A METHOD FOR MEASURING THE ECONOMIC RESULTS OF RURAL HIGHWAY IMPROVEMENTS PROPOSED FOR USE IN APPALACHIA[1/]

by

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Introduction

The range of possible benefits to Appalachia resulting from highway improvements are economic, financial, social, political, strategic, etc. Not all of these benefits may be precisely defined, and only a few of them quantified in terms of money. But when economic considerations are of major significance, as in regional development projects, a quantitative analysis must be made of all the most tangible economic benefits. The final judgment, of course, may take in to consideration qualitative impressions, the less tangible results of the projects being considered, and the political aspects.

The economic benefits from new or improved highways may be defined in two groups: (1) Savings in money and time to the present highway users in the region. These savings include vehicle operating cost reductions, fewer accidents and reduced travel time requirements. (2) Increased production and economic activity due to first-time or improved access to particular locations and due to the reductions in transport costs and time requirements. These reductions enlarge marketing areas for present products and provide the opportunity for products new to the region to compete successfully in the national market. To the extent that transport cost reductions are passed on to consumers, a part of their income is "saved" for other expenditures or investments.

The extent to which these benefits can be quanitified depends on the adequacy and availability of needed statistical data. Highway studies of this scope have been done more frequently in foreign countries, sometimes with U.S. AID funds, than in the United States. The most commonly used procedures in the U.S. are concerned only with savings in vehicle operating costs. Such studies are usually confined to a specific project area, and to the purpose of setting priorities among alternate routes or projects, i.e., which alternative affords the largest net operating cost saving. There have been no careful, or "scientific," measurements of the economic benefits or consequences of highways in rural areas, although there have been a number of "before and after" studies in American urban areas dealing with land values, tax bases, retail activities, building permits, etc.[2/]

The proposed study is regional in scope -- much broader than previous U.S. highway studies. As such it would serve both as a general planning survey for answering the question "What will be the economic consequences of major highway

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1/ This paper was presented January 17, 1966, at the 45th Annual Meeting of the Highway Research Board of the National Academy of Sciences.

2/ For details of such studies, see Chapter IV and the Bibliography of Highway Benefits: An Analytical Framework, Mohring and Harwitz, Northwestern University, 1962.

improvements in Appalachia?", and as a preliminary route selection study ranking the possible corridors or sub-regions for major highway improvements. A feature of the study proposal is a survey of some other regions in the United States to aid in understanding the interaction between highway transport improvements and economic development in settings similar to Appalachia.

Of the innumerable issues raised in economic benefit studies only a few can be dealt with in this analysis. The actual incidence of benefits among various social and economic groups will not be traced or evaluated. Herein "a benefit is a benefit." A discussion of incidence and tax equity problems, as well as others, may be found in Highway Benefits: An Analytical Framework, see3/.

I. Measurable Benefits for and from Freight Movements

A. Benefits to Base-Load Traffic

Of the several types of traffic which will use the new or improved highways, that which moves on the present highway system or which would be forecast to move if no change were made in that system, is referred to as base-load traffic. The savings accruing to this traffic from highway improvements are the only reductions in vehicle costs which will enter directly into the final benefit summation. The assumption is that this traffic moves now, and will move in the future for reasons not connected with the proposed highway improvements or with economic changes caused by such improvements. The only benefits to the base-load traffic are the savings in cost and time provided by better highways. These costs may be defined as fuel, repairs, tires, driver time for trucks and buses, and depreciation. The latter may be reflected either in lengthened vehicle life or in more trips during the present life span.

These savings to vehicle owners and users (shippers and passengers using common or contract carriers) may arise from two types of traffic: 1) traffic already moving on routes to be improved plus the forecast increases (if any) assuming no improvements, and 2) traffic diverted from parallel routes in the region which would become inferior to the improved route. With regard to the second group, if a number of highway improvements were made at once, the diversion among highway routes might be reduced to a less significant factor.

Accurate measurements of vehicle operating costs are of the utmost importance. The most desirable source of cost data would be the detailed records of fleet operators, particularly those with vehicles operating over several different highway conditions, including new highways of the standards proposed for Appalachia. Assuming records were available for several years, this procedure would provide accurate maintenance and major repair data for the region, perhaps with variations according to class and condition of the highways.

3/ For details of such studies, see Chapter IV and the Bibliography of Highway Benefits: An Analytical Framework, Mohring and Harwitz. Northwestern University, 1962.

If enough cooperative fleet owners (they would have to allow detailed analysis of vehicle operating records and cost accounts) are not available, it will be necessary for the study group to rent representative types of vehicles and conduct road runs under controlled conditions and careful observation. Two groups of routes should be chosen for these test runs. The first group should represent existing conditions of road surface, and average curvature and gradient. The second group would consist of roads in the eastern United States which approximate the standards which would be used for the improved highways in Appalachia. The same vehicles would operate over both groups of routes, in one case establishing present operating costs and in the other indicating probable future operating costs. The difference between the two sets of costs would represent the cost savings or benefits.

Average speeds would be carefully recorded both for determining prospective time savings and for adjusting estimated costs if necessary. Increases in speed cause increased tire wear and fuel consumption under identical operating conditions. The tests should cover 10 trips by each vehicle over each group of routes, the groups being 250-400 miles in length. Half the trips on new roads would be run at the average speeds observed on the old roads in order to get direct comparisons of tire wear. Accurate measurements would be made of fuel consumption and of tire wear (weight of rubber worn away). Maintenance and repair costs would be derived from fuel and tire costs to complete the estimate. The possibility of important measurable savings from reductions in accidents should be investigated, primarily through analyzing differences in accident rates according to traffic density and geometrical standards on existing highways in the region.

As a concluding step diversion from other transport modes, both rail and water in this case, requires analysis. The cost to society of the parallel rail and water services is the long-run marginal cost of providing those services and not the rates which the carriers may charge for specific shipments. It could well be that, due to the complexities of rate structure, traffic could be transferred from the low-cost mode to a higher-cost mode because the price (rate charged) of the latter to the shipper -- using either public or private transport -- becomes less than the price presently charged to shippers by the true low cost mode. Traffic diverted from other modes would be included in base-load traffic in the same manner as traffic diverted from other highway routes. But diverted rail or water traffic should be included only when it is certain that the social cost of highway transport is below that of the other mode.

B. Benefits from Increased Traffic

It is assumed that for a number of products the reduced cost and time of transport made possible by highway improvements would lead to increases in radius of market or in penetration of existing markets. Products not now made in Appalachia due to transportation disadvantages could be marketed for the first time. The economic benefits of these production increases are best quantified through calculation of changes in the regional value of product, referred to here as Gross Regional Product or GRP. In such calculations, benefits are accounted for through an increase in the net value of regional production rather than through identified savings to the additional vehicle movements required by the traffic.

It should be noted, of course, that some products with inelastic or restricted markets would not be aided by transport cost reductions in a manner which would support production increases. Shippers, transporters and receivers would share the cost saving which would here be included in the base-load traffic.

There are two types of increased, or induced, traffic. The first type will be referred to as generated traffic -- the traffic resulting from the increased output of existing production facilities, but which requires no major additional investments in production factors and no changes in land use. This traffic represents trips not now made or forecast to be made under present conditions, but which would be made following the proposed transport improvements.

The second type of increased traffic, and the most significant from the point of view of regional development, is that arising from changes in land use, including new, or greatly expanded production sources, and the conversion of existing producers to different products. This traffic will be referred to as developed traffic. This concept assumes that additional commitments of production factors (capital, land, labor) will be made. Since, in the GRP accounting, we are primarily concerned with the net value of increases in product, the greatest contribution to this net increase for the region would be made by the utilization of production factors not now employed, particularly land and labor. To the extent that presently employed factors are shifted to other types of production there is an offsetting decrease in the former production in the GRP accounts. If production factors are shifted from other regions into Appalachia, there would be a net increase in the gross regional product but a much lesser, if any, increase in Gross National Product.

The distinction between generated and developed traffic is a purely artificial one from the standpoint of traffic measurements as well as from the standpoint of net change in GRP. However, generated traffic requires no additional investment of importance and may be available as an economic benefit immediately upon completion of the highway improvement. It is probable that the full amount of generated traffic would be realized within the first two years of operation. Development traffic, on the other hand, requires additional investment, which may be both public and private, and inevitably involves substantial time lags -- perhaps as much as seven to ten years in extreme cases -- before the economic benefits are realized. These differences are quite important from the standpoint of regional economic impact and of short and long range economic planning, including the financing and scheduling of investments other than highways.

C. Other Measurable Benefits

It is assumed throughout this study that a proportionate share of the savings in transport costs are passed on to the clients of common and contract carriers. In spite of the rate structure complexities alluded to earlier, there is probably sufficient competition among all the elements of the highway transport industry to assure the passing of a major share of the savings to end users over a reasonable period of time. Some of these savings will, however, be retained by the carriers and vehicle operators. Through these processes arise what economists refer to as consumer and producer surpluses.

For consumers, both within the region and without, the ability to buy at a lower price than they have been paying (or are willing to pay) constitutes a clear gain. The differences between the old and the new price represents income that can be used for additional purchases or savings. Such consumer surpluses as may be discerned and estimated during the GRP accounting are included in the final summation of benefits.

The savings realizable from lower transportation costs may accrue to the producer of the transportation service in a combination of two ways: (1) He may reduce the price of his service and thereby increase sales. Such an increase will immediately be reflected in the GRP calculation. (2) He may maintain his prices (and presumably his sales) at present levels and absorb the cost savings himself. This absorption in the form of an increased return for his service (product) creates the producer's surplus. It arises when his return exceeds the minimum return necessary to keep the factors of production under his control modernized and committed to their present use. Admittedly, calculation of these surpluses involves subjective standards for the minimum earnings the owners of the various factors of production are willing to accept. These earnings include wages, rents, interest, and profits, i.e., all forms of income earned by the owners of factors of production. Where strong competition exists, it tends to drive producer's surpluses down to zero.

It is possible to estimate these surpluses and for some types of benefit studies the effort might be worthwhile. However, in the present instance it will be assumed that producers' surpluses are reinvested in factors of production (including transport facilities) and that the increase in production thereby made possible will be reflected in a net increase in GRP.

The transport producer's surplus will arise from improved use of equipment (reduction in number of vehicles required or more trips from the present number), heavier loads, shorter turnaround times, and reduced down time for major maintenance -- all made possible by the improved highways directly, or by improved equipment utilization resulting from increased traffic. It may be noted that from the standpoint of the national accounts the reduced use of transport resources relative to production resources in the region would be a national economic saving.

II. Measurable Benefits for and from Passenger Movements

Although benefit measurements will differ from freight, passenger traffic may be grouped in a similar manner. Base-load traffic is that presently moving (including parallel routes subject to diversion), and that which would be forecast if no changes were made in transportation facilities. Traffic increases above the base load presumably would arise from three sources: (1) additional "routine" intraregional passenger movements resulting from a more rapid rate of population increase in the region than that now forecast, (2) an increase in external, business-connected traffic resulting from accelerated economic development and (3) an increase in tourist and recreational traffic.

The last category is the only increase in passenger traffic above base load whose measurement will be discussed here. If population and development trends show need for estimating (1) and (2) this could readily be made. Tourist and recreational traffic may be segregated into generated traffic (requiring no further major investments and representing intensified use of present facilities), and development traffic (requiring changes in land use and additional investment).

While it would be possible, as in the case of freight traffic, to estimate operating cost savings for passenger traffic increases above the base load, the regional accounts approach will yield a better result and lead to the measurement of the full economic benefit which is the net increase in sales arising from tourism and recreation (including boating, skiing, hunting and fishing).

The measurement of benefits provided by the increases in freight and passenger movements above the base load is, of course, most easily accomplished for a specific project in a localized setting. However, it is clearly possible to make regional estimates of a somewhat cruder nature and thereby compare the net economic benefits provided by alternative groups of highway improvements.

III. The Interaction of Transportation and Other Economic Factors in Regional Development -- A Survey of Other Regions in the United States

The lack of precise knowledge concerning the role of transportation in economic development, particularly under conditions of advanced development as in the case of the past 30 years, requires a survey of selected regions of the United States. Since there are no carefully observed "before and after" data for major transport investments (except for a few large urban areas), this survey will have to depend on generally available data at the county level and on the analytical judgment of the investigators. The Department of Commerce has considered preparing data in 18 categories for use in surveys such as here proposed. These data would be drawn from the 1940, 1950 and 1960 censuses, covering 20 years for every county in the U. S. Other data are available for each year back at least to 1946.

The survey in each region should determine the timing of major highway improvements in the region during the past 30 years, and more specifically, during the past 15 years. Comparisons would then be made of data on county economic indicators before the improvements with the same indicators for successive intervals of two, five and ten years thereafter, if possible. Where highway improvements along a route have been made in installments over an extended period of years, unrelated economic changes may be so extensive as to eliminate any certainty in the relationship between transport improvement and other economic trends. Data to be reviewed would include population, labor force, banking transactions, retail sales, building construction, assessed valuation, real estate prices, physical production, and other specifically identifiable industrial, institutional and recreational developments.

The regions chosen are rural regions in the eastern half of the United States where recreation and tourism are of some importance and where, in some cases, the product mix and terrain may be similar to Appalachia. Those regions where transport improvements have been very gradual or where data at the county and city level are very poor should quickly be abandoned and attention given instead to the more likely prospects. The following list of regions is suggestive rather than definitive.

1. Northern Tier New England States. The analysis should first look for response in these states to the multi-lane highway improvements in Massachusetts and Connecticut which have greatly reduced the access time, and then examine the discernible impacts of the Maine Turnpike, Interstates93 and 95 and primary routes 3, 5, and 7 in Vermont and New Hampshire. It is assumed that Route 1 improvements are old and have been pieced together over such a lengthy period that they are of no observational value. Changes in the modal mix of tourist travel of these states would be important due to their long history.

2. Cape Hatteras Area. Completely unlike Appalachia, this area is included only because it draws on the same tourist market and is similar in distance. A circle of constant radius based on New York City cuts through Cape Hatteras; Roanoke, Virginia; White Sulphur Springs, West Virginia; Montpelier, Vermont; and Kennebunk, Maine. In the course of these studies, the time of access and the degree of inconvenience should, if possible, be measured for each of these areas.

3. Central New York State before and after the completion of the Thruway. Special attention should be given to the region between Syracuse and Buffalo and to comparison of the counties straddling or adjacent to the thruway with the tiers of counties to the north and south.

4. Northern Michigan and the Upper Peninsula. This study should include response to the Mackinac Bridge, Interstate 75, and Primary Routes 10, 23, 27 and 131.

5. Northern Wisconsin. Response to improvements along Interstate 90 and Primaries 12, 16, 41 and 141.

6. The Ozarks of Missouri and Arkansas. Response to improvements along Interstate 44, Primaries 54, 66, 67 and 167.

IV. Economic Development Factors in Sub-Regions of Appalachia

While all of the principal subdivisions of Appalachia will be examined during the natural resource, agriculture and industry studies, the experience of some of the sub-regions are particularly pertinent to the relationship, if any, between transportation and economic development and should be surveyed at the same time as the other U. S. regions. The procedures will be similar

to those suggested for the other regions in the United States, the use of all available county data over a period of years with careful attention paid to the timing of any important transportation improvements. Some suggested sub-regions are:

1. The Poconos, Eastern Pennsylvania. This region is certainly well located in relation to major markets for tourism and recreation and is well served by transport. What is the nature of problems that have led to a virtual economic decline in this sub-region? Changes in recreational tastes have been suggested as a factor.

2. Hinterland of the Pennsylvania Turnpike. This relatively high-class route has crossed Appalachia for 30 years. What has been the economic history of those counties straddling or adjacent to the Turnpike compared with counties one or two tiers removed from the Turnpike?

3. Hinterland of the West Virginia Turnpike. While this turnpike is a less significant improvement than the Pennsylvania highway, it cuts through a very difficult part of Appalachia. The first question is the same as that posed for the Pennsylvania Turnpike and the second is that of the adequacy of the north and south connecting roads.

4. Tennessee Tri-Cities Area. Although Johnson City, Bristol and Kingsport have demonstrated unusual economic vitality, including industrial diversification, they do not seem to be well located with respect to transportation. Factors may be observable here which can shed light on possibilities elsewhere and on the relationship between transport and flourishing development.

5. The TVA Recreation Areas. What are the characteristics, in terms of amenities and facilities, that draw people to this sub-region? What are the observable characteristics of the highways vis-a-vis the origin of the travelers who use them?

These five studies will obviously provide leads to more detailed analyses which will be helpful in forming judgments about the extent of interaction between transportation and economic expansion at the current levels of development and about the plausibility of crediting some of the estimated benefits to highway improvements.

V. Individual Product Studies

A necessary prelude to a forecast of the increases in gross product for Appalachia are a number of product studies for the major crops and industries, present and prospective, which will enable measurement and forecasting of the economic benefits of generated and development traffic (I. B.) and will also indicate the magnitude of additional investments which would be needed.

As a practical matter, it will be necessary to:

- Conduct a systematic review of past and present production using censuses of industry, mining and agriculture.

- Select a limited number of areas with differing economic activities which would be generally representative of the Region. The basic resources of each selected area including raw materials, water, power, industrial sites, labor and natural features such as climate, topography, minerals, and vegetation will indicate the logical possibilities for industrial expansion.

- Analyze the lists of products and select those for which the cost of transportation constitutes a relatively high percentage of total cost at the market place.

- Determine which high-transport-cost products already exist in the Region as well as those which do not, the significance being that:

    a. Those which exist may have a competitive disadvantage due to unduly high transportation costs.

    b. Those which do not exist in the Region but for which it has the requisite resources might be initiated there through an improvement in the highway system.

- Identify economic islands -- places with resources which in relation to market location and plant have an obvious and immediate economic feasibility for one or more specific enterprises.

- Compare the market potential under existing conditions for industries oriented to local consumers with prospective conditions after highway improvements.

Products would initially be classified by economic importance and by transport characteristics. This review would aid in classifying industries as to those offering only base-load traffic, and those providing now or in the future generated or development traffic. A market survey for each of the selected products within the groups should include:

1. Production and consumption trends, regional and national.

2. Portion of product consumed within Appalachia.

3. Price trends, structure and mechanism of the markets or distribution systems.

    a. An important matter in relation to prices is the extent of Appalachian penetration of the market. If the region is already an important producer, its increased production could result in lower prices. Such production may increase

the GRP but would require a relatively larger increase in non-transport investment than those products wherein Appalachian market penetration is of a size that would not significantly reduce market prices due to the additional volume. Obviously, the net increases in GRP are greater when prices don't drop, due to probable reduced production costs.

4. The relationship between the quality of the Appalachian product and the market demands should be carefully noted.

5. The role of transport in the present marketing of the products including:

   a. The modes used.

   b. Transport cost as per cent of market price.

   c. Importance of speed or convenience.

   d. Changes in price needed to importantly affect market penetration and the traditional relationship of market prices to transport costs (use of "basing point" prices for instance), marginal utility and sales volume.

The resources of Appalachia have been said to be "wood, water and coal." Obviously, other minerals and crops and, most importantly, an abundance of labor must be included in the available resources. The initial product review will suggest many possibilities for new products or radical expansion opportunities for present production. Using the census data, other regions with similar resources can be studied for suggestions. Industrial economists working from these leads and from Appalachian resource inventories would investigate the possible propagation of new products with expansion potentials, as well as the products now made in unimportant quantities. Since transportation cost savings and service improvements would be the sole altered factors making possible new or increased production in this analysis, it must be limited to products affected by these factors.

It is theoretically possible to make the regional product analysis described here by the use of input-output models. This procedure cannot be specifically recommended until the available data have been examined in some detail. If data quality, time and money allow their use, the most advanced statistical and data processing techniques could be employed in this study. Multiple regional models for comparing Appalachia with other regions and for ranking the effect of alternative government actions are formulated in some detail in an A.R.A. Workpaper, "Transportation and the Economy of the Appalachian Region," Transportation Center, Northwestern University, August, 1963. However, the efforts to specifically incorporate transportation costs

into these models were frustated by lack of organized inputs concerning the role of transport in prices and marketing practices, and it was necessary to treat transportation as a "cost controlled by government," an unrealistic and unsatisfactory conclusion.

VI. Tourism and Recreation Study

The market surveys of tourism should be reviewed for material on the relative importance of cost, and time of access to recreational travelers. Assuming the latter to be most important of the two, time savings should be carefully measured, as such measurements would probably become a principal basis for the forecast of generated and developed tourist traffic. Time savings are relative and comparisons would be necessary. The present time of access from major markets in the northeastern megalopolis and perhaps the Lake Erie megalopolis should be compared with times from the same markets to Northern New England, Cape Hatteras, and Northern Michigan. Other areas such as the Adirondacks are also possibilities. In making the forecast it would be necessary to include adjustments for future reductions in time of access to the competitive regions. Future times must be compared with future, not present, travel times.

Existing motivational studies of travel and tourism and the more detailed market studies should be reviewed. Questions to be answered are "What makes people want to come?" and "What attractions and facilities do people want?" followed by "Can they be supplied in Appalachia?". While motivational studies may be needed for Appalachia before a complete investment plan is drawn up, they will probably not be needed for the proposed highway transportation study. What will be needed, however, is a geographical inventory of present and prospective attractions to assist in identifying the most likely corridors for highway improvements.

VII. Non-Highway Investment Program

Since the creation of what is referred to as developed traffic requires by definition additional non-highway investment, this investment will have to be estimated. The material developed in the product and tourism studies should provide a sufficient basis for investment estimates. It may be necessary, however, to make supplementary studies of capital output ratios in Appalachia (or other production locales with similar labor and geographic characteristics). The addition of these investment estimates together with those for highways will permit an accurate allocation of the investment needed for the GRP increase between highway and non-highway investments, and will enable calculation of total cost-benefit ratios or rates of return, and their allocation between investments.

VIII. Conclusions

The conclusion of the proposed study should consist of: (1) a group of tables summarizing the analytical data, and (2) a group of statements of findings and conclusions, similar, but not limited to the following:

1. General conclusion on the existence of a clearly definable relationship between highway improvements and economic development in the past 15 to 30 years based on the regional studies performed. If a clear relationship is found, the levels or proportions of benefit should be indicated. Pertinent judgments on the viability of the estimated economic benefits should be given, based on analysis of the evidence in the regional studies.

2. Statement of the cost savings for base-load traffic similar to Table I which follows. These savings would be segregated by major vehicle classes and would be adjusted for circuity (reduction in present length of highway routes). For purposes of comparing future annual data with the present year data, a specific forecast year could be selected for use in the tables. However, it would be preferable to use a calculated year representing the midpoint of the increases forecast for future years. This year could be multiplied by the number of years in the forecast to determine directly the total benefits, thus relating the comparative future year directly to the full span forecast. A forecast period of 20 years is suggested here on the basis that if the projected improvements do not provide net benefits within this time, that other projects in other locations be considered first. Longer forecasts are of dubious reliability in any event.

3. Statement of the increase in Gross Regional Product for each of the principal groups presented in a manner similar to Tables II and III following. The finding would separate the net increase in GRP for the Appalachian region alone from the GRP increase of the remainder of the United States. In addition, a number of specific conclusions on industries and products should be made.

    a. Products for which reduced transport costs and quality improvements alone will determine new or expanded production in significant volumes. Such findings would assume or demonstrate that the quality and production costs of the Appalachian product before transport will meet the market's demand.

    b. Products which appear to offer a wider radius of distribution with modest demand increases if transport is improved.

    c. Summary statement of the principal locations, or types of location, for the production discussed in a. and b., together with the corridors or regions for highway improvements which are suggested.

d. The total capital investments required both for highway and non-highway production improvements and the cost of such capital, including differences in public and private capital costs. Nothing has been presented on determining near future highway investment costs up to this point. It should be possible to make reasonable estimates for the purpose of this study from highway construction performed in the region during the past five years. Non-highway investment could be estimated from such industry data as capital output ratios.

4. The summary of tourism and recreational benefits would be similar to Table IV following. Additional conclusions should include:

   a. The relative economic importance of these activities in Appalachia at the present time and the broad outline of future prospects, including saturation of other eastern areas.

   b. The relative importance of reduced access times and increased convenience in entering and moving within Appalachia.

   c. The principal types of tourism and recreation facilities which should be added or improved, their locations and the amount of investment, together with the suggested corridors for future highway improvement.

5. Estimates of consumer surpluses arising from the highway improvements, similar to Table V, which would include estimates of the surpluses available to consumers outside of the Appalachian region.

6. Summation of the net economic benefits similar to Table VI and drawn from the preceding tables. At this point, care would have to be exercised in making certain that all double counting were eliminated. Since prices contain not only producer surpluses but payments to all factors of production and distribution, the use of prices as proposed here could be misleading unless carefully analyzed. A summary of the proposed development corridors and regions (from 3., c. and 4., c) together with capital cost estimates should appear at this point.

7. Estimates of the future value of making the proposed highway improvements today, and of the probable length of time to recover the capital investment using discounted income flows (Table VII).

8. Suggested priority ranking of corridors or regions for making detailed feasibility studies and preliminary designs.

(The preparation of this study plan was undertaken in association with W. B. Saunders & Co., Washington, D. C., for the President's Appalachian Committee)

Table I

Benefits To Base Load Traffic - Savings In Vehicle Operating Costs

I. Present and Forecast Vehicle-Miles Per Year
(assuming no change in present highways)

	1964	1970	1975	1980	1985
A. Heavy trucks, buses	-	-	-	-	-
B. Light trucks, school buses	-	-	-	-	-
C. Passenger cars, pickups	-	-	-	-	-

II. Present and Forecast Operating Costs[1] Per Mile (¢)

	Operating Costs Averaged for Present Highways	Operating Costs Averaged for[2] Future Highways	Difference (Saving)
A. Heavy trucks, buses	--	--	--
B. Light trucks, school buses	--	--	--
C. Passenger cars, pickups	--	--	--

III. Forecast Savings of Operating Costs[3]

Annual Average Calculated at Midpoint of Forecast Years	Heavy Trucks and Buses	Light Trucks School Buses	Passenger Cars Pickups
A. Forecast vehicle-miles[4]	--	--	--
B. Operating cost saving per mile	--	--	--
C. Factor for reduction in circuity	--	--	--
D. Total savings in operating costs (A+B+C) in $	--	--	--

Footnotes for Table I

1/ Includes fuel, lubrication, tires, repairs, depreciation and driver wages where applicable. Taxes are not included as they vary artificially from state to state and year to year. If present ratios of linked highway revenues to improvements were to be maintained, increases might be needed.

2/ Adjusted for average increases in speed, see curves in AASHO Report on Road User Benefit Analyses, Part I; Passenger Cars in Rural Areas, supplemented by any road test data produced during the study.

3/ These are savings to vehicle owners. The difference between this amount and an estimated saving to vehicle users (shippers and passengers) would be a producer's surplus accruing to owners. If the total cost of highway transport, including generated and development traffic, in any forecast year is less than the present cost, this difference is a saving to the national economy and should be included in the total of benefits.

4/ Includes vehicle-miles of traffic diverted from other highways, if of significant amount. Diversions from rail and water should not be included unless there is a clear presumption of true operating cost savings.

Table II

Benefits from Generated and Developed Traffic

	Increase in GRP Including Tax Payments				
	Agri-culture	Raw Materials	Industrial Manufactures	Consumer Manu-factures	Total Produc-tion
	(Thousands of Dollars)				
A. Present Year Value of Sales 1/ - Total	--	--	--	--	--
1. Sales in Appalachia	--	--	--	--	--
2. Sales outside Appalachia	--	--	--	--	--
B. Value of Sales Year X 2/ After Highway Improvement: Total	--	--	--	--	--
1. Products for which no change in price is forecast 3/ - Total	--	--	--	--	--
a) Sales in Appalachia	--	--	--	--	--
b) Sales outside Appalachia	--	--	--	--	--
2. Products with decreases in forecast prices - Total	--	--	--	--	--
a) Year X total sales @ present prices	--	--	--	--	--
b) Estimated loss due to price differentials	--	--	--	--	--
c) Adjusted sales (a - b)	--	--	--	--	--
c) in Appalachia	--	--	--	--	--
c) Outside Appalachia	--	--	--	--	--
C. Net Increase in Year X GRP 4/ - Total (before tax adjustment)	--	--	--	--	--

B.1 / B.2 - A.)

Footnotes for Table II

1/ Value measured by retail sales at point of consumption and nearest equivalent for materials and semi-finished manufactures sold to industries located outside Appalachian region.

2/ This summary table should consist of the annual average of future years. This would then directly relate the present year to the total forecast which is the sum of the cumulative annual differences between present year sales and sales in each future year. (Amount in average year - amount in present year x 20 = total increase over 20-year study period.)

3/ See Part V, 3.a. of text.

4/ Since all increases in GRP as measured by sales value are included here, the saving is somewhat overstated. The secular trends of increase, if any, at the time of present year are credited to highway improvements in future. If necessary, a further adjustment should be made.

Table III

Benefits from Generated and Developed Traffic

	Calculation of Net GRP				
	Agri-culture	Raw Materials	Industrial Manufactures	Consumer Manu-factures	Total Produc-tion
A. Average Annual Increase in GRP (Tab. II. Line C.)	--	--	--	--	--
1. Less ___% tax allowance[1]	--	--	--	--	--
B. Distribution of GRP Less Taxes By Function and Location					
1. Increased payments for Transport, if any[2]	--	--	--	--	--
2. Increase payments for Marketing[3]	--	--	--	--	--
a) Portion of 2. external to Appalachia (deduct)	--	--	--	--	--
b) Net increase in marketing payments in Appalachia	--	--	--	--	--
3. Increased payments for Production	--	--	--	--	--
a) Portion of 3. external to Appalachia[4] (deduct)	--	--	--	--	--
b) Net increase in payments to production in Appalachia	--	--	--	--	--
C. Net Gross Regional Product (B., 1. + 2.b + 3.b)	--	--	--	--	--
D. Additional Contribution to Gross National Product (B., 2.a + 3.a)	--	--	--	--	--

Footnotes for Table III

1/ Allowance for indirect taxes levied on particular goods and services transactions. Since indirect taxes are paid to the government, they do not get into the stream of payments reaching people for their contribution to production. Hence, they do not act as incentives to use resources one way or another. However, these taxes are a part of consumer prices and, therefore, exert an influence on how consumers use their incomes. Changes in these taxes may create changes in prices without any change in the resources devoted to production. National income accounting, generally followed here, avoids these distortions by eliminating such taxes from calculations.

2/ Includes rail, water and air transport except as products using those modes exclusively are excluded from calculations. These figures are rates and fares paid, not costs of producing transport services.

3/ Includes all non-transport costs of distribution, largely wholesalers' commissions, retailers' markups and warehousing.

4/ Value of raw materials, semi-finished and finished goods, purchased from outside Appalachian region for use in manufacturing or assembling the region's products.

Table IV

Benefits from Tourism and Recreation[1/]

	Annual Number of Persons	Average Length of Stay (Days)	Average Per Person Expenditures ($)	Total Expenditures (000's $)
1. Present year	--	--	--	--
2. Forecast for year X[2/] If no highway improvements	--	--	--	--
3. Forecast for year X[2/] Based on highway improvements	--	--	--	--
4. Average annual increase Due to highway improvements (3. - 2.)	--	--	--	--

---

1/ This assumes the usual approach based on average days of stay and average daily expenditure. If statistics make possible an analysis by functions (food service, over-night accommodation, charges for recreational facilities) or by objectives (touring, boating, hunting, fishing) these would be preferable and would reveal significant factors.

2/ Average of the years used for the forecast period.

Estimate of Consumer Surpluses

(Consumer funds released for other purchases or investments due to declines in prices attributed to transport cost savings)

	Agriculture	Raw Materials	Industrial Manufactures	Consumer Manufactures	Total Production
A. Present year sales of products declining in price[1]:					
Value	--	--	--	--	--
Units	--	--	--	--	--
B. Year X sales of present year units at lower (yr. X) prices:					
Value	--	--	--	--	--
Units	--	--	--	--	--
C. Total consumers surplus[2] (A. - B.)	--	--	--	--	--
D. Estimated surplus in Appalachia	--	--	--	--	--
E. Estimated surplus outside Appalachia	--	-	--	--	--

1/ See Part V, 3.a of text.

2/ Assumes only savings by consumers willing to purchase at present prices and does not include those willing to buy at some price level between present year and year X.

Table VI

Summation of Economic Benefits - Comparison of Present Year with Average of the Forecast Years

1. Distribution of Total Required Investment

		Dollars	Per Cent[1/]
A.	Highway improvements	--	50
B.	Agriculture	--	5
C.	Raw material extraction	--	10
D.	Manufacturing for industry	--	15
E.	Manufacturing for consumers	--	15
F.	Tourism and recreation	--	5
			100

2. Economic Benefits from Highway Improvements

	Appalachia's Benefits	Source	1 Average of Forecast Years	2 Forecast Total of Benefits (Col. 1 X 20 yrs.)
A.	Vehicle operating cost savings	T.I., III.D.	--	--
B.	GRP increase from generated and developed traffic	___% of T.III.,C[2/]	--	--
C.	Tourism and recreation	___% of T.IV., 4 [2/]	--	--
D.	Consumer surpluses	T. V., D.	--	--
E.	Savings in total transport user costs, if any[3/]		--	--
F.	Total Appalachian benefits		--	--
	Benefits Outside Appalachia			
G.	GNP increase from generated and developed traffic	T.III.,D	--	--
H.	Estimated consumer surplus	T.V, E.	--	--
I.	Total outside benefits		--	--
	Total Economic Benefits (L.2, F. + L.2, I.)		--	--

1/ For example only.

2/ Per cent of increase attributable to highway improvement.

3/ Estimates of price reductions by other modes due to reductions in price of highway transport.

Table VII

Estimated Flow of Economic Benefits and Their Present Value

	Years	1. Vehicle Operating Benefits 4/	2. Discounted at 4% 2/	3. Discounted at ___% 3/
1.	1970 1/			
2.				
3.				
4.				
5.				
6.	1975			
7.				
8.				
9.				
10.				
11.	1980			
12.				
13.				
14.				
15.	1985			
16.				
17.				
18.				
19.				
20.	1990			

1/ For illustration. An appropriate year would be one or two years before substantial completion of highway network.

2/ Approximate cost of public financing. Representative opportunity cost would be 7%.

3/ Rate necessary to recover investment in highways in 20 years.

4/ Columns 1, 2, and 3 would be repeated for each major benefit, Table VI, 2., A-F and the total of benefits including both Appalachian GRP and GNP.