

# Nonuser Benefits from Highways

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The paper evaluates the concept of nonuser benefits. It presents evidence obtained from economic impact studies of such benefits in the nature of advantages to land-use patterns and to land values and other indirect beneficiaries of highway improvements. It describes these various fields on which highway benefits impinge and focuses on some specific areas of benefit such as land values and industrial and commercial development.

The scope of the economic impact studies is described as well as the shortcomings of this approach wherever relevant, especially in relation to the quantification of such indirect benefits. Some of the theoretical means proposed by various researchers to quantify and account for these benefits are delineated.

•THE LITERATURE of highway research abounds with the concept of benefit measurement. This concept follows the tradition that, at its very least, a public works facility should indicate an order of "benefit" to the community at large. For this reason, legislatures apportion part of their tax funds to the provision of social overhead items for the community. The assumption is made, implicitly or explicitly, that investment in social overhead furnishes immediate benefits to a community at large and provides the means for increasing the stream of future benefits to the community.

Yet, the placing of any particular public works improvement (e. g., highways) results in a change in the traditional relationship of people to commodities and services and affects their demands for particular items because of time-distance factors, cost factors, and spatial rearrangements in general. As one commentator (1) has stated,

...the contribution of social overhead to increase productivity is widely acknowledged, but its exact importance is hard to assess.... Nevertheless, the marginal contribution of good schools, an efficient road and highway system, reliable water supply and utilities and even recreational facilities may be decisive in the improvement of productivity. Though not precise, the evidence to this effect is sufficiently convincing to entrepreneurs to cause them to give these factors substantial weight in selecting localities for investment.

Through the years, in public works research, it has become conventional to separate user benefits from nonuser benefits. The rationale is that an individual should financially support public facilities according to the benefit that he receives from them; this has been interpreted by many to mean according to his use of such facilities.

Yet, in addition to benefit enjoyment by those who use a facility, there are advantages that accrue to particular types of business and parcels of land only because of their location near the facility. Thus, the advantage that accrues to such economic entities appears at least to be different in nature and locale from the advantage that accrues to the user of the highway facility.

In attempting to evaluate these separate means of identifying and measuring benefits, one needs to be aware of the pitfalls of double-counting benefits and measurement of transfers of economic activity, suggested by some researchers. Others find a suffi-

cient difference in type and magnitude of such benefits, thus reinforcing their belief that these nonuser benefits are proper objects of taxation, in an effort to recoup for the community any undue advantage accruing to such beneficiaries. These theories and others are discussed later.

Nonuser benefits from highway improvements as used in this paper encompass various broad elements of social and economic life, as well as some fairly restricted ones. At the very least, advantages or disadvantages that flow to an individual or a community from a highway improvement might include drainage, view, and amenity changes of various sorts. At the other extreme, they could include such items as the benefits accruing to industry, commerce, and residence, in rural and urban areas. In addition, they might include benefits to specific groups such as landowners, or separable benefits such as to public utilities and to outdoor advertisers for the use of highway right-of-way.

### TYPES OF IMPACT RESEARCH

The Bureau of Public Roads has recently had the occasion to analyze the concept of nonuser benefits and to summarize the research materials on this subject in the Highway Cost Allocation Study (2, 3) which the Bureau recently submitted to the U.S. Congress. One of its objectives was the identification and measurement of these nonuser benefits.

The attempt to define and quantify "nonuser benefits" led into many byways of research activity. Thus, it was obvious that some representation of highway effects on urban and rural communities would be required. It was likewise obvious that in a mobile and dynamic system like that in the United States, the benefit that could be related to highways alone, apart from its integral relationship with other activities, would be difficult to assess.

One recognizes that it might be possible to evaluate the benefits accruing to the Nation as a whole from highway construction at one point in time. Thus, a detailed snapshot grid of input-output data could indicate the effects of highway construction expenditures on the primary and derivative purchases of labor, materials, and capital equipment by all supplying industries. Such an estimate would not deal, however, with the dynamic results that might occur from each of these purchases in stimulating relocation of activities, in changing space demands, or in any way altering the straight-line linkage patterns already in existence in the basic framework. In such a construction-induced multiplier, a dollar of investment on highway transportation would not be different from a dollar of investment on any other form of investment activity.

Although on the surface there appear to be no essential differences in the results emanating from ordinary investment expenditures versus highway expenditures, such an estimate would not indicate what would happen to the local structure of economic activity. The Corporation for Economic and Industrial Research (CEIR) of Arlington, Va., made some preliminary estimates of this nature which would indicate the magnitude of the investment multiplier associated with the expenditure of an assumed amount of highway construction funds per year in the United States as a whole.

This research firm estimated the effect of the investment in highways of an assumed \$4 billion per year in 1947 prices. Material and service requirements were generated directly and indirectly throughout the economy so as to multiply the original expenditures between two and three times the original investment. A rough computation of annual business generated for each of 192 industries shows annual volumes of \$400 million for structural metal products down to \$100,000 for motion picture products (in 1947 prices). The major impact is, of course, in steel, cement, aggregates, and petroleum products (4, pp. 37-40, Appendix B).

In addition to such effect on material requirements throughout the economy, there are all sorts of investments that occur through the reorganization of economic facilities and the increased efficiencies that occur. Better accessibility, time and distance savings, and many other factors, of course, inspire such new investment, and each such increment has its own ramifications throughout the economy. These ramifications are familiar in terms of what has happened along Mass. 128, Dallas Expressway, the California freeways, and various other facilities. Furthermore, these estimates would

give no indication of the upgrading of land use and, hence, values that accompany the placement of highway facilities.

To obtain representative coverage of the United States on the local effects of highway improvements, research efforts by State highway departments through their universities were accelerated in a program of economic impact research. Because of the emphasis on controlled-access facilities in recent years, as in the Interstate System, there were a number of studies that had been completed in Texas, California, and other States in which these types of facilities were already in existence. In order not to omit the rural aspects of highway impact, a number of studies of this nature were sponsored.

The spread of economic impact research can be seen in two bibliographies on this subject prepared by the Virginia Council of Highway Investigation and Research (5, 6) for 1956 and 1961. The 1956 bibliography on economic impact research listed only 90 references, of which 30 were legal and right-of-way items. The bulk of the remaining references was concerned with work completed in the State of California and especially with bypasses. The similar bibliography prepared during 1961 consisted of 451 items, with some 300 authors identified by name.

In the urban areas, impact has been evaluated in cities like San Antonio and Dallas, Texas; Minneapolis, Minn.; Oakland, Calif.; and Richmond, Va.; rural trading centers have also been represented.

Beginning with the 1920's, the interest in highway impact was noted in rural areas. More recently, perhaps a decade ago, a number of studies were undertaken of individual highway facilities. These studies were associated with a variety of highway problems, including right-of-way acquisition, public hearings, route location, cost allocation, design, public relations, and similar aspects of highway work. Today, there are over 100 completed economic impact studies that have been sponsored by State highway departments and the Bureau of Public Roads and an additional 40 that are in progress. Almost every State is represented in this research.

In only a few instances are the State highway departments themselves, with their own personnel, engaged in the complex research involved. In several cases, special consultants have been retained by the State highway departments. In the vast majority of cases, universities have carried on this work. In several instances, the Bureau of Public Roads itself sponsored inquiries on particular phases of nationwide scope.

### Description of Studies

The studies on which much of Part VI (dealing with nonvehicular benefits) of the Highway Cost Allocation Study was based depended on various kinds of research approaches. In general, the methodology encompasses a "before and after" technique—an analysis of some period before a highway improvement compared with a period after the completion of the improvement. Evaluation (7) of the data compiled indicates the trend of economic events associated with these highway improvements.

Because of differences in periods of road construction and research projects, results are not exactly comparable in time. Little study experience is available for sections of the Interstate System because of the recency of much of this construction. However, wherever possible, data have been developed for highways of a similar type (that is, of the limited-access variety) as well as for more conventional types of facilities. Consequently, in the material presented in this report there is a substantial dependence on highway experience in such States as Massachusetts, California, and New York as well as other States that have had significant experience with limited-access facilities which have been studied and recorded. Many of these research efforts involve such facilities as the Boston Circumferential Highway, the Connecticut Turnpike, the Atlanta Expressway, the Edens Expressway in the Chicago metropolitan area, the California freeways, the Lexington, Ky., Belt Line, the Watterson Expressway in Louisville, the Dallas Expressway. Highways of conventional design (in terms of access control) and secondary roads constitute the subjects for study in a number of instances. Bypass studies are also strongly emphasized. The studies were made in urban areas, small communities, and rural areas. A number of the more recent studies are concerned with regional influences of highway transportation. In studies such as the Boston Inner Loop Study, attempts were made to assess all the regional influences so that the net effects can be approximated.

To the degree that these studies isolate the impact of highway improvements on economic activity, they provide a measure of the manner in which the improvements influence a community's economic structure. The procedures used in answering questions posed by these studies range from the collection and analysis of field data to various deductive and mathematical approaches. Various methods have been used in quantifying data.

These studies generally attempt to filter out the highway influence. This has been accomplished, at least to a limited extent, through a device generally used in other sciences, namely, the "study" and "control" area or "study" and "control" influence zones. Admittedly, such a technique, by itself, omits the wide ramifications traceable to a highway improvement or to an entire highway network. It does, however, furnish information on the economic influence generated by the highway for the area under study. This method is, of course, most useful in smaller communities, least subject to outside influences.

The subject matter in these studies varies widely. Most of it has been concerned with the highway influence on land use (physical use as well as the economic activity which reflects the use) and the influences on the land values near a particular highway facility. Included with these are the advantages accruing to public utilities from the use of highway right-of-way, the impact of the highway influence on various public services, and other community influences. As previously indicated, economic impact research has resulted in representative studies of various kinds of highway facilities, so that the influence of modern-type, limited-access facilities and bypass routes can be distinguished from the conventional, urban highways or farm-to-market roads.

It is perhaps fortunate that the nature of these studies varies widely. In addition to the subjects enumerated, some studies contain an analysis of general economic effects. Some concentrate on retail and industrial aspects, others on recreation, others on tax bases, special assessments, public utilities, still others on residence. Aspects of small communities have been stressed in several instances. The impact of highway improvements on agriculture is dealt with in special studies.

### Information Analyzed

In any analysis of change, as in the economic impact studies, the mixture of possibilities in commercial, industrial, and personal reorganization is very great. In some instances, the net benefit to a community from the highway improvement is clear. In other cases, it has been necessary to standardize some important items such as the study areas, zones, time periods, and historical growth patterns in order to approximate the impact. In still other situations, the highway influence is not entirely clear.

For the purposes of the Highway Cost Allocation Study, the advantages and detriments of highway improvement to all groups other than motor vehicle users were analyzed as a widely diffused bundle of effects which permeate the entire economic and social system, and come to rest in particular urban, rural, and other communities. The expenditure of funds for highway improvements serves as an infusion of highway investment into the economy which reverberates throughout all industries, their labor forces, their spending patterns, etc.

The very nature of highway improvement, however, serves to reorganize local activity. These improvements have a tendency to cluster development about them. They aid in channeling economic growth along specific locations and, in addition, they make it possible to reduce industrial costs (through transportation savings) and thus aid in the more efficient distribution of economic resources.

In dealing with local communities, however, it is extremely difficult to ferret out what some have called the "net" benefits to an area derived from the highway improvements. Communities blessed with an abundance of natural resources, skilled labor, etc., have better opportunities to attract economic growth immediately into their areas. Other communities, of course, do not have such opportunities to the same extent. It is only in very special cases that improvements in transportation can furnish equal advantage to all areas. As Garrison (8) has remarked:

The very nature of specialization and the geographic system means a differentiation of benefits among places, and therefore it is very important to keep in mind the fact that benefits from transportation improvements are almost always differentiated geographically as well as in more obvious ways. By more obvious ways, we refer to differentiation among industries, among kinds of highway users, among kinds of transportation, and the other things.

It is precisely this approach to analyzing the different kinds of benefits or detriments that accrue to differentiated geographic entities from highway improvements that was taken in this analysis.

It would only be fair to say that no valid assumptions can be made that a particular type of highway improvement will lead inevitably to a particular set of consequences. No assurance can be given, for example, that widening a two-lane highway to a four-lane facility will result in traffic flows of some given amount, or land value increases of some given amount. All results are dependent on the economic and social activities served by the highway and whether these are responsive to the particular highway improvement. The nature of the impact is determined by both the type of transportation systems developed and the existing complex of cultural interrelationships associated with transportation demand (8).

Because transportation is conditioned by the arrangement of land uses, and because the arrangement of land uses, in turn, is conditioned by the nature and quality of transportation service, the studies cited make available knowledge of the structure of the dependence and interrelationship of various individual and business uses by different kinds of highway improvements. These studies provide clues to the highway benefits derived by households and business and industrial firms. These benefits arise from the increased use of lower cost transportation as well as from possibilities for the more efficient operation of vehicles, firms, and households. Thus, both vehicular and nonvehicular benefits occur. Nonvehicular benefits are associated with the influence of highway improvements when other conditions are ripe for such effects.

#### CONCEPTS OF NONUSER BENEFITS

There were a number of theoretical attempts to measure the "net" nonuser benefits from highway improvements. In the normal pattern, some activities in an area are declining, whereas other activities are gaining as the result of competitive forces alone. Grafted atop these usual variations are changes introduced through the advantages given to one area over another by a highway improvement. It is necessary to separate or "net" the gains attributable to the highway; the "control" area mechanism affords one means to accomplish this task.

A major problem to be faced in this endeavor is that of the redistribution of economic activity or the transfer of activity that may be stimulated by the new advantageous locations abutting the highway. Although this activity might have come to rest elsewhere but for the new highway, belief in a dynamic system impels one, however, to reason that a portion of the new activity was stimulated by the highway investment; it might never have resulted elsewhere.

Various researchers have reasoned that it is more appropriate to count the benefits accruing from a highway improvement through an identification of the amount of highway use. The savings attributable to the users would, they feel, provide the entire economic benefit to an area. This dichotomy between user and nonuser benefits has led some commentators to suggest that this is a double entry type of arrangement. Various user benefits have been identified, such as reduced operating costs, reductions in the strains of congested driving, reduction in accident costs and time savings; at the other end of the spectrum have been the nonuser benefits. The latter have been identified through the impact studies. These two are difficult to separate inasmuch as both types of benefits are linked one to the other. Zettel (9) and others have pointed out that the principal benefits accruing to the so-called nonuser interests come by way of motor vehicle use.

These observers believe that reductions in motor vehicle transportation cost may be reflected or capitalized in an increase in the value of land to be served by the high-

way improvement. Also, the expectation of transport savings may induce investments at the terminal points or interchanges of a major highway facility. These researchers believe that any attempt to add these together may result in "double counting" of benefits.

Northwestern University's Transportation Center (10), in a framework study conducted for the U. S. Bureau of Public Roads, examined the increase in highway use attributable to a new highway facility. They believed that the increased accessibility to land attributable to the highway can be valued in user savings which are capitalized in land. They proceeded to adjust some early data developed by Wheeler (11) in connection with the Floating Bridge in the State of Washington and obtained results that they feel reasonably approximate user savings. This led to the reference that, if all data were treated in this fashion, it would be possible to prove that the measurement of quantitative benefit of use and of nonuse (land values) would tend to be the same.

Though no one would deny that many of the benefits from highway improvements reach the public via motor vehicle use, the mere adding up of benefits, even if possible, would not give a true indication of the total benefit. The total amount of nonuser benefits would tend to be greater than any amount that could be calculated by user savings because of the "multiplier" effect on the flow of highway benefits to the user which proliferates into all elements of the economic and social systems. In addition to these effects, one would also have to value the "separable" benefits accruing to public utilities, outdoor advertisers, etc.

Inasmuch as the benefits of highway construction tend to extend in all directions, some researchers have suggested that some part of highway investment should be supported by taxation for general fund purposes rather than by taxation based on highway use alone.

Peterson (12) and others (10) believe that a highway investment is, in essence, like any other kind of investment that has economy-wide ramifications. There is a major difference, however, between the impact of highway improvements and other forms of investment. Because transportation is so significant in personal, commercial, and industrial lives, any alteration of this element of space and location will tend to affect the ordering of economic and social activities.

Other researchers are concerned with locating the highway benefit through the use of a commercial or pricing approach or marginal cost pricing (13, 14) or measurement of welfare (15) in order to recoup the outlay for highway investment in whole or in part.

There is one current concept that is fairly close to the belief that nonusers should support highways. Hennes (16) of the University of Washington has labeled this the "motivation" approach. He finds that highway improvements are often made because of pressures from realtors, developers, etc., who stand to gain, and should, therefore, be taxed for the social contribution to their private gain. Following this approach leads into the thought that highway planning needs to be coordinated with comprehensive master planning of land use because highways tend to create regrouping of economic and social activities.

As previously expressed, not all indirect benefits can be accounted for by savings in transportation. A number of researchers, Garrison, Tinbergen, Bos and Koyck, and others, have found that transportation savings induce other changes that induce increases in output above the magnitude of the savings.

Starting from the criterion that the only net benefit to the society that accrues from highway investment is one that contributes a social dividend, Garrison has pointed to the element of reorganization benefits. These concern a new arrangement of resources that imply a certain efficient allocation.

In analytical papers developed in 1957 by Tinbergen (17, 18) of Harvard University and one year later by Bos and Koyck (19), an input-output analysis was prepared. This procedure set up a static model in terms of present costs, prices, and volumes of production. A road improvement program was stipulated. This reduced some transportation costs and the effect of this was traced to the total output. This "before" and "after" change is assumed to be a yardstick of the value of the road to the economy. There were two assumptions made by Tinbergen as to degree of elasticity and two by Bos and Koyck as to costs and prices. Tinbergen's analyses gave a multiplier of 1.9 and 3.8;

thus, the increase in National income would be 1.9 or 3.8 times the reduction in transportation costs; Bos and Koyck calculated benefit values of 10.52 and 1.52. Thus, traditional methods highly underestimate the value of a new road.

Also, in the Northwestern University study, attention was directed to the "benefit on existing highway use" and transportation savings resulting from the substitution of transportation-intensive methods of output. These user savings did not take account of economies of scale that may result from larger plants or reduced unit production costs. Mohring and Williamson (20) tried to deal with this and found a savings because of reduction in trucking costs of 88.7 percent as an "existing use benefit" and of 11.3 percent as "reorganization benefits." The Northwestern researchers point out that the phenomenon of induced investment is characteristic of all types of investment and is not necessarily associated with highway investment alone. In addition, Harwitz attempted to define a multiregional programming model in the Northwestern study in order to delineate impact between regions. The data and theory problems here made it rather difficult to implement this model.

All the model formulations described here dealt with truck use and were not concerned with the bulk of highway transport, which is passenger transportation.

These input-output model analyses have demonstrated a benefit to society over and above the savings in transportation costs, indicating that an element of nonuser benefit exists which is not reached by the user analyses. One commentator (21, p. 60) using this type of analysis in a slightly different field has stated:

...conceptually, although not empirically, one of the simplest ways to describe a community's economic activities is to show the local inter-industry relations in some given historical period. Such a "snapshot" picture can be used to determine, for a particular period, the impact of any given transaction upon each sector in the local economy; it can be used to describe how the benefits or injury of any transaction are distributed among the various local industries; it can be used to assess the relative importance of each sector to community welfare.

The input-output approach is certainly a systematic means of determining dollar impact on sectors of the economy. It is, however, not easily translatable into the size, nature, and location of the specific activities and their relevance to highway transportation. It is a means of finding the effect of investment expenditures either by Government or private industry on the material, service, and labor inputs of each industry so that total direct and indirect effects of such expenditures can be accounted for. Any activity which is different in nature from what had preceded the establishment of the basic input-output chart would be ignored in this analysis. Through the input-output system of accounts one could trace the changes stimulated by highway investment. Despite the limitations of this method, it is possible to work out the full incidence of the investment in the community at large. Spatially, however, the locations of incidence would have to be placed through other analytical means.

The usual input-output analysis of this type does not concern itself, of course, with the land value phenomenon. The latter is considered a transfer and hence is not included in the activity measures. To the extent, however, that changes in income to individuals occur, whether they be through land sales or any other way in a locality, they affect consumption expenditures in an area and may redirect other investments in the area.

The most discouraging feature of the use of input-output accounting is that local data are not available in proper form and they are expensive to collect; even the National data are more than a decade behind present times. Thus, the 1947 U.S. Bureau of Labor Statistics National chart of interindustry relationships, which has built in it 1947 price, productivity, and technological constraints, is being used by some as representative of present-day National and local economic structures.

Although a 1958 chart is being developed by the U.S. Department of Commerce, it is questionable whether these National coefficients would be relevant on a lower level

of application than regional analysis. In the case of local product accounting, considerable advances are being made to the State level, at least.

Research in local use (22, 23) of many of the social accounting systems is still in its infancy. The major advantage of these systems is that they place data in an understandable and interrelated fashion for quantification.

### ECONOMIC IMPACT FINDINGS

The various model analyses indicate what might be involved in a rigorous delineation of the benefits to nonusers. Although these hypothetical models provide some understanding of the analytical elements to be weighed in the consideration of nonuser benefits if interpreted as a net social dividend, they lack empirical verification.

What is immediately evident in any study of highway effects is the extent of resource rearrangements that occur near highways. In the following pages, some of the major findings with reference to the industrial, commercial, and land value effects of highway construction have been summarized. There are many other findings that can be alluded to only very generally in this paper, especially those regarding the social effects of highway improvements.

Such subjects as the importance of highways to farm life, residential development, and public services were discussed at the 1962 Highway Research Board Annual Meeting. A considerable amount of material was presented on two important subjects, based in the main on research conducted for the Highway Cost Allocation Study: social effects of highways (24) and statistical evaluation of the influence of highways on rural land values (25). These may be considered as companion pieces to this paper in their specialized areas.

#### General Effects—Urban and Rural

The findings from the over 100 economic impact studies which will be specified in the following pages detail the highway influences on investment, output, and the general scale effects on industry, commerce, and residences. In this summary, it is difficult to cite more than a few instances of the magnetic force that highway improvements have become for industry and commerce. These are available in the individual impact studies.

Allusion has already been made to the tendency that highway improvements have to direct investment into nearby locations. This channeling of investment into highway locations apparently occurs because there are situations awaiting a "triggering" by an outside agent in order to effectuate a shift; for example, from vacant to industrial land. Highways often provide this triggering and, because of the complex linkages between industries, the effect of the original investment is multiplied.

In a dynamic society, resource allocation is constantly shifting in response to changing demands. To the extent that highway improvements lead to efficient satisfaction of basic demands—through the more intensive uses of present resources and shifts between present resource combinations—highways contribute a net increment to society as a whole. The beneficial effects on production and output associated with the increased efficiencies of highway locations have been experienced by enterprises of varying types and sizes.

Many of the larger modern plants locating within highway proximity are able to achieve efficient output because of internal economies in the use of land, labor, and materials. Savings in resource combination can often be realized best at a decentralized location near a modern highway where adequate space is available for large-scale operations.

The possible effect of transportation betterment on the scale or size of an establishment's operations may also be apparent from consideration of production costs. If the price of even one variable input rises, the marginal cost of the product at each output will rise. This will serve to reduce sales and output, and thus the scale of the enterprise will be diminished. At the other extreme, the lowering of transportation costs and the rearrangement of resource use, as previously described, tend to lower costs, and to increase the size of the enterprise. The magnitude of this size or scale effect depends mainly on the degree of importance of the input being considered, and its relationship to the transportation factor.

Smaller enterprises, as well as large-scale operations, often realize substantial increases in efficiency as a result of highway improvements. Benefits accruing to small enterprises include such highway-associated savings as faster deliveries and more efficient storage and warehousing.

Many of the economies provided by highways are, of course, external to the plant itself—whether the establishment is large or small. Savings in storage and warehousing, in marketing, and in recruiting labor, though external or primarily external to the plant, all tend to increase plant efficiency. These advantages are often maximized in industrial parks and suburban shopping centers—developments which are, of course, particularly oriented to highway transportation. Establishments in industrial parks, for example, are often able to realize the economies already mentioned, to benefit from easy access to the services of other firms in highway locations, and to participate in downtown-type, face-to-face contacts in parklike surroundings. Thus, highway improvements are associated with changes in investment, output, and in the effect on scale of operation.

Just as highway improvements tend to make possible a different size or scale of individual plant and commercial center than that which previously existed, highways also provide expanded opportunities for farm investment and output. Among the general effects of the improved accessibility to farming areas provided by modern-type highways are the tendency for farm land near highway locations to become ripe for conversion to higher uses, economies in farm operations, in marketing and in obtaining labor and supplies, and improved opportunities for off-farm employment and nonwork associations.

These economies in highway transportation, which are, of course, external to the farm, may have a number of different consequences. Transportation betterment may, for example, tend to reduce the artificial competitive advantage of farm lands near market areas by lowering the total costs of farms at some distance from the market. Improved transportation may also help improve the character or tone of a rural community or it may open up opportunities for social, educational, or cultural activities that may have been too remote before the existence of a highway improvement.

Efficiencies in highway transportation may also foster the current trend to larger farm enterprises, particularly if there is a reorganization of farm lands as a result of acquiring highway right-of-way. This movement to larger farms is, of course, dependent on a number of causes, including modern highway transportation (26).

- Transportation reduces the cost of goods—through the encouragement it lends to large-scale production. Large-scale production may exist which is not dependent upon cheap transportation. But in many instances large-scale production means that either raw materials or finished products must be transported long distances.

### Highway Benefits to Industry

A considerable amount of evidence exists to substantiate that highways have played an important role in the development of nearby land for industrial use.

The outward expansion of industry from congested central business districts to suburban locations is an innovation resulting from many factors. The increase in the use of trucks and concomitant lessening of dependence on rail transportation is a major cause of the shift of industrial location in suburban areas near large sources of labor. Another factor which stimulated suburban industrial development has been the increased building of industrial parks which afforded a manufacturer more space at less cost while affording him closer proximity to his customers and suppliers, ample parking for employees, and less congestion.

Only a few of the many cases which tend to illustrate the encouragement a modern highway can apparently give to new industrial investment are mentioned here: Mass. 128 near Boston, a circumferential highway, often referred to as the "miracle" highway, resulted in opening up vast areas for industrial development. The plants located along Mass. 128 represent an enormous amount of investment. By the fall of 1958 over 200 companies were in operation along the facility and, in addition, many other plants and industrial parks were under construction.

The demand for land for industrial use along Mass. 128 appeared to have a dynamic effect on land use and land values. For example, in Needham, formerly poor land within the complex of the New England industrial center was developed for industrial use; the resultant increase in the assessable tax base amounted to \$5.6 million, and \$300,000 annually was realized in additional annual taxes. If this same land were developed residentially, the increase in the tax base would have been about \$3½ million and new taxes would have totaled only \$187,000. Of course, this net difference depends on the value of the services required in each instance.

In Waltham, almost unusable land was converted to industrial use for plants costing \$22 million and paying about \$400,000 in taxes. Acreage prices responded to heavy demand for land after development and rose from \$1,000 to \$1,500 an acre to about \$8,000 an acre.

Two recent Kentucky studies (27, 28) evaluated the economic effects of two highway facilities (one a limited-access highway and the other a free-access belt line) on adjacent properties. The free-access highway was found to have a more positive influence in connection with the conversion of land to a higher use than did the expressway. Since completion of the Belt Line in 1953 the demand for land along the facility for industrial use has continued unabated. Whereas no commercial or industrial activity existed in the area before construction of the Belt Line, 40 percent of the area within 500 ft of the facility was later developed for commercial or industrial use.

A recent comparative study of the present and proposed Belt Line routes west of the Twin Cities in Minnesota revealed that warehousing and manufacturing development are associated to a great extent with highways and railways. Retail and service establishments, on the other hand, tend to associate themselves with residential density as well as with highway traffic. It was found, for example, that 89 percent of the warehousing and manufacturing enterprises (with 74 percent of the acreage) were within 1,000 ft of a major highway. This association of belt lines and distribution facilities has also been encountered around the Capital Beltway in Washington, the Baltimore Belt (29) and other circumferential highways because of the accessibility of large metropolitan areas from such facilities.

Another modern highway facility which has attracted a tremendous amount of new industrial growth is the New York Thruway (30, 31). Many leading industrial companies have constructed multimillion dollar manufacturing complexes within its range of influence. An executive of one of these companies claimed that the Thruway afforded a number of advantages, including better transportation for employees, proximity to intercity and interstate truck lines, advertising benefits, and facilitation of establishment of satellite plants.

The influence of the Eastshore Freeway on industrial development in the San Francisco-Oakland area has been great. A survey (32) of an area encompassing only 9 percent of the available land in Alameda County suitable for industrial development revealed that in only 7 years (1951-57) this area accounted for over two-fifths of the county's expenditures for new industrial development and 30 percent of the total of new plants built. When executives of the firms locating adjacent to the Eastshore Freeway were asked what motivated them to locate where they did the answers most frequently given were (a) the area offered a central location with respect to markets, and (b) access to the Eastshore Freeway.

#### Highway Influence on Investment

Modern highways, though not encouraging industrial investment in the absence of other favorable factors, have in several instances, been able to attract industrial development into nearby areas. For example, industrial investment along Mass. 128 during a recent year amounted to almost two-fifths of all new investment in the Boston Metropolitan Area. In Indiana, almost one-half of the 354 new industrial plants established during the past three years are located within a 45-mi band straddling the Indiana Turnpike; and during a recent period in Alameda County, Calif., over 40 percent of the industrial development occurred within an area most subject to highway influence comprising less than 10 percent of the county's industrial acreage.

In addition to assisting the development of new or vacant areas, highway improvements ordinarily improve the productive efficiency of established industrial areas. Redevelopment projects in a number of cities demonstrate the importance of modern highway facilities in preserving or rejuvenating industrial facilities.

The need for adequate highway transportation in established industrial centers is particularly important because of the increasing decentralization of many market areas and of industrial activities generally. In Detroit (33) for example, the number of "in-city" manufacturing establishments increased by 47 percent during a recent eight-year period, whereas in the region outside of Detroit the increase was some 220 percent. This general decentralization of industry results from such factors as (a) the need for space for expansion; (b) easier access to markets, supplies, and labor; (c) desire to improve public relations; and (d) savings in storage and inventory.

Highways of modern design obviously facilitate access to markets and supplies. Many firms at freeway sites on the fringe of metropolitan areas are able to serve the central city, a large suburban area, and a large hinterland as well. For instance, companies located along the Santa Ana Freeway in California have found that it takes less time to get to the city's center from their new outlying locations than from their former in-town sites. Location close to markets is especially important to industries (e.g., bakeries) whose finished product is perishable, whereas material-oriented industries (e.g., food preserving or cotton ginning and baling) seek improved accessibility to supplies.

Public relations advantages are also a factor in the increasing popularity of highway locations away from population centers. Many businessmen value sites near highways of modern design because of the opportunity it affords to be seen by the traveling public. In addition, decentralized locations often result in savings in storage and inventory costs because of the ability to serve a wider area from a single point.

### Industrial Parks

Decentralization of industry has resulted in the development of industrial districts or industrial parks which characteristically place an important reliance on highway transportation. There were over 800 of these industrial parks in 1958, ranging in size from 17 to 1,700 acres (34, 35). Industrial parks, which are primarily a post-World War II development, tend to maximize the advantages of decentralized locations by careful control of the use made of land and by facilitating the exchange of services between neighboring firms.

Case studies verify the importance of highway factors in industrial location consideration. Of 68 industrial location cases recently studied (36), location factors related to highways were considered to be dominant in 23 cases.

### Benefits of Highways to Commercial Activities

The motor vehicle and technological changes have had far-reaching effects on American retailing patterns and shopping habits. During the past half-century, trading areas have undergone tremendous expansion, from a few miles in the beginning of the century to 30 to 150 mi presently. Although the number of retailers increased by less than one-third during the past 20 years, retail trade volume quadrupled and population increased by almost 50 percent during this same period.

The trend toward large retailing operations with limited storage facilities has resulted in increased dependence on large outlying warehouses with rapid and flexible transportation connections with selling outlets. Thus, the motor truck has proven to be an integral part in this distributive process while functioning in the added service of home delivery.

According to census data, metropolitan areas have in recent years been outgrowing the central cities. One of the outcroppings of this growth as described by both Garrison (8) and Horwood (37) has been the rapid development of suburban shopping centers, regional, community, and neighborhood. Because most of the patrons of these shopping centers are auto-borne, these business complexes are extremely dependent on good highways. This is particularly true in connection with regional shopping centers which

depend on trading areas of over 100,000 people in heavily-settled residential areas.

Almost all choice locations for these centers are located on, or adjacent to, expressways. In fact, many of the larger downtown department stores have found it more profitable to open branches in regional shopping centers. A survey shows that branches of large department and specialty stores in 50 large cities increased from 350 to 644 between 1952 and 1956. Only 50 of the 644 branches are in city locations and 594 are located in shopping centers or other suburban places. Only 9 or 10 percent of the 90 branches opened in 1956 are in cities.

An analysis of profits of seven branch stores in shopping centers by the National Retail Dry Goods Association revealed that none of the branches experienced a loss and that the branches showed net profit margins that were higher than those of the downtown stores.

Conventional highways and expressways and freeways differ as to the measure of protection they afford established business in cities and towns along the highways. Conventional highways, when built, immediately open up new sites for businesses that have an opportunity of intercepting business from motorists using that highway. The limited-access facility, on the other hand, does not afford opportunities for establishing highway-oriented enterprises. Motorists using limited-access highways are obliged to transact business with establishments in regular trading areas or along frontage roads. The claim is made that limited-access highways therefore make for more cohesive business areas while affording higher standards of construction and service.

#### Suburban Shopping Center Development

The well-being of the central business district has undoubtedly been affected, in many instances, by the development of suburban shopping centers. These shopping centers have mushroomed in both number and activities during the same period that many central business districts have experienced a relative decline in retail trade activity. It is not at all clear, however, that the growth of suburban shopping centers has taken place at the expense of retail trade activities in central business districts, because there are differences in the kinds of merchandise handled in central business districts and suburban shopping centers.

Until recently shopping centers have evolved piecemeal and on an unplanned basis, primarily as a result of business establishments locating themselves near intersections of major streets or highways or at other points of easy access. Today, planned shopping centers have developed and the number has increased dramatically, some 2,500 having been constructed since World War II. These planned shopping centers, though differing in size, composition, and area served, are alike in the emphasis they give to serving auto-borne customers. Special attention to easy access by highway and customer parking is a fundamental characteristic of these centers.

#### Central Business Districts

Although highway transportation has been generally advantageous to central business district development in the past (by permitting increased specialization, expanded markets, etc.), current highway influences may be of uncertain advantage to central business districts. Some observers feel that the mushrooming of suburban shopping centers spells difficulty for certain kinds of downtown business enterprises. This concern appears to result from the decline in certain activities in the central business districts of many large American cities, though in many instances this is simply a relative decline; that is, a slower rate of increase in central business district activities than in surrounding areas.

#### Retail Trade

The relative decline in central business district activity is especially apparent in retail trade activities, one of the most important functions of the central business district. During a recent six-year period, the percentage increase in retail sales occurring in 168 major metropolitan areas amounted to over 30 percent (in current dollars), whereas the increase for the central business districts of these metropolitan

areas amounted to less than 2 percent (38). For a few areas, this decline in retail trade activity is absolute, an actual decrease in retail trade activity. Retail trade activity decreases are more pronounced in central business districts of cities with a million or more population.

### Office Space

Although central business district activity in many major metropolitan areas has ceased to grow, absolute gains in particular areas or in particular phases of retail trade have also occurred. More important, retail trade losses in downtown locations are being replaced, at least to some extent, by other activities—notably, office space. In some cities, increases in office space in central business districts appear to be sufficient to more than offset any losses in retail trade activities. A survey (36) of 60 cities each with at least 100,000 population shows that relative gains in office space during the past 10 years have been greater in large cities than in smaller cities, amounting to 1 to 2 percent in a city of 3 million. New York City provides a dramatic example of the post-war office boom, adding 42 million square feet or about 1,000 acres of floor space.

Some types of office space activities (for example, insurance offices) appear to be undergoing an outward shift, at least in some cities. Examination of the location decisions made by 69 insurance companies during the past 12 years shows that 68 percent of the new insurance establishments were located in outlying areas, whereas 32 percent have settled in the predominantly commercial area near the city center. The suburban shift of insurance activities is also apparent in terms of employees; in 1946, 4 percent of all headquarters and regional office employees were located in outlying areas compared with 30 percent in 1958.

Unlike insurance offices, banking continues to be a strong central business district activity. Although the number of banks is growing rapidly in outlying areas, central business districts account for the major part (about 80 percent) of bank deposits, the primary measure of banking activity.

The location of public utility companies also sheds some light on the role of the central business district and the influence that highway transport is having in urban areas. About 92 percent of all utility company headquarters offices are located in central business districts; in the 1946 to 1958 period, approximately 75 percent of the floor space added for public utility offices was established in or near central business districts. Though there has been some transfer of establishments from the central business district to outlying locations, employees and floor space added through growth in the central business district have offset any loss of public utility activities.

There is some tendency though, for public utility companies to decentralize a portion of their functions, particularly in larger cities. The factors that encourage the decentralization of utility company activities are similar to those influencing decentralization of other activities: sites with easy access in urban areas, traffic and parking problems in central business district locations, etc.

### Location of Commercial Enterprise

Like shopping centers, individual business establishments ordinarily seek locations where their markets can be served as effectively as possible. These location decisions are often influenced by highway considerations. A survey of business firms in Chicago, Hartford, and Pittsburgh, for example, revealed that of the 10 dominant location criteria, five were directly related to highways. Among the more important of these location criteria are access and exposure to highway networks (3, Tables IV-9 and IV-10).

### Bypasses

Information concerning 90 bypassed communities in 22 different States reveals that, generally, business activity either benefited or was unaffected in areas where bypasses caused traffic to be directed from the main business thoroughfares (3, Tables IV-1 through IV-6).

A variety of indicators was used to measure highway influence in bypassed areas, including retail trade volume, number of businesses, retail employment, sales taxes, business starts and stops, land value and land use changes.

Fifty of the 76 bypassed areas for which retail trade information was available showed a larger increase (or smaller decrease) in business than occurred in comparable areas without bypasses. Even in the case of service stations, which are highly highway oriented, gains were recorded which were greater than those for the control group in about one-half of the 46 instances where information was available.

Many of the studies found that bypass routes were beneficial to business activity primarily because they aided in the elimination of non-buying through traffic, thus making for less congestion and better parking conditions for local shoppers. Local bypassed businesses are also aided by the fact that most of the modern bypass highways are of the limited-access type which precludes ribbon development of businesses. Thus, the through traveler must shop in the bypassed area nearest the bypass route if a purchase is to be made.

Findings from these bypass studies also pointed out that through travelers do not purchase as much from highway-oriented businesses as one might suppose. A study of commercial development along US 41 between Chicago and Milwaukee, for example, showed that even along this heavily-traveled route most of the business was done with local customers who lived or worked within five miles of the facility.

### Urban Land Values

Highway improvements generally have a tendency to increase the alternative uses of nearby land and alter the time-distance factor, thus affecting land values. Improved accessibility to land through improved highways may enlarge the amount of land available for productive use and for uses to which the land would not have been put in the absence of the new road facility.

Land value increases are more or less expectational in nature. That is, gains in land values do not always wait for physical developments to occur. Rather, such impact on values begins to assert itself almost as soon as it becomes known that a highway project has been approved. There are a number of studies that reveal that land values generally increased at a faster rate than the values of the improvements on the land.

Certain broad findings were adduced from approximately 60 land value studies conducted over the past 20 years. For example, the value of land adjacent to a major highway improvement increased faster than land farther from the highway. This undoubtedly was a reflection of the relocation of activity closer to the new highway facility.

A study of effects of the Gulf Freeway found that land in two zones near the freeway increased 667 percent and 242 percent of former average values, whereas land in two control zones not influenced by the freeway increased in value by 80 and 203 percent. Along the Dallas Expressway the value of land near the facility increased four times faster than did similar land farther away from the expressway.

The dramatic changes in the values of land influenced by the 427-mi New York Thruway have been well documented. The value of land at certain strategic locations along the Thruway increased sharply over relatively short periods of time (2, pp. 75-78).

### Industrial Land Values

Where a highway improvement effects changes in the use of land in the area of influence, such changes in land use are generally accompanied by very significant changes in land values. Not only does the present use of the land determine land values but future use also has a bearing on the price of land. For example, a shift from agricultural to industrial land use (or an expectation of such use) generally produces increases in land values. An analysis of industrial land values in 7 studies conducted in California, Texas, and Georgia indicated annual increases in industrial properties of from 7 to 117 percent on a constant dollar basis.

A study of the economic effects of the Lexington, Ky., Northern Belt Line found that no commercial or industrial development existed in the area. Several years after opening of the facility, 40 percent of the area within 500 ft of the Belt line was being used for commercial or industrial purposes. During the period of development land

prices jumped from \$500 an acre to \$10,000 an acre. Smaller commercial parcels of less than 25,000 sq ft sold for over \$20,000 an acre.

The Lexington Northern Belt Line also had the effect of retarding the conversion of nearby land to residential use. When the commercial potential of the belt line became apparent, nearby land which was earmarked for residential development was converted instead, to commercial and industrial use with attendant increases in land values there-fore.

In Alameda, Calif., a shift to industrial use of land (from agricultural use) near the Eastshore Freeway resulted in acreage prices rising from \$500 to \$10,000 (in current dollars) between 1941 and 1953. Land along a frontage road of the Santa Ana Freeway sold for \$55,000 an acre, the land to be used for industrial development.

### Commercial Land Values

A number of studies made in connection with highway effects on commercial land values indicate that highway improvements have had a generally favorable effect on nearby commercial properties. A summarization of results of highway influence on commercial land values from 11 studies in California, Georgia, Kentucky, and Texas bears out this conclusion. In North Sacramento, commercial property prices rose by about 40 percent in current values after opening of a bypass route. In Texas, the Dallas Central Expressway in most cases had a beneficial effect on business volumes, and commercial property values rose rapidly. Downtown commercial properties in Houston, served by the Gulf Freeway, experienced value increments much faster than similar properties located elsewhere in the city. The San Antonio Expressway exerted a similar influence on San Antonio commercial property values.

### Residential Land Value

One effect that can be reasonably expected of highway improvements is a shortening of travel time to work or business and to social, cultural, and educational activities. A lessening of such travel time may very well serve to enhance affected residential properties and hence increase the value of residential land.

From studies made in a number of States it was found that, generally, residential properties adjacent to modern highway facilities had more rapid increases in value than did similar properties farther away from the facility. At least, such was the case along Park-Presidio Boulevard in California and US 50 in Lawrenceville, Ill.

There are, to be sure, cases in which immediate gains from highway improvements do not manifest themselves. The Louisville Watterson Expressway, with its heavy traffic, resulted in land close to the highway becoming less valuable. However, land a short distance away from the facility enjoyed value increments mainly because of better access and the absence of nuisances created by the highway. In Needham, Mass., the values of older homes near Mass. 128 did not increase in value nearly as much as did homes further removed from the highway.

### Summary of Percentage Changes in Land Values

Among these studies of the impact of highways on land values, the changes in urban property values are impressive (3). These percentage changes in land values by themselves do not tell the entire story, because no comparison with unaffected or less affected areas (control areas) is afforded. They do, however, give the order of magnitude and the spread of property value changes as found in these impact studies. For instance, out of 56 studies in 19 States it was possible to identify 183 separate study segments that lent themselves to systematic analysis.

The median values (in constant dollars) of these annual percentage changes, classified according to kinds of land and proximity to highways, indicates that the greatest annual changes in land values are associated with industrial land or unimproved land. All types of land had a median annual percentage change of 8.8 percent (Table 1).

Comparison with control area data affords a more realistic impression of the highway influence. There were 44 study segments which gave the changes in value of land and improvements as a total. The ratios of the percentage changes were distributed according to Table 2.

TABLE 1  
MEDIAN ANNUAL PERCENTAGE CHANGE

Kind of Land <sup>1</sup>	Median Annual Percentage Change <sup>2</sup>
Industrial	17.5
Commercial	10.3
Residential	8.5
Unimproved	12.5
Total classified	9.3
Unclassified	5.8
Total	8.8

<sup>1</sup>After improvement.

<sup>2</sup>Constant dollars.

TABLE 2  
PERCENTAGE CHANGE RATIO DISTRIBUTION

Ratio <sup>1</sup>	Number of Study Segments
0.0 - 0.5	3
0.5 - 1.0	9
1.0 - 2.0	9
2.0 - 4.0	14
4.0 - 8.0	5
8.0 - 38.0	4
Total	44

<sup>1</sup>Study area to control area.

From the table it is plain that a part of the increase in land values shown by the percentage-change tabulations is accounted for by nationwide or areawide trends. For example, out of the 44 study segments giving values of land and improvements in 12 (27%), the ratios to percentage change in the control area were 1.00 or less. On the whole, however, this table shows a substantial advantage to the study area. Of the 44 study segments, 32 (73%) show ratios of more than 1.00; 9 (20%) have ratios of more than 4.00; and 4 (9%) have ratios of more than 8.00.

#### Rural Land Values

Changes in rural land values are equally impressive. There does not seem to be any doubt that, other things being equal, farms situated on paved roads are worth more than those situated on gravel roads; and that those situated on gravel roads are worth more than those situated on earth roads. These differentials appear to be directly associated with the differences in all-weather travelability and in operating costs and time costs in driving to and from the market town.

In 1958 and 1959, the Department of Agriculture conducted a survey involving 11,452 agricultural land sales throughout the United States. Actual sales data were gathered for farms on dirt, gravel, and paved roads, classified according to distance from the nearest trading center and by type of farming area. Local reporters familiar with farm market values were asked to estimate what the farm would have sold for had it been situated on a different type of road. The following brief summary will suffice here:

1. Farm properties on dirt roads sold for average prices per acre ranging from \$34 (spring wheat) to \$115 (central cotton); had these properties been situated on hard-surfaced roads the prices per acre would have ranged from 5 to 31 percent higher.

2. Farm properties on gravel roads sold for average prices per acre ranging from \$45 (spring wheat) to \$280 (eastern corn belt); had they been situated on dirt roads the discount would have ranged from 2 to 23 percent; for location on hard-surfaced roads the premium would have ranged from 0 to 20 percent.

#### Comment on Rural Land Values

Although the associations indicated between type of road surface and land values do not necessarily indicate a causal relationship, there is close relationship between these two variables. It is probable that more productive lands justify and ordinarily receive better roads. Therefore, higher prices for farm land along better roads should be attributed only partly to the highway. There is, however, a strong association between rural land value increases and highway improvements. It is no doubt, also, quite significant that farmers themselves consider road improvements to add to the value of their land, confirming the results of studies of market sales of farm real estate. This subject was extensively treated by Longley (25).

#### Conclusions on Quantification of Benefits

The economic impact studies originated for a variety of reasons, including the need of impact data for land acquisition purposes, highway planning, public hearings, and public relations. Because of this conglomerate set of uses, data collected in economic impact studies are not always of the same type nor of the same depth or sophistication. The designs of the various studies differ considerably.

A major purpose of the impact studies encouraged or sponsored by the Highway Cost Allocation Study was to obtain a representative overview of impact on various segments of the population. Therefore, many of the studies dealt with one geographic section or one specific subject of interest. Because the economic impact studies were usually concerned with a strip or zone analysis, the data tend to give some conception of the benefit differential to highway-abutting areas, but do not provide data for overall quantification. The studies gathered information on a variety of subjects dealing with tax losses, central business districts, special assessments, industry location, and many others, and it was not possible to obtain complete coverage of each subject.

Analysis of the land value results furnishes similar limiting factors. Many of the land studies have been concerned with only one particular time, in a static approach to the subject, or in an attempt to study short-run dynamics of land values. Both of these methods are subject to the criticism that no means have been developed to determine whether successive impacts of additional highway improvements tend to affect land value increments, or whether land increments reflect transfers in use of land between different segments of a community.

Nevertheless, the findings of land value studies indicate at least what the short-run results might be that should be given consideration in highway planning.

Various attempts to add up the results of impact data collected in the pattern described in order to obtain a figure of nonuser benefit have not been successful although frequency distributions of the results of the land value and bypass studies were attempted, and they tend to furnish a consistent picture.

Recognition of these limitations led the Bureau of Public Roads (3, pp. 5-6) to state in House Document No. 72, in its discussion of land value changes to state:

Over 50 studies of land values along major highway improvements in urban, suburban, and small town centers have been made at various times during the past two decades, almost 30 of which have tabulations of land-value data that lend themselves to systematic evaluation. The studies have varied as to time, type of highway improvement, community, methods of deriving land values, and the unit of land studied. Some studies used assessments for obtaining comparative data; others depended upon appraisals. Most of

the studies used actual market sales and a simple comparison of land prices "before" and "after" the highway improvement. A few limited studies dealt with parcels of land while those in metropolitan areas dealt with bands, zones, and sections of land adjacent to the highway compared with those more distant from the highways. Many of the communities for which land-value data were gathered were in varying stages of historical growth and development.

Development of overall nonuser benefit figures can, however, be associated with the model analyses described in the early part of this paper. It would be necessary to indulge in an involved input-output or other model analysis to develop the community effects of an investment program. As Isard (39) has stated, in a somewhat different context:

The most difficult economies to estimate are, of course, the positive welfare effects. However, it is possible that certain indirect effects of alternative size complexes upon community or regional growth can be compared by some sort of regional multiplier approach, perhaps utilizing input-output concepts.

In the light of current knowledge, however, no definite methodology has yet been established to clearly quantify nonuser benefits.

Nevertheless, evidence abounds that highways have brought about extensive reorganization of land uses, particularly in urbanized areas. The outward growth of metropolitan areas, the rise of the suburbs, and the decline, relative or absolute, of central cities have been well documented.

The economic impact studies do not lend themselves to any precise quantification of nonuser benefit on a national, regional, area, or other extended basis; they are generally concerned with the effects of individual highway projects with the exception of some nationwide studies sponsored by the Bureau of Public Roads. They do, however, provide an indication of the powerful changes that can be wrought by the highway in economic and social life. Such generalized indications provide the basis, when added to the theoretical formulations already described, of finding a nonuser benefit from highway improvement over and above the savings in transportation costs.

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