THE ECONOMIC BENEFITS ACCRUING FROM THE SCENIC ENHANCEMENT OF HIGHWAYS

by

Paul Davidson, Associate Director

and

John Tomer and Allen Waldman, Research Assistants

Bureau of Economic Research

RUTGERS - THE STATE UNIVERSITY

in cooperation with

NEW JERSEY DEPARTMENT OF TRANSPORTATION

and

BUREAU OF PUBLIC ROADS

UNITED STATES DEPARTMENT OF TRANSPORTATION

68-025-7783

THE ECONOMIC BENEFITS ACCRUING FROM THE SCENIC ENHANCEMENT OF HIGHWAYS

The Highway Beautification Act of 1965 (Public Law 89-285, 79 Stat. 1028) is a joint attempt by the Federal Government and the various state governments of the U. S. to provide for scenic development and road beautification of Federal-aided highway systems. There exist three major sections of the Act: Title I and Title II deal with provisions for limiting and controlling outdoor advertising and junkyards adjacent to highways, while Title III is concerned with the need for the landscaping and scenic enhancement of highway systems.

The primary objective of our study was to focus on Title III of the Act by concentrating on the problems involved in identifying and quantifying the benefits and costs that result from the beautification of highways.

In undertaking such a study, problems arise as to the selection of the proper method for evaluating the economic effects and social benefits of the scenic enhancement of highways. Also confusion exists as to what constitutes "scenic enhancement." Moreover, the lack of proper data necessary for the determination and measurement of the effects of highway beautification has proven to be a troublesome factor.

Two procedures yielding two widely different measures of the expected effects of a highway beautification program can be suggested. The first, which has been suggested by the Bureau of Public Roads, is what can be called an economic impact study. This approach is a valid way of measuring the regional effects of scenic enhancement of highways on employment, income, and levels of economic activity in the area of the enhancement project. It fails to measure, however, the total net benefit of the proposed action to the whole nation and therefore, it does not reveal whether the project should be undertaken in order to increase the national welfare. Instead, impact studies merely measure the "make work" capacity of a government project; hence this type of analysis is relevant from the national viewpoint, only as a measure of counter-recessionary efficacy - despite its obvious attractions to local real estate interests and local chambers of commerce.

Whereas economic impact studies reveal only the redistributive effects of government action on particular sectors within the economy, the use of the second type of study, a cost-benefit approach can be made to reveal the costs, or disadvantages to the nation as a whole, and the benefits, or advantages to society of the various alternatives, governmental programs, thus developing a systematic basis for analyzing the desirability of public expenditure on a scenic enhancement program. This approach can suggest the magnitude of net gain or loss to society from allocating economic resources to programs for scenic enhancement of highways.

The main problem of utilizing the cost-benefit approach in a study of the effects of a highway beautification program is in correctly enumerating and evaluating the benefits and costs involved. (The same problems are, of course, found in other areas in which cost-benefit analysis has been applied - weapons systems, air pollution, water resources use, etc.) Fortunately, the cost aspect seems to contain no major difficulties and can be readily ascertained from engineering estimates of the cost of scenic enhancement per mile of highway; although the problem of exactly what it is that constitutes "scenic enhancement" and how it differs from "highway improvements" has to be thoroughly defined. The identification and economic quantification of benefits is considerably more difficult, however, especially in the absence of market transactions.

I. THE PRESENT STATE OF THE PROBLEM

The existing literature on the economic importance of scenic beautification of highways is relatively small, thus suggesting that in the past there has not been much interest in subject. One possible explanation of the cause of the paucity of analysis is that the benefits of beautification have been viewed as being intangible and incapable of being quantified. Accordingly, the use of resources to beautify highways has often not appeared justifiable. On occasion, proponents of beautification have had to argue that, at a minimum, some attempt should be made to preserve the existing natural beauty of the environment.

> The problem is not that man manipulates his environment to suit his own purposes. Rather it arises because this tampering has lacked integration and harmony with the physical resource base. Until recently, we have largely disregarded natural processes and misused the natural environment. [7, p. 12]

The attempt to merely preserve existing natural beauty requires a distinction between seeking to beautify and seeking to minimize ugliness [8]. As has already been noted, there is little consensus on what is beautiful, and there exists no precise definitions of the terms "highway beautification" and "scenic enhancement." [23, p. 10] Accordingly, some advocates of the position of the preservation of existing natural beauty feel that it would be easier to get a consensus on what is ugly.

To insure that scenic countryside is not despoiled, however, will require resources to be allocated in a way to preserve best the natural beauty of the land. Accordingly, we must evaluate the benefits of beauty despite the incorporeal nature of the subject. As one investigator has noted:

> The unsavory prospect of assigning numbers to a concept fraught with moral considerations must be balanced against the more unsavory concept of inadequate pollution control, stripmined landscapes and rings of junkyards around our cities. [13, p. 52]

Different approaches to highway design and aesthetics have been taken by those interested in making our highways more beautiful. Several authors feel that probably the most important characteristic of a scenic highway is that it be properly integrated into the surrounding area. Tunnard, for example, has emphasized the external and internal harmony of the freeway [17]. The State of Washington has established a number of visual criteria to evaluate their highways according to their scenic merit [12, pp. 18-20]. Appleyard, Lynch and Myer have suggested that the highway designer has to visualize the highway as the motorist and his passengers will see it and then determine what this implies for highway design [1, p. 2].

Scenic enhancement of highways can have a functional aspect as well. Garmhausen suggests that

> Aesthetic highway design pays off in added safety. Driven tension and fatigue, which are believed to be hidden causes of many automobile accidents can be relieved by interesting highways and roadside development. [6, p. 126]

According to this view highway design should be such that the driver can look ahead to see beauty. Safety-rest areas should be provided along the road when breath-taking views are afforded.

There are many other ways in which the proper use of landscaping can bring functional beauty to the road rather than merely cosmetic beauty. Plantings along the road can provide erosion control, reduce need for guard rails, possibly reduce mowing requirements and lessen driver monotony. Other functional uses of plantings include: minimization of headlight glare, or utilization for snow fencing, noise abatement, road focus, and directional "piloting for driver guidance." Northern states have experienced savings of up to $500 per mile in maintenance costs by using living snow fences [2, p. 78]. Other savings can result from either the decreased maintenance requirement or from the increased safety of the highway. Plantings can also be useful to screen undesirable or distractive views, hide litter, and reduce fumes. Finally it has been pointed out that the scenic qualities of a highway often last longer than the highway itself [16, p. 42] [23, p. 225].

Thus far no systematic attempt has been made to systematically quantify the benefits of highway beautification. Where specific public investment projects are involved benefit-cost analysis has been used primarily when the benefits have been tangible, i.e., readily measurable via a market process. There has been considerable divergence of opinion on the proper use of benefit-cost analysis when intangible or non-market benefits are involved [15, p. 728]. Nevertheless, most economists would agree with Tunnard who feels that the attempt to measure the benefits of highway beautification should be made to "prove that beauty can pay off" [17, p. 205-206].

The major benefits from scenic enhancement of highways, aside from possible reduction in maintenance costs, are (1) increased safety and (2) greater pleasure for the highway user. Thus, it should be possible to hypothesize a relationship between the aesthetic character of the road and safety which could be tested statistically.

> To establish conclusive proof of the relationship between visual qualities of the road alignment and accidents or fatalities, it would be necessary to isolate the aesthetic factor by eliminating influences such as traffic volume and traffic stream characteristics, manner of operation, degree of law enforcement, and technical design faults. [17, p. 205]

In this study, we have been able to statistically quantify such a relationship between safety and scenic highways.

Benefits derived from providing pleasure to highway users can be viewed as being similar to benefits derived from engaging in any outdoor recreational activity. Evaluation of these benefits is a problem that has received considerable attention recently [4] [3].

Certainly, it may be difficult to accurately quantify "the immediate enjoyment which consists of the sense of pleasure experienced immediately before, during, and after participation in outdoor recreation," and it is perhaps even more difficult to measure the long-term benefits which may be both physical and psychic or the type of benefits which may be received by the nation as a whole [5, pp. 57-58]. Often, statements are made that "outdoor recreation fills some profoundly felt need; that it has personal, unique, and highly variable values for individuals; that outdoor recreation defies any kind of measurement; or simply that it is priceless.....[Nevertheless, most economists believe that] such values are directly reflected in economic values and that there is no irreconcilable conflict between the social values and the more specific economic values." [3, p. 213]

Analysis of a driver's preference for scenic highways provides some clues to the benefits of highway beautification.

> Surveys of motorists' desires show that scenic or beautiful highways are preferred by nearly all highway users. Some motorists have such a strong preference for scenic routes that they will travel farther or longer in order to traverse a scenic highway. [23, p. 180]

A research study, "The Effect of Expressway Design on Driver Tension Responses," tends to support the conclusions obtained from the surveys.

> It was found that a freeway with complete control of access and good geometric design generates significantly less driver tension than less rigorous designs. [10, p. 107]

In a subsequent publication, the same author concluded that

> Whenever the alternates available are equally stress inducing, drivers will always choose the route that takes the least time. From the results of the study reported, drivers will actually tolerate a time loss, as well as a distance loss, if the total stress to which they may be subjected is perceptibly reduced. [9, p. 235]

Conceivably, evidence of drivers' preference for scenic highways could be used to measure some of the benefits due to scenic enhancement of highways. This is the basis of our approach to the problem in this study.

In summary, possible benefits derived from scenic enhancement of highways appear to fall into three major categories: (1) visual pleasures which make a more enjoyable trip, (2) a possible improvement in safety and (3) a possible difference in highway maintenance costs.[1]

The measurement of these benefits, once they are identified, however, hinges upon the availability of appropriate data to determine the significance and magnitude of the benefits as well as their economic value and particular applicability to the populations of specific states possessing widely different social and economic characteristics affecting highway use.

Preliminary investigation of the available literature revealed that very little data has been collected primarily for the purpose of allowing selected benefits of scenic enhancement to be analyzed through statistical techniques. Data related to the aesthetic benefits derived from scenic enhancement, for example, seem to be almost entirely lacking. Given the time limitations of our study, it did not seem that this problem could be surmounted by a sample survey.

Accordingly, we have attempted to utilize data collected from various sources for other purposes to enumerate and evaluate (1) the persons who engage in driving for visual enjoyment (benefits) and (2) to see if differences in accident rates can be statistically associated with scenically enhanced highways.

---

[1] A possible alteration in the time of trips does not appear to have been seriously considered by other investigators. An apparent lack of data prevented us from analyzing this category.

II. AN ANALYSIS OF THE RELATIONSHIP BETWEEN SCENIC HIGHWAYS AND SAFETY

Tunnard has argued that scenic highways are safer highways. Accordingly, we attempted to test the hypothesis that when statistical account was taken for other factors such as volume, speed limit, traffic signals, medians, etc., there was no relationship between scenic highways and reduction in accidents, injuries, and fatalities. Two sources of data were used in this analysis - one related to the New Jersey highways and one related to State of Washington highways.

1. New Jersey Highway Data

The data on New Jersey highways was furnished by the New Jersey Highway Department. This data consisted of observations of 92 segments of New Jersey State Highways which were selected arbitrarily by Mr. Wesley R. Bellis of the New Jersey Department of Transportation.[2] Eleven highway variables plus the number of accidents, injuries, fatal accidents, and traffic volume were observed on these highway segments. Observations on the scenic classification of these segments were made by Mr. Bellis. Based on his judgment each road segment was classified as either scenic or not scenic. The variables included in the data and used in our empirical analysis are:

---

[2] Mr. Bellis has been working in the highway field for 40 years. He is currently Director of Research, Department of Transportation, State of New Jersey.

Variable	Symbol	Description
Scenic Classification	S	1 if scenic 0 if not scenic
Length	L	length (miles) of highway segment
Volume of traffic	V	average annual daily traffic $(X10^{-2})$
Accidents	A	total annual accidents for highway segment
Injuries	I	total annual injuries for highway segment
Fatal accidents	F	total annual fatal accidents for highway segment
Lanes	N	number of lanes for the segment
Roadway width	WN	road width in one direction (feet)
Median type	M1	0 if undivided 1 if divided
Median width	MW	width of median
Traffic signals	R	number of traffic signals per mile
Access points	C	number of access points per mile
Access Control	C_o	0 full or partial control 1 no access control
Type area	YP	0 if business area 1 if rural or residential
Speed limit	P	speed limit in miles per hour
Median type	M2	0 if other 1 if barrier median

In the regression analysis of the data, three dependent variables were used, accidents per vehicle-mile, injuries per vehicle-mile, and fatal accidents per vehicle-mile. The purpose of regression analysis was to try to explain the variation of these three dependent variables by the variation of the highway characteristics and whether the highway was scenic or not.

Many possible combinations of variables were tested. In general we were unable to establish any good statistical relationship between fatalities per vehicle mile and any of the independent variables. On the other hand, the scenic coefficient was normally significant in our regressions on injury per vehicle mile, while it was at best, only occasionally marginally significant in our accident per vehicle mile regressions. Our best fitting injury per vehicle mile regression used only three independent variables, the scenic variable, number of traffic signals, and number of lanes. It is:

$$\text{Injury per vehicle mile} = .0547 - \underset{(.0127)}{.0289S} + \underset{(.0021)}{.0043R} + \underset{(.0045)}{.0168N} \quad (1)$$

where the numbers in parentheses below the coefficients are the standard errors of the coefficient. The R^2 was .18 (adjusted for degrees of freedom) and the F-test was 7.87, which means that at the .95 confidence level we can reject the hypothesis that the explanatory variables in this equation do not exert any influence over the dependent variable, injuries per vehicle mile.

The equivalent equations for accidents and fatalities are:

$$\text{accidents per vehicle mile} = .0399 - \underset{(.0179)}{.0231S} + \underset{(.0030)}{.0038R} + \underset{(.0064)}{.0310N} \qquad (2)$$

$R^2 = .2115$

F-test = 9.14

$$\text{fatalities per vehicle mile} = .0024 + \underset{(.0006)}{.0009S} - \underset{(.00010)}{.00002R} - \underset{(.0002)}{.0003N} \qquad (3)$$

$R^2 = .0231$

F-test = 1.72

The scenic coefficient is not significant for either accidents or fatalities per vehicle mile. Moreover, the poor fit of the fatalities regression is consistent with our results for various combinations of the independent variables. Apparently, the "explanatory" pattern for fatalities involves different variables than accidents or injuries.

Although we had identified a relationship (equation 1) which disproved the null hypothesis that scenic highways are unrelated to the injury rate, it was felt that because the ability to demonstrate only occasionally a marginally significant affect for accidents and no pattern at all for fatalities, it would be desirable to test these hypotheses against more data.

2. Washington State Highway Data

We were extremely fortunate that a study of the scenic merit of Washington State Highways has just been completed. In this study [12], Norton and Robertson rated 111 highway segments containing 3754 miles of

Washington State highways for their scenic value. The criteria utilized for obtaining a scenic rating was based largely on an earlier study, the criteria and how they were combined into a scenic coefficient are given in Appendix A.

The Norton study merely provided scenic coefficients for 111 different road segments of the Washington state highway system. For these particular segments of road, other information had to be obtained. The job involved matching scenic segments from the Norton study with segments of road from Rural State Highway System Accident Report 1965, State of Washington - Washington State Highway Commission. From the Accident Report the following information was obtained: 1) section length (miles); 2) average daily traffic volume; 3) number of fatal accidents, 4) total accidents; and 5) number of persons injured.

The Norton scenic segments were compared with the similar segments of road in the Accident Report and the above information collected. Because of differences in classifying highway segments it was not possible to maintain 111 segments and consequently the total number of observations was reduced to 89. This was primarily due to the fact that at times two or more Norton scenic segments corresponded to only one segment of the Accident Report, thus requiring two or more separate Norton segments to be spliced together to equal one Accident Report segment. Consequently, the original number of observations were reduced. For example, the Norton survey number 91 is from Elbe to Morton (16.4 miles) and number 92 is from Morton to Kosmos (8.4 miles), but the Accident Report segment covered the area from the GCT of SR141 (Kosmos) to the Pierce Co. line (Elbe) (22.8 miles). The mileage is fairly close and the difference is due to the inclusion of the town area in the Accident Report and not in the Norton Survey. Because the Accident Report covered the two Norton segments in one entry, one observation was lost. In total there were twenty-one such overlay matches that resulted in combining two or more Norton segments to equal one Accident Report segment. In all these cases the different scenic coefficients were averaged and applied to the whole of the Accident Report segment. The only other troublesome type of case occurred when two or more Accident Report road segments were equal to one segment in the Norton survey. This problem, however, did not result in losing any observations. In this latter case, traffic volume for the different segments was averaged, and the accident, injury and fatality information was totaled. In general the matching of the Norton scenic segments with the road segments of the Accident Report was successfully accomplished.

Further information on the remaining 89 road segments was required; in particular (1) the number of lanes; (2) the type of road surface; and (3) the width of the road. This information was obtained from the Log of Washington State Highway System 1966 - Washington State Highway Commission. Information was also obtained on the number of major intersections that each of the 89 road survey segments had by consulting the 1966 Washington State Highway Map - Washington State Highway Commission. Unfortunately information on the number of traffic signals or the speed limit on these 89 road survey segments was not readily obtainable.

To sum up, the following information about our sample of 89 road segments was collected:

1) a scenic coefficient

2) section length (miles)

3) average daily traffic volume

4) number of fatal accidents

5) total accidents

6) number of persons injured

7) number of lanes

8) type of road surface

9) width of road surface

10) number of major intersections

This was the basic information which was used in our regression analysis. These variables were used in the following form in our regression analysis.

WASHINGTON HIGHWAY DATA

Variable	Symbol	Description
Scenic Coefficient	S	quantitative rating of scenic merit of highway segment
Accidents	A	total annual accidents for highway segment
Injuries	I	total annual injuries for highway segment
Fatal Accidents	F	total annual fatal accidents for highway segment
Traffic Volume	V	average daily traffic volume for highway segment
Road Length	L	highway segment length (miles)
Width	W	width of road (feet)
Type of Surface	T^1	0 if one type surface 1 if combination of surface types
	T^2	0 if other 1 asphalt or bituminous or both
Major Intersections	MI	number of major roads intersecting the highway segment
Lanes	N	number of lanes in each highway segment

A number of different regressions using the various independent variables were tried. Although the R^2 were somewhat lower, our results seemed to be consistent with our New Jersey highway findings, namely a significant negative relationship between scenic highways and injuries per vehicle-mile. Two of the best equations that we obtained were

$$\text{Injuries per vehicle mile} = .0748 - \underset{(.0008)}{.0019S} \tag{4}$$

$R^2 = .0536$

F-test = 5.98

$$\text{Injuries per vehicle mile} = .1174 - \underset{(.0008)}{.0019S} - \underset{(.0012)}{.0019W} + \underset{(.0099)}{.0165T_1} - \underset{(.0015)}{.0017M_1} \tag{5}$$

$R^2 = .0776$

F-test = 2.85

No significant relationship was established between scenic highways and either accidents or fatalities.

Although the computation of the scenic coefficient for the Washington highway segments is somewhat arbitrary, it has one big advantage over the 0 - 1 "dummy" scenic variable used in the New Jersey study; i.e., it displays degrees of scenicness on a scale from 1 to approximately 30. Accordingly, it was possible to fit a logarithmic form to the Washington data. This form remarkably improved the fit of the equivalent linear equation 5. It was:

$$\text{log of injuries per vehicle mile} = -1.8925 - \underset{(.0184)}{.2422\log S} + \underset{(.0259)}{.0714W} + \underset{(.2162)}{.8058T_1} - \underset{(.0330)}{.0045M_1} \quad (6)$$

$R^2 = .2677$

F-test = 8.68

This equation implies, for example, that a 10 per cent increase in scenicness (as measured on the Norton scale) would lead to 2.4 per cent reduction in injuries per vehicle mile, all other things being equal.

The equivalent equations for accidents and fatalities are:

$$\text{log accidents per vehicle mile} = -1.9129 - \underset{(.0783)}{.1567\log S} + \underset{(.0249)}{.0856W} + \underset{(.2079)}{.5642T_1} + \underset{(.0318)}{.0273M_1} \quad (7)$$

$R^2 = .2350$

F-test = 7.45

$$\text{log fatalities per vehicle mile} = -3.7813 - \underset{(.0939)}{.0962\log S} + \underset{(.0251)}{.0470W} + \underset{(.2400)}{.1012T_1} - \underset{(.0326)}{.0462M_1} \quad (8)$$

$R^2 = .0826$

F-test = 1.99

Accordingly, the logarithmic relationship for the scenic coefficient is marginally significant with respect to accidents and not significant for fatalities.

3. Conclusion on Scenic Effects on Safety

In conclusion, our analysis definitely indicates (1) there is a significant negative relationship between scenic highways and injuries, (2) there is some evidence of a negative (log) relationship between scenicness and accidents, although a linear arithmetic relationship was not readily discernable, and (3) there is no obvious relationship between scenic highways and fatalities.

Having therefore verified the correctness of our New Jersey highway relationship, at least for injuries, it is possible to compute that, according to equation 1, a scenic highway will have approximately 8 less injuries per annum per ten million vehicle miles than non-scenic highway. In 1966, the average non-fatal injury cost in New Jersey was $3,000. This implies that if there is a one mile segment of New Jersey highway on which the average daily volume is 27,397.25 vehicles (or 10,000,000 per year), then if this highway is scenic, there will be 8 less injuries per annum than if it is not scenic. Accordingly, scenically enhancing such a non-scenic highway segment will mean a savings to the New Jersey public of $24,000 per year in injury costs. Capitalizing this savings in injury costs at a 5 per cent interest rate, the present value of that savings stream over time is $480,000. Consequently, if this hypothetical one mile highway segment is presently non-scenic, then the community could spend up to a maximum of $480,000 for scenic enhancement and be no worse off than before. In fact, to the extent that either less than $480,000 is spent, and/or the users of the highway get increased pleasure merely from utilizing the highway (independent of the improved safety), the welfare of the community will be improved.

Obviously if the highway segment has a different volume of traffic per mile, then a different maximum sum could be spent on scenic enhancement and still improve the welfare. Table I lists the estimated annual reduction in injuries per mile and the capitalized cost savings (benefits) which would result from scenically enhancing one mile highway segments having different annual traffic volumes.

TABLE I

Daily Traffic Volume Per Mile of Highway	Annual Traffic Volume per Mile of Highway	Annual Reduction in Injuries per Mile	Annual Reduction in Injury Costs ($)	Capitalized Value ($)
100	36,500	.029	87	1,740
1,000	365,000	.29	870	17,400
10,000	3,650,000	2.9	8,700	174,000
20,000	7,300,000	5.8	17,400	348,000
27,397.25	10,000,000	8.0	24,000	480,000
30,000	10,900,000	8.7	26,100	521,000
40,000	14,600,000	11.6	34,800	695,000
50,000	18,300,000	14.5	43,500	870,000

III. BENEFITS DERIVED FROM DRIVING FOR PLEASURE

A survey of 922 households done by the Michigan Survey Research Center in the fall of 1959 was the basic source of data for the analysis of this section. Among the many socioeconomic and attitudinal questions asked of each household was the frequency of engaging in pleasure driving over the past twelve months.

A multivariate regression analysis of this data was undertaken to isolate the significant variables that influence one's desire to engage in pleasure driving. Our concern is, of course, not only with whether a person went pleasure driving or not, but also the number of times during the year that such an event occurred. The natural approach might seem to be using days of pleasure driving as the dependent variable, regarding those who did not go as zero days. There is a statistical weakness in this approach, however, since there may be many non-pleasure drivers. This will lead to a concentration of values at zero, while there can be no negative observations. Thus while an estimated linear regression relation will have a tendency to be above the axis over the relevant range, the relationship will tend to be very flat because of the bunching of the zero observations. This will lead to an underestimate at the high end of the relationship. Thus the normal regression model is likely to be inappropriate when the variation of the dependent variable is bounded and there is a concentration of observations at the boundary.

To avoid this problem, the regression analysis is normally broken into two stages. Initially, the regression analysis is utilized to determine the conditional probability of participation in pleasure driving via a dummy dependent variable with a zero vs. one code for no participation during the past twelve month vs. participation (regardless of amount). When the first stage, which indicates the major significant explanatory variables which affect the probability of engaging in this activity is completed, then the zero participants are normally removed from the sample and the actual days of participation used as the dependent variable of the pleasure driving sample population. In the present study, it would have been desirable to carry out both the first and second stage of this regression procedure in order to explain the amount of participation in terms of number of days. Considerable experimentation, however, revealed that because the Michigan Survey data had an open-ended terminal class group of all those who participated more than four days, it was impossible to significantly distinguish among most of the participants; accordingly, our approach had to be modified at the second stage as explained below.

The following are the variables which we used in our analysis:

Variable	Symbol	Description
Age of Car	C	discrete midpoint values of class intervals
Income	Y	discrete midpoint values of class intervals
Pleasure Driving	D	1 if pleasure driving 0 if not pleasure driving

Variable	Symbol	Description
Use of Car	F1	1 if car used for pleasure 0 if other uses
	F2	1 if car used for pleasure and/or vacation 0 if other uses
	F3	1 if car used on vacation 0 if other uses
Age of Head	A	discrete midpoint values of class intervals
Life Cycle	L1	1 if children in household 0 if no children in household
	L2	1 if children under 14 yrs. old in household 0 if no children under 14 yrs. old in household
Urbanization	U1	1 if suburban or rural location 0 if urban location
	U2	1 if rural location 0 if other location
Occupation	O1	1 if white collar 0 if blue collar
	O2	1 if not working 0 if employed
Region	G1	1 if Northeast or Northcentral 0 if other
	G2	1 if Northeast 0 if other
Sex	SX	1 if male 0 if female
Race	R	1 if white 0 if non-white

In general, the independent variables that we are testing consists of two types, socioeconomic variables (e.g., age, income, sex, race) and locational or physical variables, i.e., variables related to region of the county, urban-nonurban environment and age of car.

Pleasure driving is apparently a ubiquitous phenomena with almost 80 percent of the households in the sample indicating some engagement in this activity in the twelve months prior to the survey. Moreover, 12% indicated that they wished to participate even more often than they had in the past year. Unfortunately our data does not indicate whether the inaccessibility of facilities or some other factor is constraining participation in pleasure driving.

1. The Factors Which Affect Driving for Pleasure

Our analysis has provided some interesting results. We found, for example, that the age of the car was not a significant variable in explaining the probability of participation. Apparently if an individual goes pleasure driving, his demand for this activity is not impaired by the age of his car. Moreover, neither region of the country nor the degree of urbanization of the area in which the respondent resides affects the probability of his engaging in this activity.

Income, age, the sex of the respondent, and whether he is full time employed or not are the major factors which explain the probability of driving for pleasure.

Our best equation was

$$D = .7406 - \underset{(.0011)}{.0047A} - \underset{(.0261)}{.0511SX} + \underset{(.0166)}{.0902Y} - \underset{(.0010)}{.0050Y^2} - \underset{(.0459)}{0.1372O_2} \qquad (9)$$

R^2 = .1525

F-test = 32.77

This equation may be interpreted by substituting the particular value of a variable which describes an individual. If the classical assumption of orthogonal variables, that is independence in the statistical sense, holds, then the magnitudes derived from substituting each of the values which describe a particular individual in this equation are additive, and yield a conditional probability of driving for pleasure - given the particular values, which have been used to describe this individual. Furthermore, if a certain characteristic pertaining to an individual is unknown then the mean value for this variable can be substituted, and the probability becomes a conditional probability given each particular characteristic known and the mean value for the substituted variables.

The constant term in the equation is .7406. The magnitudes in the equation are added to and subtracted from this value to yield the conditional probability. The coefficient of age is -.0047, hence, as the age of the sample person increases, the probability of driving for pleasure falls at the rate of .0047 for each yearly increase in age. Thus the probability of a 40 year old individual going pleasure driving is .094 less than a 20 year old who has all the same socioeconomic characteristics except the age of the 40 year old. Accordingly, despite the fact that driving does not require strenuous, physical activity, or agility which is normally associated with youth, age does reduce the probability of participation.

The importance of income is fairly obvious, at least at low levels of income, since some minimum is required to own or at least operate a car for pleasure. Our analysis shows that 40% of the sample population whose income is below President Johnson's $3,000 poverty line did not participate in pleasure driving at all. This compares with 24% whose income is between $3,000 and $4,999, 12% of the $5000-7499 income group, and 8.6% of the 7500-$9990. Only in the $10,000 and over group does the proportion of the population who did not participate reverse this downward trend as 20.5% in the highest income group did not participate.

Our conditional probability analysis of the effect of income shows the probability of pleasure driving increases with rising income until approximately a level of $17,840 when it begins to decline. This does suggest not only the importance of some above poverty income level which is necessary to engage in pleasure driving, but that at the highest income levels the pull of competing activities (either recreational or vocational) reduce the probability of pleasure driving for the rich. Accordingly, both the very rich and the very poor are less likely to drive for pleasure.

collar and blue collar occupations. We do note however that people who are not normally in the labor force - that is - housewives, students, retired people, etc., have a significantly lower probability of pleasure driving (even after their income level is taken into account) then those who normally are in the labor force. According to our equation, a worker has a .1372 higher probability of driving for pleasure than a person with the same socioeconomic characteristic who is outside the employed labor force. Thus, it appears that the availability of leisure time itself may be a necessary but is not a sufficient condition for increasing the probability for engaging in this activity.

The most surprising result we obtained is that the probability of engaging in pleasure driving is 5% greater for females than males. A similar but more restrictive finding was obtained in the 1960 National Recreation Survey which indicated the percentage of females who went driving for pleasure exceeded males in general and especially for the 18-24 age category.

Finally it might be noted that we were unable to identify a significant relationship between variables such as race, or degree of urbanization and driving for pleasure.[3]

---

[3] Preliminary (and confidential results) of a similar regression analysis of the National Recreation Survey of 1960 yields approximately the same relationship.

2. An Estimate of the Amount of Pleasure Driving in New Jersey

The final empirical work attempted to obtain projections of participation probability and days of pleasure driving estimates for each of the counties of New Jersey through the year 2000. Using the probability equation (10) and inserting appropriate values for the relevant exogenous characteristics for the population of each of the counties for each year,[4] an estimate of the dependent variable, probability of driving for pleasure, can be computed. These can be used to generate a conditional probability table for driving for pleasure.

The basic equation for the probability of driving for pleasure is:

$$DP = .7406 + .0902Y - .0050Y^2 - .0511SX - .0047A - .1372\ O_2 \qquad (10)$$

From equation 10 we derived conditional probabilities of driving for pleasure in the State of New Jersey for the years 1968-2000 and for the counties for the decade years until 2000. For the age variable the median age for each of the age groupings 18 to 44 years, and 45 to 64 years was used. For the open ended class 65 and over group the median age was determined to be 74.

The 1960 median family income for each county and the state was obtained [21], and an annual growth rate of 1.75 per cent was applied to the 1960 level of median family income. The 1.75 per cent rate of growth of income was assumed in line with past trends of income. The values thus obtained for each year were squared to obtain the Y^2 values for the counties and the state up to the year 2000.

---

[4] The development of the population projections is discussed in Appendix B.

The value for the 0_2 variable (per cent of over 18 years of age population who are not employed was obtained) for each county in the following manner. From the 1960 county population all those under 18 years of age were subtracted. The 1960 total employed persons in the civilian labor force for each county was determined [21]. Thus, the per cent of population of employed persons over 18 years of age could be determined. Subtracting, the fraction of employed persons from unity, determined the fraction of each county's population in 1960 that was not working. The value of 0_2 so determined was used for each county.

The necessary calculations were carried out to determine the conditional probabilities for the counties and the state for each year through the year 2000. For example, the conditional probability of driving for pleasure in Atlantic County in 1960 is given in Table 2.

TABLE 2

1960 Atlantic County Conditional Probability of Driving for Pleasure

Age	Male	Female
18-44	0.8112	0.8623
45-64	0.7007	0.7518
65+	0.6114	0.6625

This table can be interpreted as follows: the probability of going pleasure driving for a male between the ages of 18 and 44 and possessing the mean value of the 1960 Atlantic County population for the other significant variables is .8112. Alternatively we can interpret the .8112 coefficient as indicating that 81.12% of males between 18 and 44 in Atlantic County in 1960 went pleasure driving.

For the State of New Jersey in 1960, the conditional probability of driving for pleasure is given in Table 3.

TABLE 3

1960 State of N. J. Conditional Probabilities of Driving for Pleasure

Age	Male	Female
18-44	0.8654	0.9165
45-64	0.7549	0.8060
65+	0.6656	0.7167

Similar condition probability tables were developed for the State for each year through the year 2000 and for each county for 1970, 1980, 1990 and 2000.

Once the conditional probabilities were determined for the necessary years for the State and for the counties, the number of participants for each county and year could be estimated. For the state of New Jersey and for each county in the state population estimates for each cell was obtained by combining information from various published and unpublished sources as described in Appendix B. The conditional probabilities were then multiplied by the population of the corresponding cells to determine the number of participants in driving for pleasure.

Thus, for example, Table 4 shows that in Atlantic County in 1960 19,035 males between 18 and 44 years of age went pleasure driving, while Table 5 indicates that 913,473 males in that age category in the State engaged in pleasure driving activities. Similar tables were derived for each county and for each of the aforementioned years.

The next step was to determine the total days of participation in driving for pleasure. From ORRRC Study Report 19 [13], it was calculated that each participant in driving for pleasure participated 40.2 days per year. We then multiplied 40.2 by the number of New Jersey participants in driving for pleasure to determine the total number of days of participation in driving for pleasure. Thus multiplying each cell on Table 4 and 5 by 40.2 yielded Table 6 and 7 respectively. Consequently, according to our calculations males between 18 and 44 years of age in Atlantic County drove for pleasure a total of 765,225 days during 1960, while the same category of drivers drove 36.7 million days in 1960 in the state. Consequently, utilizing this approach we could estimate the actual number of driving days for each county and the state as a whole through the year 2000.

Since the purpose of this analysis is to get some measure of present benefits which would result from utilizing scenic highways, it is obvious that what we are interested in the present value of all the days of driving activity in the state. Accordingly, the days of participation were discounted from the year 1968 through to 2000 at a 5 per cent per annum rate to obtain the present value of participation days (in units of discounted days) in 1968. This result is shown on Table 8.

TABLE 4

1960 ATLANTIC COUNTY
NUMBER OF PARTICIPANTS
DRIVING FOR PLEASURE

Age	Male	Female
18-44	19,035	22,909
45-64	12,687	15,536
65 +	6,213	8,296

TABLE 5

1960 STATE OF NEW JERSEY
NUMBER OF PARTICIPANTS
DRIVING FOR PLEASURE

Age	Male	Female
18-44	913,473	1,023,148
45-64	488,219	544,718
65 +	163,832	223,613

TABLE 6

1960 ATLANTIC COUNTY
NUMBER OF DAYS OF PARTICIPATION
DRIVING FOR PLEASURE

Age	Male	Female
18-44	765,225	920,961
45-64	510,028	624,561
65 +	249,776	333,482

TABLE 7

1960 STATE OF NEW JERSEY
NUMBER OF DAYS OF PARTICIPATION
DRIVING FOR PLEASURE

Age	Male	Female
18-44	36,721,626	41,130,533
45-64	19,626,393	21,897,683
65 +	6,586,056	8,989,236

If a series of arbitrary dollar values of a day's driving for pleasure is applied to the magnitudes in Table 8, it can be converted to a table of present values of benefits. Thus, for example, if it would be worth, on the average, $.01 to each driver for each day he goes pleasure driving, then the present value of benefits derived from pleasure driving for the Atlantic County population is approximately $815 thousand, while for the New Jersey population through the year 2000 it is $31.3 million. Of course, if a day is worth $.10 then the value of benefits would be $8.15 million for Atlantic County and $313 million for the State.

Accordingly, Table 8 can be a useful guide for policymakers. If these decision-makers believe a pleasure driving day is worth, say, $.10, then multiplying each item in Table 8 by 0.10 yields an estimate of benefits for each county. This should then be compared with the existing stock of scenic highways in each county and the costs of further scenic enhancing in the stock of highways in deciding on how to allocate expenditures on highway building and enhancement. If for example, County X is already well endowed with scenic roads (as measured, perhaps, by some index which takes into account of miles of scenic roads/per participant as well as other variables e.g. volume, etc.), then it might be desirable to spend funds for scenic enhanced in a less well endowed county such as County Y, even if the estimate of benefits for County Y were smaller than the estimates of benefits for County X. Moreover, if for example, County Z was found to have no existing scenic roads, while its benefit estimate was $10 million, then it would improve the welfare of the community to spend up to $10 million on scenic enhancement solely with this purpose in mind.

TABLE 8

Sum of Total Discounted Days
Driving for Pleasure 1968 - 2000

County	Present Value Future Days Driving for Pleasure (in thousands)
Atlantic	81,462
Bergen	368,758
Burlington	122,367
Camden	182,762
Cape May	24,688
Cumberland	57,261
Essex	377,844
Gloucester	64,659
Hudson	234,939
Hunterdon	37,181
Mercer	134,946
Middlesex	281,839
Monmouth	233,344
Morris	182,610
Ocean	93,417
Passaic	202,564
Salem	27,274
Somerset	109,747
Sussex	36,394
Union	238,096
Warren	38,073
Total	3,130,225

IV. SUMMARY

Our analysis has shown that there is a significant relationship between scenic highways and a reduction in injuries. Table I provides estimates of the maximum amount which could be spent on scenic improvement of non-scenic highways and still not involve any net social cost to society. These sums vary, of course, with traffic volume per mile.

Secondly, we have been able to estimate the number of days the population of each county in New Jersey will engage in pleasure driving through the year 2000. This projection has been reduced to a present value figure which can provide a guideline for policy decisions on the need for scenic highways in the counties of New Jersey.

APPENDIX A

Determination of Scenic Coefficients on Washington Highway Segments

In the pamphlet, Recommendations for the Establishment of Additional Scenic Areas Along the State Highways of Washington [12] by Thomas J. Norton and John L. Robertson, 111 highway segments containing 3754 miles of Washington State highway were rated according to their scenic merit. (The criteria for this scenic rating is based largely on an earlier Washington report entitled "Criteria for the Establishment of Additional Scenic Areas," by Wolfe, Norton, and Cohn of the University of Washington.) In this report, two alternative forms of route element analysis are developed. The first alternative relies heavily on expert judgment by a person or persons of "great aesthetic discrimination" as to the scenic merit of the road. The second alternative was a much more detailed and demanding appraisal technique. The second has the advantage of being more objective and consistent, since it does not depend so greatly on the particular tastes of the evaluator. Thus the latter alternative with a few modifications was selected as a means of determining the relative scenic merit of the highway segments.

The main criteria of the selected method are listed below:

Route Element - Analysis

A. Materials which are sensed

1. Color

2. Texture

3. Pattern

4. Rhythm

5. Shape

B. Forms

1. Single, self-contained forms

a. Man-made objects

1. Utilitarian

2. Artistic

3. Curious

b. Architectural examples

2. Relation of forms

a. Architectural combinations

b. Geomorphic forms

c. Hydrographic forms

d. Floral forms

e. Landscape design

f. Marine

3. Landmarks

4. Viewpoints

   a. Major prospects

   b. Impressive vistas

   c. Nearby scenes

C. Expressions

   1. Past associations

   2. Present associations

The "scenic coefficient" was computed for each highway section based on the criteria above and using the following formula:

$$\text{Scenic coefficient} = \frac{\left(\text{Material miles} + \text{Form miles} + \text{Expression miles}\right) \times \text{Grade miles}}{(\text{highway segment mileage})^2}$$

The elements which are utilized in this formula are defined as follows:

Material miles = total mileage in which various "materials" subcategories were observed.

Form miles = total mileage in which various "forms" subcategories were observed.

Expression miles = total mileage in which various "expression" subcategories were observed.

Grade miles = scenic grade (1-5) times the mileage designated in each grade, totaled.

APPENDIX B

Population Methodology

The population data required for the State was of two distinct types: a) the total population of the State year by year until 2000, as well as the individual county populations for these same years; and b) the age and sex distribution of the population for the state and counties for the necessary years. The age classification used in our estimates is: under 18 years of age (assumed to be nondrivers); 18-44; 45-64; 65+. The male-female ratios for each of these age categories were also required for 1960-2000.

Population data for the counties were obtained from two sources [11] [14]. For five counties (Burlington, Camden, Gloucester, Mercer, Salem) the Penn-Jersey study [14] provided data on county population totals and data was also provided for the age-sex distribution of the population. This study did not go beyond 1990 but the data was projected forward by applying the 1975-1990 rate to obtain totals for the intervening years until 2000. This projection was then checked against state estimates [11].

Age-sex distribution ratios through 1990 were given in the Penn-Jersey study and these were projected to the year 2000 in a similar manner. A problem did arise in distributing the 15-19 year old population for these counties because the data in the Penn-Jersey study were in five year age cohorts which did not exactly fit the age breakdown we desired; specifically separating the under 18 years of age who could be considered the non-driving population. We distributed the 15-19 year olds for each county by placing 60% of this age group in the under 18 year old category, and 40% in the 18-44 category. We assumed that in the five year age grouping the population was evenly distributed and that this arbitrary distribution of population was not an unjust assumption.

For the remaining counties of the state, we used data provided by the New Jersey Department of Conservation and Economic Development [11]. The data was provided in five year intervals and it was interpolated for the intervening years. The state data covered the complete period 1960-2000.

In order to check the accuracy of our combined Penn-Jersey and State data for the total state population, an outside reference projections done by the Census Bureau was utilized [19] [20]. For 1980, our estimate of the statewide population was 8,863,100 people and the Census Bureau estimated a range (based on various fertility and migration assumptions, and one mortality assumption) of between 8,331,000 and 8,993,000. Method II-B of the Bureau yielded an estimate of 8,875,000 people. Our combined statewide population total for the year 1985 was 9,612,600 and the Bureau estimated a range of between 8,893,000 and 9,877,000 people, while using method II-B they estimated a population total of 9,697,000 people. The close approximation of our combined totals with the latest revised Census Bureau estimates have led us to believe that our combined population estimates are in line with other published data and can be accepted up to the year 2000 without grossly misestimating the population of the state and counties.

Our next problem was to determine the age and sex distribution for the state and the individual counties, excluding the Penn-Jersey counties. We were unable to locate any statewide projections of population based on an age and sex distribution of the population. The Census Bureau [2] provided us with statewide estimates of the age and sex distribution of the population for the years 1960, 1970, 1975, 1980, and 1985, using the same age categories that we were interested in using. To obtain the statewide age and sex distribution of the population for the years 1960-1985 the data was interpolated within the given benchmark years. In order to determine the future statewide composition of the population beyond 1985 we used the following method. The 1960 to 1985 rate of age-sex population change was taken and these changes projected until the year 2000 to obtain the required distribution of the statewide population for the years 1986-2000. A statewide estimate of the age and sex distribution of the population for the years 1960-2000 was then made.

However, we were still lacking the age and sex distribution of the county populations beyond 1960. To obtain these estimates the following procedure was used. From the 1960 Census [21] the age and sex distribution of each county's population in the desired categories was obtained. Thus, for example, Atlantic County's 1960 population data was tabulated as follows:

County

Age	Total	% of Total County Pop.	Male	% Male of Total	Female	% Female of Total
Under 18	49,407	30.1	25,173	51.0	24,238	49.0
18 - 44	50,090	31.1	23,513	46.9	26,580	53.1
45 - 64	38,835	24.1	18,006	46.7	20,829	53.3
65+	22,548	14.1	10,112	44.8	12,436	55.2

It was assumed that the county age and sex distribution of population would change over time, but still remain in the same relation that the county-state 1960 relation had been. For example to determine the age and sex distribution in any given county in 1970 the following formula was used:

$$\frac{\text{\% 1960 County 18-44 year olds}}{\text{\% 1960 State 18-44 year olds}} = \frac{\text{\% 1970 County 18-44 year olds}}{\text{\% 1970 State 18-44 year olds}}$$

The statewide age and sex ratio having been determined, the only unknown to be solved would be the individual county age or sex ratio category. This procedure was used to determine the age and sex ratio for the necessary counties in the years 1970, 1980, 1990, and 2000, assuming that the counties will change as the state age and sex distribution ratios change but remain in the same relation (constant variance) as the 1960 county-state ratios had been. This method, though far from perfect, does give approximate age and sex distributions of population for the counties in the future years. The percentage figures thus obtained were applied to the county population data to obtain the approximate distribution of the population for each of the counties.

REFERENCES

1. Appleyard, Donald; Lynch, Kevin, and Myer, John R., The View from the Road, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1963.

2. Baker, Robert F., "Feasibility of Incorporating Natural Beauty Into Highway Design," Before Symposium of the Ohio State University Natural Resources Institute, Columbus, May 1966, p. 65 (unpublished)

3. Clawson, Marion, and Knetsch, Jack L., Economics of Outdoor Recreation, The Johns Hopkins Press, Baltimore, Maryland, 1966.

4. Davidson, Paul, Adams, F. G., and Seneca, Joseph, "The Social Value of Water Recreational Facilities Resulting from an Improvement in an Estuary: The Delaware - A Case Study," Western Resources Conference, Vol. 3, Resources for the Future, 1965.

5. Dorfman, R. (ed.), Measuring Benefits of Government Investments, Washington, D. C., 1965, Brookings Institution.

6. Garmhausen, Wilbur J., "Highway Scenic Beauty Doesn't Just Happen," Public Works, Vol. 97, No. 9, p. 126, September 1966.

7. Huff, Judith M., and Johnson, Hugh A., "Toward Measuring the Intangible Values of Natural Beauty," U. S. Department of Agriculture, Washington, D. C., August 1966, p. 8 (Paper presented at annual meeting, Soil Conservation Society of America, Albuquerque, New Mexico, unpublished).

8. Kates, Robert, "Pursuit of Beauty," Before Symposium of the Ohio State University Natural Resources Institute, Columbus, May 1966, p. 34 (unpublished).

9. Michaels, Richard M., "Attitude of Drivers Determine Choice Between Alternate Highways," Public Roads, Vol. 33, No. 11, December 1965.

10. Michaels, Richard M., "The Effect of Expressway Design on Driver Tension Responses," Public Roads, Vol. 32, No. 5, 1962.

11. New Jersey Department of Conservation and Economic Development Research and Statistics Section - Division of Economic Development, Trenton, New Jersey, September 1966.

12. Norton, Thomas J., and Robertson, John L., Recommendations for the Establishment of Additional Scenic Areas Along the State Highways of Washington, University of Washington, Seattle, 1964.

13. Outdoor Recreation Resources Review Commission, National Recreation Survey, ORRRC Report 19, Washington, D. C., 1962.

14. Penn-Jersey Transportation Agency, Foreground of the Future, Vol. 2, Penn-Jersey Reports, Philadelphia, 1964.

15. Prest, A. J., and Turvey, R., "Cost-Benefit Analysis: A Survey," Economic Journal, p. 683, December 1965.

16. Snow, W. Brewster, The Highway and the Landscape, Rutgers University Press, 1959, New Brunswick, New Jersey.

17. Tunnard, C., and Pushkareo, B., Man-made America: Chaos or Control, New Haven and London: Yale University Press 1963, Hartford, Connecticut.

18. Tybout, Richard A., "The Problem of Collective Choice in Aesthetic Matters," Before Symposium of the Ohio State University Natural Resources Institute, Columbus, May 1966, p. 51 (unpublished).

19. U. S. Bureau of the Census, Current Population Reports, Series P-25 No. 362, March 7, 1967 "Illustrative Projections of the Population of States 1970 to 1985 (Revised)"

20. ________________, Current Population Reports, Series P-25 No. 326, February 7, 1966 "Illustrative Projections of the Population of States 1970 to 1985" Table 6

21. ________________, U. S. Census of Population 1960, General Population Characteristics, New Jersey, Final Report PC (1)-32B Table 27.

22. ________________, County and City Data Book 1962.

23. U. S. Department of Commerce Bureau of Public Roads, Economic Impact of the Highway Beautification Act, Staff Report, Washington, D.C., March 1967.

ADDITIONAL BIBLIOGRAPHY

1. Advisory Committee on a National Highway Program, A Ten Year National Highway Program: A Report to the President, Washington, D.C. 1955.

2. American Association of State Highway Officials, Committee on Planning and Design Policies, Road User Benefit Analysis for Highway Improvements, Washington, D. C. 1960, pp. 76-77.

3. Becht, J. Edwin, "New Roads and Their Consequences," Business Review, Vol. 7, No. 5, May 1960, pp. 8-14.

4. Bos, H. C., and Koyck, L. M., "The Appraisal of Road Construction Projects: A Practical Example," Review of Economics and Statistics, No. 43: pp. 13-20, February 1961.

5. Brooke, Glenn, E., "Traffic Usage of Main Turnpike," Public Roads, Vol. 28, pp. 224-230, 1955.

6. Brownlee, O. H. and Heller, W. W., "Highway Development and Financing," American Economic Association Papers and Proceedings, No. 46: pp. 232-50, May 1956.

7. Buchanan, J. M., "Private Ownership and Common Usage: The Road Case Re-examined," Southern Economic Journal, No. 22: pp. 305-16, January 1956.

8. Burdiss, T. K., "The Economics of New Roads with Particular Reference to MI (London-Birmingham Motoring)", Applied Statistics, No. 9: pp. 113-21, June 1960.

9. Burton, Robert C., Edens, David G., and Knopp, Frederick D., Jr., Socio-Economic Impact of the Capital Beltway in Virginia, University of Virginia, 1963.

10. Campbell, E. Wilson and McCargar, Robert, Objective and Subjective Correlates of Expressway Use, Highway Research Board Bulletin, No. 119, pp. 17-38, 1956.

11. Carey, Omer L. "The Economics of Recreation: Progress and Problems", Western Economic Journal, Spring 1965, Vol. 3, No. 27.

12. Ciriacy-Wantrup, S. V., "Benefit-Cost Analysis and Public Resource Development," Journal of Farm Economics, No. 37: pp. 676-89, November 1955.

13. Claffey, Paul J., "Characteristics of Passenger Car Travel on Toll Roads and Comparable Free Roads," Highway Research Board Bulletin, No. 306, pp. 1-22, 1961.

14. Clawson, Marion, Statistics on Outdoor Recreation, Resources for the Future, Inc., Washington, D. C., 1958.

15. "Congress Provides Tools for a Clean-up, Prettier Landscape and Purer Water," Business World, September 25, 1965.

16. Cotner, M. L., "Criteria and Problems in the Use of Quantitative Analytical Procedures for Public Development Investments," Journal of Farm Economics, November 1962, Vol. 44, pp. 1085-92.

17. Covey, F. M., Jr., "Service on Limited Access Highways: Organized Pressures and the Public Interest," Land Economics, No. 35: pp. 368-73, November 1959.

18. Drew, E. B., "Lady Bird's Beauty Bill," Atlantic, No. 216: pp. 68-72, December 1965.

19. Eckstein, Otto, Water-Resource Development: The Economics of Project Evaluation, Cambridge, Harvard University Press 1958.

20. Federal Inter-Agency River Basin Committee, Subcommittee on Benefits and Costs, Proposed Practices for Economic Analysis of River Basin Projects, Washington, D. C. 1950.

21. Ferguson, A. R., "A Marginal Cost Function for Highway Construction and Operation (in Virginia)", American Economic Association Papers and Proceedings, No. 48: pp. 223-34, May 1958.

22. Foster, C. D., "The Economics of Roads: Surplus Criteria for Investment," Oxford University Institute of Economics and Statistics Bulletin, No. 22: pp. 327-57, November 1960.

23. Frome, M., "Let's Rescue Our Roadsides Now!", American Forests, No. 69: pp. 10-11, November 1963.

24. George, J. J. and Ryley, T. W., "The New Jersey Turnpike," Land Economics, No. 33: pp. 154-64, May 1957.

25. Gerckens, L. C., "Incorporating Natural Beauty into Highway Design," Before Symposium of the Ohio State University Natural Resources Institute, Columbus, May 1966, p. 65 (unpublished).

26. Gilmore, K. O., "Let's Clean Up This Highway Mess," Reader's Digest, No. 85: pp. 86-92, November 1964.

27. Glassborow, D. W., "The Road Research Laboratory's Investment Criterion Examined," Oxford University Bulletin of Economics and Statistics, No. 22: pp. 327-35, November 1960.

28. Graham, Guilbert R., and McFerran, C., South Carolina Economic Impact of an Interstate Highway on Land Values and Uses, University of South Carolina Report, 1964.

29. Great Britain, Road Research Laboratory, The London-Birmingham Motorway: Traffic and Economics, London, HMSO, 1960, Road Research Technical Paper No. 46: pp. 56-58.

30. Grosse, Robert N., An Introduction to Cost-Effectiveness Analysis, Research Analysis Corporation, Economics and Costing Division, RAC-P-5, July 1965.

31. Grotewald, A. and Grotewald, L., "Commercial Development of Highways in Urbanized Regions: A Case Study of U. S. Highway 41 Between Chicago and Milwaukee," Land Economics, No. 34; pp. 236-44, August 1958.

32. Grubbs, C. M., "Problems of Highway Cost Allocation," National Tax Journal, No. 16: pp. 416-25, December 1963.

33. Haikalis, George and Hyman, Joseph, "Economic Evaluation of Traffic Networks," Highway Research Board Bulletin, No. 306, Washington, D. C., 1961.

34. Haney, Don G., The Value of Travel Time for Passenger Cars: A Preliminary Study, Stanford Research Institute, Project No. IMU 3869, 1963.

35. Hines, L. G., "The Hazards of Benefit-Cost Analysis as a Guide to Public-Investment Policy," Public Finance, Vol. 17, No. 2, 1962, pp. 101-117.

36. Hummel, C., "A Criterion Designed to Aid Highway Expenditure Programming," Highway Research Board Bulletin, No. 306, Washington, D. C., 1961.

37. Johnson, M. Bruce, "On the Economics of Road Congestion," Econometrica, January and April, 1964, Vol. 32, Nos. 1 and 2.

38. Johnson, M. Bruce, "Travel Time and the Price of Leisure," The Western Economic Journal, Vol. 4, No. 2, Spring 1966.

39. Kafoglis, M. Z., "Highway Policy and External Economics," National Tax Journal, No. 16: pp. 68-80, March 1963.

40. Kain, John F., Commuting and the Residential Decisions of Chicago and Detroit Central Business District Workers, A paper presented to the Conference on Transportation Economics of National Bureau of Economic Research, April 1963.

41. Knetsch, J. L., "Outdoor Recreation Demands and Benefits," Land Economics, No. 39; pp. 387-96; November 1963.

42. Krutilla, J. V., "Welfare Aspects of Benefit-Cost Analysis," Journal of Political Economy, Vol. 69, June 1961, pp. 226-35.

43. Kuhn, Tillo E., Public Enterprise Economics and Transport Problems, (reprint) University of California, Berkeley 1962.

44. Lawton, L., "Evaluating Highway Improvements on Mileage and Time Cost Basis," Traffic Quarterly, 1950.

45. "LBJ's Plan for Roads: Beauty or No Money," U. S. News and World Report, No. 58: 62-3, June 7, 1965.

46. Le Baron, A. D., "The 'Theory' of Highway Finance: Roots, Aims, Accomplishments," National Tax Journal, No. 16: pp. 307-20, September 1963.

47. Lemly, James H., Economic Consequences of Highways By-Passing Urban Communities, Georgia State College, 1956.

48. Lerner, Lionel J., The Demand Value Structure of Recreation, New Horizons for Resources Research: Issues and Methodology, University of Colorado, Boulder, 1965.

49. "Less Clutter Along Highways," U. S. News and World Report, No. 59: p. 13, October 18, 1965.

50. Maass, Arthur, "Benefit-Cost Analysis: Its Relevance to Public Investment Decisions," Quarterly Journal of Economics, Vol. LXXX, May 1966.

51. Marglin, Stephen A., Public Investment Criteria, London, Allen and Unwin, 1966.

52. McKain, Walter C., The Connecticut Turnpike - A Ribbon of Hope: The Sociological and Economic Effects of the Connecticut Turnpike in Eastern Connecticut, Connecticut Agricultural Experimental Station Bulletin No. 387, Storrs, Connecticut, January 1965.

53. McKean, R. N., Efficiency in Government Through Systems Analysis, New Wiley 1958, Publications in Operations Research No. 3.

54. Meek, R. L., "An Application of Marginal Cost Pricing: The 'Green Tariff' in Theory and Practice," Journal of Indian Economics No. 11; pp. 217-36 and No. 12: pp. 45-63, July and November 1963.

55. Meiburg, C. O., "An Economic Analysis of Highway Services," Quarterly Journal of Economics, No. 77: pp. 648-56, November 1963.

56. Meyer, J. R., and Swick, C. J., "The Theory and Measurement of Private and Social Cost of Highway Congestion," Econometrica, No. 31: p. 249, January, April 1963.

57. Mohring, H., Highway Benefits: An Analytical Framework, Northwestern University Press, 1962.

58. Mohring, H., "Land Values and the Measurement of Highway Benefits," Journal of Political Economy, No. 69: pp. 236-49, January 1961.

59. Moses, L. N. and Harold F. Williamson, Jr., "Value of Time, Choice of Mode and the Subsidy Issue in Urban Transportation," Journal of Political Economy, June 1963, Vol. 71, No. 3.

60. Mumford, Lewis, The Highway and the City, Harcourt, Brace, World Co., New York, 1963.

61. Munhy, D. L., "The Roads as Economic Assets," Oxford Bulletin of Economics and Statistics, No. 22: pp. 273-97, November 1960.

62. National Park Service, Land and Recreational Planning Division, The Economics of Public Recreation, The 'Prewitt' Report, Washington, D.C. 1949.

63. Nelson, J. C., "The Pricing of Highway, Waterway, and Airway Facilities," American Economic Association Papers and Proceedings, No. 52: pp. 426-35, May 1962.

64. Neutze, G. M., "The External Diseconomies of Growth in Traffic," Economic Record, No. 39: pp. 332-45, September 1963.

65. Renshaw, E. F., "The Economics of Highway Congestion," Southern Economic Journal, No. 28: pp. 372-77, April 1962.

66. Reynolds, D. J., "Some Problems of Planning the Improvement of the Road System," Oxford Bulletin of Economics and Statistics, No. 22: pp. 313-26, November 1960.

67. Shaffer, Helen B., "Highway Design and Beautification," Editorial Research Reports, May 5, 1965, pp. 323-40.

68. Silver, I., "Ugliness and the Law," Commonweal, No. 83: pp. 144-6, November 1965.

69. Stroup, Robert H., Vargha, Louis A., and Main, Robert K., Predicting the Economic Impact of Alternate Interstate Route Locations, University of Kentucky Report, 1962.

70. Tinbergen, J., "The Appraisal of Road Construction: Two Calculation Schemes," Review of Economics and Statistics, No. 39: pp. 241-49, August 1957.

71. Trice, Andrew H. and Woods, Samuel E., "Measurement of Recreational Benefits," Land Economics, August 1958, pp. 195-207.

72. Trueblood, Darel L., "The Effect of Travel Time Over Distance on Freeway Usage," Public Roads, Vol. 26, 1952.

73. U. S. Congress, Committee on Ways and Means, Final Report of the Highway Allocation Cost Study, 87th Congress, 1st Session, House Document No. 54, Government Printing Office, 1961.

74. U. S. Congress, Highway Beautification Act of 1965, Public Law pp. 89-285; 79 Stat. 1028. An Act to Provide for Scenic Development and Road Beautification of the Federal-Aid Highway Systems.

75. U. S. Department of Commerce, Guide for Highway Beautification Impact Studies, Bureau of Public Roads, Office of Research and Development, Economics and Requirements Division, May 1965, Washington, D. C.

76. U. S. Department of Commerce, Highways and Economic and Social Change, Bureau of Public Roads, Office of Research and Development, Economics and Requirements Division, U. S. Government Printing Office, Washington, D. C., November 1964.

77. U. S. Department of Commerce, A Proposed Program for Scenic Roads and Parkways, Washington, D. C., June 1966.

78. U. S. Department of Commerce, Bureau of Public Roads, Highways in the United States, Washington, D. C. 1956.

79. U. S. Senate Committee on Public Works, Subcommittee on Public Roads, Highway Beautification and Scenic Road Programs, Hearing August 10-13, 1960, S2084, 89:1.

80. Walters, Alan A., "The Theory and Measurement of Private and Social Cost of Highway Congestion," Econometrica, October 1961, Vol. 29, No. 4.

81. Wennergren, E. Boyd, and Gardner, B. Delworth, "The Economics of Recreation: Comment," The Western Economic Journal, Spring 1966.

82. Winch, David M., The Economics of Highway Planning, University of Toronto Press, 1963.

83. Wolfe, Myer R., Norton, Thomas J., and Cohn, Sidney, Criteria for the Establishment of Additional Scenic Areas (reprint) University of Washington, 1964.