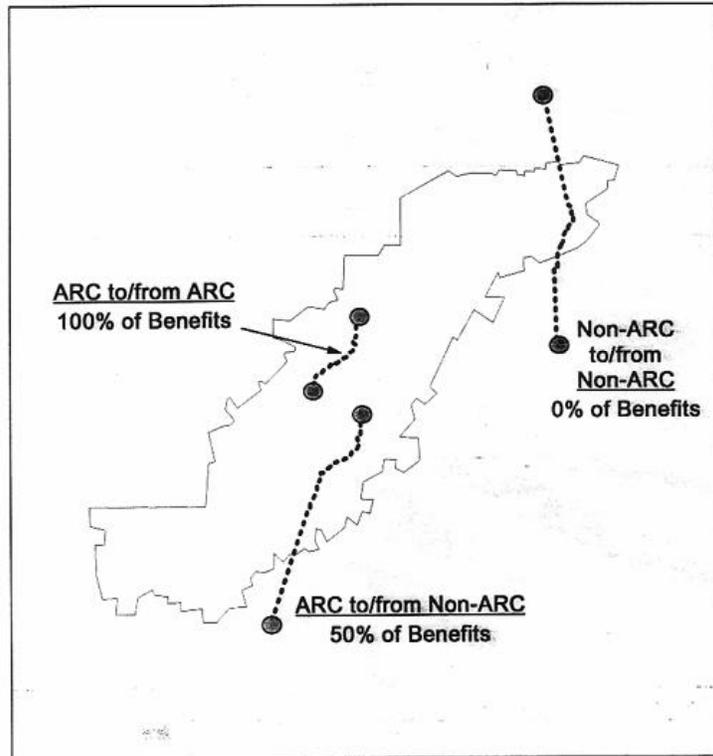
4. **Reduced Costs of Doing Business in Corridor** - Transportation cost is one factor in the cost of doing business in the Appalachian Region. If transportation costs, especially trucking costs and business travel costs, decline in the corridor, this means that the total cost of doing business in the corridor will also decline slightly.
5. **Reduced Prices of Goods and Services** - If costs of production in Appalachia decline due to transportation cost reductions, the result will be reduced prices of goods and services, or increased profits, or both. Such reductions apply to goods produced in the Appalachian Region as well as goods shipped into the Region.
6. **Increased Competitiveness of Appalachian Region's Goods and Services** - With slightly reduced costs, and therefore prices, the goods and services produced in the region should be slightly more competitive with the ADHS than without it.
7. **Increased Sales** - If the Appalachian Region's goods and services become more competitive due to price decreases, the region's businesses should be able to make additional sales of those goods and services.
8. **Increased Production** - If sales increase production of goods and services will increase by a like amount.
9. **Increased Economic Impact** - Increased production means that more of the Appalachian Region's people are employed, more income is earned, and economic activity expands.

These types of competitive position changes are calculated for the 12 corridors as a whole. To estimate these impacts, the vehicle operating cost and time savings of truck and business related automobile traffic for traffic that originates and/or terminates in the Region are estimated.

For purposes of the REMI analysis, the portion of cost savings, in terms of travel time savings and vehicle operating cost savings, for business related trips⁹ are placed into the REMI model as cost savings across all of the different industries for the Appalachian Region. These cost savings must be broken down into benefits to the direct impact area (referred to as the ARC region) and benefits for indirect impact areas (referred to as the Non-ARC region). For example, when a business located in the Appalachian Region transports goods along an improved study corridor, any cost savings incurred help make the business more competitive. Conversely, when a business that is *not* located in the region ships goods through the region, travel efficiency benefits associated with the highway improvements *should not* be accounted for in the competitive position impacts because the savings accrue to businesses outside the region. The three trip type variations of Region and non-Region trip movements are diagrammed in **Exhibit 2-6**.

⁹ While all truck trips can be considered business trips, only a portion of auto trips can be considered business trips. According to the *1990 Nationwide Transportation Survey*, 13.3 percent of all auto trips are for business purposes. This percent was used in this study.

Exhibit 2 - 6
ECONOMIC BENEFITS VARY BY TRIP TYPE



These cost savings are placed in the REMI model in the year that the cost savings occur. To distribute these costs savings across the different industries, a proxy is established for the importance of each of the industries represented in the Appalachia Region. The proxy is based upon the number of employees each of the industries has of the total employees for the region in a base year of 1995. Based on this proportion, each industry receives a portion of the cost savings as an input into the REMI model. For instance, mining has 2.2 percent of the total employees for the Appalachia Region. Therefore, mining receives 2.2 percent of the total cost savings for each of the years under examination.

- If a trip begins and ends in the Appalachian Region, 100 percent of the travel efficiency benefits accrue to residents of the Region and are input into the economic development analysis.
- If only one trip end is in the Appalachian Region, only 50 percent of the travel efficiency benefits are considered as input into the economic development analysis since it is assumed that half of these trip makers reside outside of the Appalachian Region.
- If a trip neither begins nor ends in the Appalachian Region, zero percent of the travel

efficiency benefits are considered as input into the economic development analysis because these benefits accrue to people who reside outside of the Region.

To estimate the distribution of these three types of trips, surveys from previous studies with similar road types were used.¹⁰ It was established that 92.7 percent of all auto trips can be classified as ARC auto trips while 79.85 percent of all truck trips can be classified as ARC trips. Based upon these estimates of trips that are business related and can be classified as ARC trips, the values of travel time savings and VOC savings are placed into REMI as cost savings across the various industries of REMI.¹¹

Once again, due to the historical nature of the study, savings had to be placed into REMI with some adjustments since REMI is usually a forward-forecasting model. See **Appendix A** for details of the adjustments process.

Roadside Service Impacts

A safer and more travel efficient highway system in the Appalachian Region should lead to an increase in the volume of traffic by inducing traffic to these roads. An increased volume of traffic creates an increase in the volume of sales for roadside businesses including motels, restaurants, gasoline stations, and other businesses that cater to highway users. The impacts from the roadside expenditures are considered to be net benefits to the corridor region. The volume of traffic induced onto the roads is based upon the existing traffic volumes (in terms of VMT) and is assumed to be 5 percent of the total traffic (VMT). Of this induced traffic, it was estimated that 10 percent of the traffic is from non-residents and 90 percent is from resident traffic. To avoid double counting, 8 percentage points of the 10 percentage points of non-residents is considered transient visitors while the remaining 2 percentage points is considered destination visitors.¹² The VMT created by the 8 percent of non-resident visitors plus the 90 percent of resident visitors is the basis for deriving the roadside services REMI inputs.

¹⁰ The estimate for the breakdown of trips was obtained from a survey of similar rural roads in the U.S Highway 20 Study Corridor Development Study, Iowa Department of Transportation. This breakdown of trips could be viewed as conservative for a number of reasons. First, the survey examined the proportion of trips that have origin and destination points within the State of Iowa, which is a much smaller area than is the Appalachian Region (Iowa has 55,965 square miles while the counties that make up the Appalachian Region have 185,268 square miles.) Second, the points at which the traffic was surveyed in this study are near the borders of Nebraska and South Dakota and presumably, would have a much higher percent of trips that either begins or ends outside the state than a road in the center of that state or the center of the Appalachian Region.

¹¹ The cost savings are appropriated to each of the industries in the REMI model based upon the importance of each of the industries to the Appalachian regional economy. A simple example might clarify this point. If it is determined that a new road could create \$1000 of savings, and there were only five industries within a region each with 20 percent of the employment of the region, then each industry would receive \$200 worth of cost savings. The importance of the industries is based on the proportion of total employment within each industry.

¹² The 2 percent is based on the *1990 Nationwide Personal Transportation Survey* which estimated that 2 percent of VMT is for the purpose of vacation.

To estimate the inputs for REMI from the roadside expenditures to the Appalachian Region, an expenditure per VMT mile was estimated. Data from surveys in previous studies were utilized to gain an estimate of the roadside expenditures per VMT. These surveys suggest that the roadside service impacts from road improvements is 0.193 cents per VMT.¹³ These costs by expenditure type are shown in **Exhibit 2-7**.

Exhibit 2-7
ROADSIDE EXPENDITURE RATES

<u>Expenditure Type</u>	<u>Expenditure per VMT</u>
Motel	\$0.023
Restaurant	0.021
Gasoline	0.072
Other Retail	<u>0.077</u>
Total	\$0.193

VMT = Vehicle Miles of Travel

These direct impacts per VMT are multiplied by the induced VMT (from residents and non-residents) to gain a value of inputs for the roadside services impacts.

Tourism

The Appalachian Region is attractive to visitors for many reasons, including its ski areas, fishing opportunities, scenic vistas, mountains, and lakes that are part of a network of trails and scenic roads. Tourism can create a substantial impact on a region through money expended on hotels, summer homes, restaurants, gas stations, gift shops, etc. By creating safe and efficient roads, a region can enjoy greater accessibility and have an added economic impact through an increase in the volume of tourists. Based on the *1990 Nationwide Transportation Survey* produced by the FHWA, it is estimated that two percent of VMT is vacation related. Therefore, two percent of the induced VMT was assumed to be tourist related. To establish the impact that tourists have on an area, a regression was conducted to derive a multiplier per VMT for tourist

¹³ These expenditures per VMT are based on an analysis from a previous study called St. Louis to St. Paul *Corridor Feasibility Study, 1990*. In this study, expenditures per VMT were estimated, and explained below. These values were inflated to 1995 levels.

- It was assumed that people stay at motels if they drive 500 miles. Motels cost \$50, or 10 cents per VMT. Assume only 20 percent of diverted or induced traffic stays in a motel. Impact per VMT is therefore 2 cents per VMT.
- If people traveling spend \$20 per person day, and there are 1.6 people per vehicle, and they travel 500 miles, the cost is 6 cents per VMT. If only 30 percent of the travelers stop for food (the other trips are shorter, not involving restaurants), the expenditure per VMT is 1.8 cents.
- If fuel costs \$1.25 gallon, at 20-miles/ gallon, the gross expenditures is 6.2 cents per VMT.
- Vehicle drivers also pay other vehicle user costs (oil, tires, maintenance), and buy things (gifts, other retail). These expenditures are estimated at 6.7 cents per VMT.

traffic¹⁴. The tourist VMT was multiplied by this derived multiplier to gain the value of inputs for tourism. The output of this calculation was included in REMI as an input to derive an economic impact of tourism created by the improved roads.

Highway Construction Impacts

The very act of spending large sums of externally generated (federal) construction money in the Appalachian Region also is of economic value to the Region, since contractors and construction workers are hired, gravel is purchased, etc. Economic value created in the Appalachian Region due to the act of spending such construction funds in the ADHS corridors was estimated.

Data concerning each corridor's capital costs were examined in terms of construction cost and right-of-way cost. The construction costs were treated as increases in final demand and input into the REMI model. The right-of-way costs were treated as transfers and not included. The construction costs were assumed spent, initially, within the Appalachian Region. The economic impacts due to the act of construction comprise the monies spent in the corridor and the flow of those monies in terms of respending. The impacts include the labor and expenses associated with planning, design and construction, plus the respending of those funds to the extent that such respending occurs within the Appalachian Region.¹⁵

ADHS IMPROVEMENT COSTS

The cost side of the cost-benefit calculation includes two costs: 1) the "capital costs" of constructing each ADHS completed highway segment, and 2) the annual change in highway administration, operation, and maintenance costs due to the new ADHS highways.

- **Capital Cost** - Capital costs comprise the actual funding incurred by the Appalachian Regional Commission in improving the road sections. This includes all funds expended from the ARC budget relative to the planning, design, and construction.
- **Road Maintenance Cost** - Once the ADHS highway improvements were in place, there is more road to maintain than previously. The resulting net change in maintenance and operations cost is included as a net new cost attributable to the ADHS highway investments.

Capital Costs

¹⁴ The regression analysis ran a series of regressions in which dollars spent on different tourist related service was the dependent variables, while the independent variable was the VMT of the 12 corridors. By using the regression analysis, a correlation between VMT and dollars spent on tourist services was established and this correlation is represented by the coefficients in the regression analysis. These coefficients were multiplied times the induced VMT on the 12 corridors to gain the value of inputs for tourism in REMI.

¹⁵The construction impacts should only be used to indicate the extent to which the region might benefit economically from the attraction of federal funding to the Region. They should not be used to try to justify that federal expenditure.

Economic Methodology

Exhibit 2-8 lists the ADHS costs used in this study. The construction costs (current) depict the total capital cost expenditures of the various years summed, at the price levels appropriate for the years when the expenditures were authorized (current price levels). The construction costs (Constant 1995) are the same costs expressed at Constant 1995 price levels. The current costs were converted to Constant 1995 price levels using the Highway Construction Cost Index.

Exhibit 2-8 also lists the number of traffic lanes before and after the ADHS. It indicates that many of the corridors were expanded from 2-lane highways to 4-lane highways. The exhibit then identifies the average ADHS construction costs per added lane mile and per total lane mile, all expressed at Constant 1995 price levels.

Exhibit 2-8							
ADHS Construction Cost Comparisons							
Corridor	Construction Costs (\$000)¹		Corridor Length (miles)	Average No. Lanes		Average Construction cost per² 1995	
	Current	Constant 1995		Before	After	Added Lane mile	Lane Miles
A/A1	\$54,989	\$113,911	30.4	2.3	4.0	\$1,150	\$489
B	\$927,866	\$1,825,251	249.4	2.2	4.0	\$2,013	\$906
D	\$308,346	\$843,689	189.8	2.0	4.0	\$1,417	\$708
E	\$430,702	\$903,113	109.2	2.0	4.0	\$2,209	\$1,105
F	\$147,539	\$350,560	99.3	2.0	3.0	\$1,954	\$651
I	\$100,432	\$256,341	59.9	2.0	3.0	\$9,137	\$1,192
J	\$379,704	\$630,414	214.5	2.0	3.0	\$1,228	\$409
L	\$167,165	\$457,946	60.5	2.1	4.0	\$2,349	\$1,116
P	\$207,228	\$472,046	54.7	2.1	4.0	\$2,482	\$1,179
Q	\$235,249	\$579,656	129.8	2.0	4.0	\$1,264	\$632
T	\$568,056	\$1,256,350	220.3	2.2	4.0	\$1,709	\$769
All Corridors	\$3,527,277	\$7,689,277	1,417.8	2.1	3.7	\$1,824	\$789
1) Total capital investment in the ADHS corridor. "Current" dollars are the actual expenditures by year summed over the period 1965-1995. "Constant" dollars							
2) Constant 1995 construction costs divided by number of new ADHS lane miles built and divided by total lane miles in the corridor.							

Economic Methodology

Annual Maintenance Costs

The annual estimated increase in annual highway maintenance costs were also included in the ADHS evaluation. These annual maintenance costs were estimated based on maintenance costs per functional class reported in "Highway Statistics," FHWA. The average of 1993, 1994 and 1995 maintenance costs in \$1995 were used. These unit costs are listed in **Exhibit 2-9**.

Exhibit 2-9
HIGHWAY MAINTENANCE COSTS PER LANE MILE
(1995\$, Thousands)

Rural Interstate	\$11.887
Rural Other Principal Arterial	3.957
Rural Minor Arterial	3.426
Rural Collector	3.557
Rural Local	2.949
Urban Interstate	6.834
Urban Other Freeway/Expressway	10.091
Urban Other Principal Arterial	4.916
Urban Minor Arterial	7.809
Urban Collector	3.957
Urban Local	3.957

Total Costs Present Value

The present value of the net cost increase for each corridor are listed in **Exhibit 2-10**. These are used in the study's economic benefit/cost analysis.

Exhibit 2-10
TOTAL PRESENT VALUE COSTS ^(a)
(1995\$, Thousands)

<u>Corridor</u>	<u>Construction</u> <u>Costs</u>	<u>Maintenance</u> <u>Costs</u>	<u>Total</u>
A/A1	\$ 55,318	\$4,119	\$59,437
B	879,597	23,972	903,569
D	517,035	20,711	537,746
E	444,194	38,331	482,524
F	189,274	4,729	194,003
I	161,546	2,645	164,191
J	251,514	11,865	263,380
L	264,599	5,460	270,059
P	245,423	12,507	257,930
Q	320,695	7,468	328,163
T	<u>649,074</u>	<u>28,723</u>	<u>677,797</u>
Total	\$3,978,268	\$160,530	\$4,138,798

(a) See Appendix B for the tabulation of these costs.

ECONOMIC BENEFIT/COST AND IMPACT/EXPENDITURE ANALYSES

This study's methodology indicates that the ADHS could help the Appalachian Region economy in two quantifiable ways:

- **Benefits** – Monetary value of travel efficiencies (vehicle operating cost, travel time, and accident savings) accruing to the economy; and
- **Impacts** – Economic development impacts (jobs, value added, etc.) accruing to the Appalachian Region.

The totals for these two indicators of economic consequences should not be added together; adding these together would be to double count the economic consequences of the ADHS. Instead, only selected portions can be added together, as done in Chapter 5.

But the benefits and impacts by themselves only indicate that there were positive economic consequences due to the ADHS. To indicate whether or not the ADHS was a prudent use of federal dollars, it is necessary that the economic costs to society of building and maintaining the ADHS be compared with the economic benefits or impacts derived.

This comparison is accomplished in this study by conducting a benefit/cost comparison, initially by comparing the economic benefits (efficiencies) with the ADHS costs, then by comparing the economic impacts (value added) with the ADHS costs.

Excluded from the benefit/cost calculations are the road improvement implications that cannot be tabulated in monetary terms (environmental or social implications, impacts on other modes of transportation, etc.). As a result, the economic benefit/cost calculations should be important relative to interpretations of how well the ADHS has performed, but should not be viewed as the only criterion.

Travel Efficiency Benefit/Cost Ratio

A benefit/cost approach is used to compare the net economic costs with the net travel efficiency benefits, in the form of a benefit/cost ratio. This ratio is similar to those used in other conventional studies when the road is not yet built, but is superior to the normal ratios in three important ways:

1. The benefits are based on what has already actually occurred (since the study highways are built), rather than what is estimated to occur if the corridors were built;
2. The benefits are based on actual 1995 traffic, and therefore are more accurate than benefits based on forecasted traffic;
3. The costs are actual costs rather than estimates.

Other than these differences, the ADHS benefit/cost ratios are similar to other highway feasibility studies where the analysis is conducted before the highway is built.

Life Cycle Benefit/Cost Approach

The 30-year construction period and limited historical traffic data complicates the process of presenting the study findings. Typically, study results are presented over the life cycle of the project, 20 or 30 years. The life cycle method sums the constant dollar value of all costs and benefits by the year they were incurred and discounts them by the Office of Management and Budget (OMB) discount rate of 7.0 percent. The results are then presented by a number of feasibility indicators that include:

- **Net Present Value** – All costs and benefits in future years are discounted back to the base year using the adopted discount rate. The future stream of discounted costs are subtracted from the future stream of discounted benefits. If the sum of the discounted benefits is greater than the sum of the discounted costs, the “net present value” is positive and the highway improvement is deemed to be “economically feasible” in terms of travel efficiency.
- **Discounted Benefit/Cost Ratio** – After the future streams of costs and benefits are discounted, the sum of the discounted benefits is divided by the sum of the discounted costs. If the result is 1.0 or greater, the highway improvement is “economically feasible” from a travel efficiency perspective.
- **Internal Rate of Return** - This calculation determines that discount rate at which the net present value difference between costs and benefits is zero. If the rate of return, expressed as a percentage, is equal to or greater than the adopted discount rate, then the highway improvement is deemed to be “economically feasible” in terms of travel efficiency.

Economic Impact/Cost Ratio

The value-added impacts estimated to accrue to the Appalachian Region are also divided by the costs to obtain an “Impact/Cost Ratio.” In effect, this divides Regional Impacts by National Costs. Therefore, it is not a true benefit/cost, since the numerator beneficiary is different than the denominator who is paying the cost. Nevertheless, this ratio is useful in visualizing the extent to which federal funds are helping the Appalachian Region.