The Economic Benefits Accruing From the Scenic Enhancement of Highways

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•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 to provide for scenic development and road beautification of federally aided highway systems. There are three major sections of the Act: Title 1 and Title 2 deal with provisions for limiting and controlling outdoor advertising and junkyards adjacent to highways, whereas Title 3 is concerned with the need for the landscaping and scenic enhancement of highway systems.

The primary objective of this study was to focus on Title 3 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 enchancement 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 proved 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 counterrecessionary 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 alternative government 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

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"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.

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 the 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. Huff and Johnson (7) wrote, "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."

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 of what is beautiful, and there exist no precise difinitions 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 of what is ugly.

To ensure 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 (13, p. 52) 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, strip-mined landscapes and rings of junkyards around our cities."

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 highways according to their scenic merit (12, p. 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 (6, p. 126) that "Aesthetic highway design pays off in added safety. Driver tension and fatigue, which are believed to be hidden causes of many automobile accidents, can be relieved by interesting highways and roadside development." 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 breathtaking 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 guardrails, possibly reduce mowing requirements, and lessen driver monotony. Other functional uses of plantings include minimization of headlight glare, 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 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 by a market process. There has been considerable divergence of opinion on the proper use of benefit-cost analysis when intangible or nonmarket 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 increased safety and greater pleasure for the highway user. Thus, it should be possible to hypothesize a relationship between the aesthetic character of the road and the safety that 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, according to Tunnard (17, p. 205).

In this study, it has been possible 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 recently has received considerable attention (3, 4).

Certainly, it may be difficult to quantify accurately "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 that may be both physical and psychic or the type of benefits that may be received by the nation as a whole (5, p. 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 study by Michaels (10, p. 107) 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." In a subsequent publication (9, p. 235), 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."

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

Thus, possible benefits derived from scenic enhancement of highways appear to fall into three major categories: (a) visual pleasures that make a trip more enjoyable, (b) a possible improvement in safety, and (c) a possible difference in highway maintenance costs. (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.) The measurement of these benefits, once they are identified, however, hinges on the availability of appropriate data to determine the significance and magnitude of the benefits as well as their economic value and particular applicability

TABLE 1

NEW JERSEY HIGHWAY DATA

Variable	Symbol	Description
Scenic classification	S	0 if not scenic, 1 if scenic
Length	L	Length (miles) of highway segment
Volume of traffic	V	Average annual daily traffic ($\times 10^{-2}$)
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_0	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

to the populations of specific states having widely different social and economic characteristics affecting highway use.

Preliminary investigation of the available literature revealed that very little data had been collected primarily for the purpose of allowing selected benefits of scenic enhancement to be analyzed by statistical techniques. Data related to the aesthetic benefits derived from scenic enhancement, for example, seemed 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, data collected from various sources for other purposes were utilized (a) to enumerate and evaluate the persons who engaged in driving for visual enjoyment (benefits), and (b) to see if differences in accident rates could be statistically associated with scenically enhanced highways.

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 of other factors such as volume, speed limit, traffic signals, and medians, 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 the highways of Washington State.

New Jersey Highway Data

The data on New Jersey highways, furnished by the New Jersey Highway Department, consisted of observations of 92 segments of New Jersey state highways selected arbitrarily. Eleven highway variables plus the number of accidents, injuries, fatal accidents, and traffic volume were observed on these highway segments. Each road segment was classified as either scenic or not scenic. The variables included in the data and used in our empirical analysis are given in Table 1.

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 by whether the highway was scenic or not.

Many possible combinations of variables were tested. In general, a good statistical relationship between fatalities per vehicle-mile and any of the independent variables was not established. On the other hand, the scenic coefficient was normally significant in regressions on injury per vehicle-mile, whereas it was, at best, only occasionally marginally significant in accident per vehicle-mile regressions. The 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

$$\text{Injury per vehicle-mile} = 0.0547 - \underset{(0.0127)}{0.0289\,S} + \underset{(0.0021)}{0.0043\,R} + \underset{(0.0045)}{0.0168\,N} \quad (1)$$

where the numbers in parentheses below the coefficients are the standard errors of the coefficient. The R^2 was 0.18 (adjusted for degrees of freedom) and the F-test was 7.87, which means that at the 0.95 confidence level, one 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 as follows:

$$\text{Accidents per vehicle-mile} = 0.0399 - \underset{(0.0179)}{0.0231\,S} + \underset{(0.0030)}{0.0038\,R} + \underset{(0.0064)}{0.0310\,N} \quad (2)$$

where $R^2 = 0.2115$ and F-test = 9.14, and

$$\text{Fatalities per vehicle-mile} = 0.0024 + \underset{(0.0006)}{0.0009\,S} - \underset{(0.00010)}{0.00002\,R} - \underset{(0.0002)}{0.0003\,N} \quad (3)$$

where $R^2 = 0.0231$ and 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 results for various combinations of the independent variables. Apparently, the "explanatory" pattern for fatalities involves different variables than those for accidents or injuries.

Although a relationship had been identified (Eq. 1) that 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 effect for accidents and no pattern at all for fatalities, it would be desirable to test these hypotheses against more data.

Washington State Highway Data

It was extremely fortunate that a study of the scenic merit of Washington state highways had just been completed. In this study, Norton and Robertson (12) rated 111 highway segments containing 3,754 miles of Washington state highways for their scenic value. The criteria utilized for obtaining a scenic rating were based on an earlier study (24).

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 the Washington State Highway Commission's 1965 Rural State Highway System Accident Report. From the Accident Report the following information was obtained: (a) section length (miles); (b) average daily traffic volume; (c) number of fatal accidents; (d) total accidents; and (e) number of persons injured.

The Norton scenic segments were compared with the similar segments of road in the Accident Report and the information was 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 because, 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 was 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 County line (Elbe), 22.8 miles. The mileage is fairly close and the difference results from the inclusion of the twon 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 21 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 successful.

Further information on the remaining 89 road segments was required, in particular the number of lanes, the type of road surface, and the width of the road. This information was obtained from the 1966 log of the Washington state highway system. 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. Unfortunately information on the number of traffic signals or the speed limit on these 89 road survey segments was not readily obtainable.

Information about the sample of 89 road segments was then collected to include a scenic coefficient, section length (miles), average daily traffic volume, number of fatal accidents, total accidents, number of persons injured, number of lanes, type of road surface, width of road surface, and number of major intersections. This was the basic information used in the regression analysis. These variables were used in the form given in Table 2 in the regression analysis.

TABLE 2

WASHINGTON STATE 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 than asphalt or bituminous, 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

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

$$\text{Injuries per vehicle-mile} = \underset{}{0.0748} - \underset{(0.0008)}{0.0019\,S} \tag{4}$$

where $R^2 = 0.0536$ and F-test = 5.98, and

$$\text{Injuries per vehicle-mile} = 0.1174 - \underset{(0.0008)}{0.0019\,S} - \underset{(0.0012)}{0.0019\,W} + \underset{(0.0099)}{0.0165\,T_1} - \underset{(0.0015)}{0.0017\,M_1} \tag{5}$$

where $R^2 = 0.0776$ and 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 Eq. 5. It thus became

$$\text{Log of injuries per vehicle-mile} = -1.8925 - \underset{(0.0184)}{0.2422\log S} + \underset{(0.0259)}{0.0714\,W} + \underset{(0.2162)}{0.8058\,T_1} - \underset{(0.0330)}{0.0045\,M_1} \tag{6}$$

where $R^2 = 0.2677$ and F-test = 8.68.

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

The equivalent equations for accidents and fatalities are

$$\text{Log accidents per vehicle-mile} = -1.9129 - \underset{(0.0783)}{0.1567\log S} + \underset{(0.0249)}{0.0856\,W} + \underset{(0.2079)}{0.5642\,T_1} + \underset{(0.0318)}{0.0273\,M_1} \tag{7}$$

where $R^2 = 0.2350$ and F-test = 7.45, and

$$\text{Log fatalities per vehicle-mile} = -3.7813 - \underset{(0.0939)}{0.0962\log S} + \underset{(0.0251)}{0.0470\,W} + \underset{(0.2400)}{0.1012\,T_1} - \underset{(0.0326)}{0.0462\,M_1} \tag{8}$$

where $R^2 = 0.0826$ and F-test = 1.99. Accordingly, the logarithmic relationship for the scenic coefficient is marginally significant with respect to accidents and not significant for fatalities.

Conclusions on Scenic Effects on Safety

In conclusion, our analysis definitely indicates that (a) there is a significant negative relationship between scenic highways and injuries; (b) there is some evidence of a

TABLE 3

ESTIMATES OF REDUCED INJURIES AND RESULTING COST BENEFITS

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	0.029	87	1,740
1,000	365,000	0.29	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

negative (log) relationship between scenicness and accidents, although a linear arithmetic relationship is not readily discernible; and (c) 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 Eq. 1, a scenic highway will have approximately eight fewer injuries per year per 10 million vehicle-miles than a nonscenic highway. In 1966, the average nonfatal injury cost in New Jersey was $3,000. This implies that if there is a 1-mile segment of New Jersey highway on which the average daily volume is 27,397.25 vehicles (or 10 million per year), then if this highway is scenic, there will be eight fewer injuries per year than if it is not scenic. Accordingly, scenically enhancing such a nonscenic 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 percent interest rate, the present value over time is $480,000. Consequently, if this hypothetical 1-mile segment of highway is presently nonscenic, 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 using 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 3 lists the estimated annual reduction in injuries per mile and the capitalized cost savings (benefits) that would result from scenically enhancing 1-mile segments of highway having different annual traffic volumes.

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 in this section. Among the many socioeconomic and attitudinal questions asked of each household was one about the frequency of engaging in pleasure driving during the preceding 12 months.

A multivariate regression analysis of these data was undertaken to isolate the significant variables that influence one's desire to engage in pleasure driving. Our concern was, 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 be to use 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, because there may be many nonpleasure drivers. This would lead to a concentration of values at zero, although there can be no negative observations. Thus, although 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 by a dummy dependent variable with a 0 vs 1 code for no participation during the past 12 months vs participation (regardless of amount). When the first stage, which indicates the major significant explanatory variables that affect the probability of engaging in this activity, is completed, then the zero participants are normally removed from the sample and the actual number of days of participation is 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 4 days, it was impossible to significantly distinguish among most of the participants; accordingly, the approach had to be modified at the second stage as explained below.

Table 4 gives the variables used in the analysis. In general, the independent variables tested consist of two types—socioeconomic variables (e.g., age, income, sex,

TABLE 4

VARIABLES CONSIDERED IN ANALYSIS OF DRIVING FOR PLEASURE

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
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 of household	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 years of age in household, 0 if no children under 14 years of age 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 North Central, 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 nonwhite

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

Factors That Affect Driving for Pleasure

This analysis has provided some interesting results. It was 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 the 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 employed full-time or not are the major factors that explain the probability of driving for pleasure.

The best equation was found to be

$$\underset{}{D} = 0.7406 - \underset{(0.0011)}{0.0047\,A} - \underset{(0.0261)}{0.0511\,SX} + \underset{(0.0166)}{0.0902\,Y} - \underset{(0.0010)}{0.0050\,Y^2} - \underset{(0.0459)}{0.1372\,O_2} \qquad (9)$$

where R^2 = 0.1525 and F-test = 32.77. This equation may be interpreted by substituting the particular value of a variable describing an individual. If the classical assumption of orthogonal variables holds (that is, independence in the statistical sense), then the magnitudes derived from substituting each of the values describing a particular individual in this equation are additive, and yield a conditional probability of driving for pleasure, given the particular values that 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 0.7406. The magnitudes in the equation are added to and subtracted from this value to yield the conditional probability. The coefficient of age is -0.0047; hence, as the age of the sample person increases, the probability of driving for pleasure falls at the rate of 0.0047 for each yearly increase in age. Thus the probability of a 40-year-old individual going pleasure driving is 0.094 less than a 20-year-old who has all the same socioeconomic characteristics except age. Accordingly, despite the fact that driving does not require strenuous physical activity, or agility 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, because some minimum is required to own or at least operate a car for pleasure. Our analysis shows that 40 percent of the sample population whose income is below the $3,000 poverty line did not participate in pleasure driving at all. This compares with 24 percent whose income is between $3,000 and $4,999, 12 percent of the $5,000 to $7,499 income group, and 8.6 percent of the $7,500 to $9,999. Only in the $10,000 and over group does the proportion of the population not participating reverse this downward trend; 20.5 percent in the highest income group did not participate.

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

We attempted to delve further into this interesting income effect to find out what proportion of the population indicated a preference to engage in even more pleasure driving activity than they did in the observed 12-month period. We found that 16.4 percent of the below-$3,000 class wanted to pleasure drive more than they did before. This compares with 11.3 percent for the $3,000 to $4,999 class, 9.3 percent for the $5,000 to $7,499 class, 12.1 percent for the $7,500 to $9,999 class, and 11.1 percent for the $10,000 or more class. Thus the top two classes show increasing preference for more pleasure-driving activity. Since it would not appear that lack of income would be the constraint for these high-income individuals, it may well be that the pull of vocational activities limits the pleasure driving of the rich.

The level of income is a reflection of the opportunity cost between leisure and work. Although the average factory worker's income may be restricted somewhat by a standard work week, additional income can be earned by moonlighting. Even more important, the higher incomes of executives and professionals are often directly associated with the number of hours per day, and/or days per week, and/or weeks per year, that they work. Thus, for these individuals the opportunity cost in terms of a day's loss in income by engaging in pleasure driving may be very great. Consequently, it is not surprising to find this opportunity cost effect outweighing the income effect for pleasure driving at high-income levels.

Despite this pronounced income effect, we have not been able to identify differences in the probability of participation between white-collar and blue-collar occupations. We 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) than those who normally are in the labor force. According to our equation, a worker has a probability of driving for pleasure 0.1372 higher than a person with the same socioeconomic characteristics who is outside the employed labor force. Thus, it appears that the availability of leisure time itself may be a necessary condition but is not a sufficient condition for increasing the probability for engaging in this activity.

The most surprising result obtained is that the probability of engaging in pleasure driving is 5 percent 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 in the 18 to 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. Preliminary results of a similar regression analysis of the National Recreation Survey of 1960 yielded approximately the same relationship.

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 given below and inserting appropriate values for the relevant exogenous characteristics for the population of each of the counties for each year, 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 pleasure driving. The basic equation for the probability of driving for pleasure is

$$DP = 0.7406 + 0.0902\,Y - 0.0050\,Y^2 - 0.0511\,SX - 0.0047\,A - 0.1372\,O_2 \quad (10)$$

From Eq. 10 the conditional probabilities of driving for pleasure in New Jersey were derived for the years 1968 to 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 and 45 to 64 years was used. For the open-ended class of 65 and over, 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 percent was applied to the 1960 level of median family

TABLE 5

1960 CONDITIONAL PROBABILITIES OF DRIVING FOR PLEASURE IN ATLANTIC COUNTY

Age	Male	Female
18 to 44	0.8112	0.8623
45 to 64	0.7007	0.7518
65 and over	0.6114	0.6625

TABLE 6

1960 CONDITIONAL PROBABILITIES OF DRIVING FOR PLEASURE IN NEW JERSEY

Age	Male	Female
18 to 44	0.8654	0.9165
45 to 64	0.7549	0.8060
65 and over	0.6656	0.7167

income. The 1.75 percent rate of growth of income was assumed to be 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.

The value for the O_2 variable (percent 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 of employed persons in the civilian labor force for each county was determined (21). Thus, the percent 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 O_2 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 5. The 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 0.8112. Alternatively one can interpret the 0.8112 coefficient as indicating that 81.12 percent of males between 18 and 44 in Atlantic County in 1960 went pleasure driving.

For New Jersey in 1960, the conditional probability of driving for pleasure is given in Table 6. Similar conditional 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 the counties, the number of participants for each county and year could be estimated. For New Jersey and for each county in the state, population estimates for each cell were obtained by combining information from various published and unpublished sources. 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 7 shows that in Atlantic County in 1960 19,035 males between 18 and 44 years of age went pleasure driving, and Table 8 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 years mentioned.

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. Then 40.2 was multiplied by the number of New Jersey participants in driving for pleasure to determine the total number of days

TABLE 7

1960 NUMBER OF PARTICIPANTS DRIVING FOR PLEASURE IN ATLANTIC COUNTY

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

TABLE 8

1960 NUMBER OF PARTICIPANTS DRIVING FOR PLEASURE IN NEW JERSEY

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

TABLE 9

1960 NUMBER OF DAYS OF PARTICIPATION, DRIVING FOR PLEASURE IN ATLANTIC COUNTY

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

TABLE 10

1960 NUMBER OF DAYS OF PARTICIPATION, DRIVING FOR PLEASURE IN NEW JERSEY

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

of participation in driving for pleasure. Thus, multiplying each cell in Tables 7 and 8 by 40.2 yielded Tables 9 and 10 respectively. Consequently, according to these calculations, males between 18 and 44 years of age in Atlantic County drove for pleasure a total of 765,225 days during 1960, and the same category of drivers drove 36.7 million days in 1960 in the state. Using this approach one could estimate the actual number of driving days for each county and the state as a whole through the year 2000.

Because the purpose of this analysis is to get some measure of present benefits that would result from using scenic highways, it is obvious that the present value of all the days of driving activity in the state is the factor of interest. Accordingly, the days of participation were discounted from 1968 to 2000 at a 5 percent per year rate to obtain the present value of participation days (in units of discounted days) in 1968. This result is given in Table 11.

If a series of arbitrary dollar values of a day's driving for pleasure is applied to the magnitudes in Table 11, a table of present values of benefits would be derived. Thus, for example, if on the average it would be worth $0.01 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; for the New Jersey population through the year 2000 it is $31.3 million. Of course, if a day is worth $0.10, then the value of benefits would be $8.15 million for Atlantic County and $313 million for the state.

Accordingly, Table 11 can be a useful guide for policy-makers. If these decision-makers believe a pleasure-driving day is worth $0.10, then multiplying each item in Table 11 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

TABLE 11

SUM OF TOTAL DISCOUNTED DAYS DRIVING FOR PLEASURE 1968 to 2000

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

further scenic enhancing in the stock of highways in deciding 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 that takes into account the miles of scenic roads per participant as well as other variables such as volume), then it might be desirable to spend funds for scenic enhancement in a less well-endowed county such as County Y, even if the estimates 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 although its benefit estimate was $10 million, then it would improve the welfare of the community to spend up to $10 million on scenic enhancement with solely this purpose in mind.

SUMMARY

Our analysis has shown that there is a significant relationship between scenic highways and a reduction in injuries. Table 3 provides estimates of the maximum amount that could be spent on scenic improvement of nonscenic highways and still not involve any net social cost to society. These sums vary, of course, with traffic volume per mile.

We have also 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 that can provide a guideline for policy decisions on the need for scenic highways in the counties of New Jersey.

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