

# Predicting the Economic Impact of Alternate Interstate Route Locations

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The study method employed in a recent examination of the comparative economic impact of three alternative routes for an Interstate highway in the vicinity of Mammoth Cave, Ky., appears to have general significance for such planning inquiries. The central problem in the investigation was to predict the quantitative effects of each alternative location on highway-oriented business such as is now located along a major north-south route roughly parallel to the projected one.

To facilitate the predictions, the authors use the concept of an economically "neutral" road as a standard by which the alternative locations are judged. The effects are measured in terms of business volume in the year 1975. The existing market base of highway-oriented businesses in the area studied is determined and a hypothetical 1975 business volume is projected.

A specially designed origin-and-destination study, a motel survey, a restaurant survey, national park statistics, and gross receipts and income data are used in establishing the current volume of business, its seasonality, and the apportionment of the business among park visitors, through travelers on the highway, and local area residents.

After allocating the business volume of motels, restaurants, and gasoline stations among these sources, a 1975 dollar volume for the "neutral" road is projected. The over-all prediction is based on individual forecasts for each type of business, by community, using projected changes in park attendance, traffic volume, and area population. Adjustments are made for changes in characteristics of traffic and park attendance.

Each alternative route location is compared with the neutral road on the basis of access, visibility of establishments, developmental potential, advertising restrictions, and anticipated driver behavior.

\*THE concepts and procedures presented in this paper were used in a recent study to predict the effects of three alternative locations of Interstate 65 (I-65) in a limited

area of south-central Kentucky in the vicinity of Mammoth Cave National Park. This is one of the few predictive studies completed under the provision of the 1956 Highway Act which focused on local economic consequences of the location and design of the National System of Interstate and Defense Highways.

The study was centered on a rural area adjacent to US 31W, a major north-south highway transversing Kentucky and connecting Louisville and points north with Nashville and points south. Although farming and the processing of farm commodities constitute the principal economic activities, Mammoth Cave National Park is an important feature of the local economy. Figure 1 shows there are four small towns located within the area where alternate locations were under consideration. These towns contain a number of businesses that serve local customers, tourists visiting the park or privately operated caves in the area, and persons traveling between metropolitan or recreational centers to the north and south.

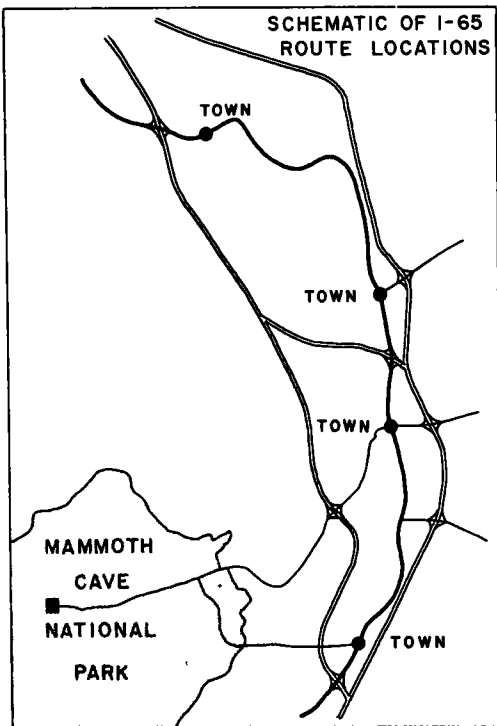


Figure 1.

Because tourist service establishments figure significantly in the study area's economy, there was active interest in the final location of the interstate facility through the area. To obtain quantitative economic information pertinent to the location of the route, the Kentucky Department of Highways requested the Bureau of Business Research of the University of Kentucky to conduct a comprehensive economic study of the area.

The economic evidence requested was to be used in conjunction with quantitative data derived from engineering and traffic studies. Estimated user costs were to be based on 1975 traffic estimates for I-65, and so economic evaluations necessarily had to be predictive. The multiple hazards of quantitative prediction of the effects of a highway improvement, much less of a specific location, need no elaboration. Yet, if a rational decision about the route's location were to be made, quantitative predictions of economic effects were essential.

The 1975 forecast was linked with the date for which traffic service was to be evaluated. Shorter range forecasts were regarded as involving complicating assumptions about the order in which various sections of the interstate system would be completed and open to traffic, which should not affect 1975 projections because the interstate system should be completed by

then. In addition, because of temporary adjustments in such an "interim" period, short-range forecasts were not deemed adequate for planning purposes.

#### CONSIDERATIONS IN THE SELECTION OF AFFECTED ECONOMIC ACTIVITIES

Previous impact studies (both economic and noneconomic) have shown that highway improvements have widespread direct or indirect effects. At the same time they have shown that some aspects of impact are isolated or independent of the specific location of the new facility. The study excluded those economic activities not affected by both the construction of I-65 through the immediate area and its specific location because researchers were concerned only with differentials. Thus, locally based businesses

(such as grocery stores, furniture stores, and automobile dealerships) were eliminated from consideration although the new highway could lead to shifts toward greater concentration of trade in regional centers, and locally based businesses would be affected. Such shifts, however, would occur regardless of the specific location of the road. By use of the same criteria (the effects of the construction of the road and its specific location) the major economic activities of agriculture, manufacturing, processing, and extraction were eliminated. For these activities the new road would be an addition to the present highway system. However, for tourist- or highway-oriented businesses the new road would be a replacement for the highway adjacent to which they are located. Consequently, tourist- or highway-oriented businesses were singled out as the activities in the area significantly affected by the new road's specific location. It should be realized that the relative simplicity of a rural economy facilitates the selection of study variables.

### FOCUS OF LONG-RANGE FORECASTS

During a 15-year period existing establishments could be expected to undergo a number of changes. Thus, long-range forecasts should be divorced from specific and existing establishments, except for inclusion of such units as features of the developmental setting. Focus in long-range forecasts should be shifted to the level of economic activities, their growth or decline, and the degree to which they measurably can change. Without the development of the interstate facility, the receipts and importance of tourist-oriented businesses in the area studied would grow beyond the capacity of existing business establishments. Increased traffic would reinforce this trend. Thus, the study variable selected was area economic growth in the sphere of tourist services as affected by the three highway locations.

An important policy implication is contained in the selection of economic growth as the study variable. Size, stature, or volume attained are "real" manifestations of growth or decline. Projected size, stature, or volume may be realized, but are subject to qualifying statements concerning their probability. It should be realized, then, that the effects of the highway locations were to be based on predicted growth. A presently unrealized value in dollar terms was to be advanced as a tangible effect. In essence, "potential" was to be given the status of "realized" in the analysis.

### THE PREDICTION APPROACH

Comparison and evaluation of the economic effects of the three alternative locations on highway-oriented businesses seemed to necessitate the development of a method of predicting future business volume for each of the three alternatives. Projection of potential economic consequences for each location was facilitated by first making an over-all projection of potential 1975 business volume in the study area. This over-all projection was made by imagining a road constructed through the area in a manner that would not alter existing trends in the pattern of land use or change existing locational advantages and the future development of locational advantages consistent with current trends in business growth. Also, the hypothesized road would be capable of handling the projected 1975 traffic volume on I-65, while still retaining the access characteristics of US 31W, the existing major north-south route. Its specific design characteristics are not relevant here.

The relevant characteristics of the hypothetical road are economic. This highway would be an economically neutral facility. Locational advantages and trends in the pattern of land use would not be significantly altered. If such a neutral highway facility were constructed, projected 1975 traffic and Mammoth Cave Park visitation would have definite predictable economic consequences.

The "neutral" facility cannot be physically constructed. It would necessarily follow the alignment of the present road without changing present access to abutting lands. Certainly no actual highway could conceivably meet such requirements and carry the projected 1975 traffic for I-65.

The basic reason for adopting this approach is the necessity for retaining perspective on over-all possibilities for area business volume in the future. The "neutral" road is

a convenient and expeditious basis for comparison in terms of total segments of the anticipated travel-oriented business. As compared with some procedural alternatives, it may prevent error. This hypothetical road has no significance other than as a procedural device.

The "norm" developed here, which could be used in other situations where route alternatives are to be evaluated, is analogous to the "perfect market model." This model is widely used for comparing prevailing market prices with predicted prices to provide a base for subsequent investigation keyed to discovering the causes of price variations. Here, however, analysis is "ex ante" rather than "ex post," and expected deviations from the normative assumptions are evaluated and their consequences predicted.

The effects on tourist- or highway-oriented business of such a truly neutral facility would depend then on the effects of increases in traffic volume and changes in traffic composition by the year 1975. They would also depend to some degree on other factors, such as population growth and changes in income; but trends in these factors, though taken into account, were not assumed to be affected by the addition of the new facility. By making use of highway department estimates of traffic volume and composition in conjunction with existing business relationships, it was possible to project a potential highway-oriented business volume in the area, including that which the hypothesized neutral road would generate. Thus, potential business volume could be predicted in quantitative form and used as a base from which to evaluate alternative routes.

It was expected that, barring unforeseen developments, each of the alternative locations would result in a predicted volume of business different from that projected for the neutral road. The measurable effects would not be the variation of each from a neutral facility, but the differences among the variations of them from the hypothetical road as a result of route and interchange location.

To predict the effects of increased traffic and the changes in traffic associated with the "neutral" highway on highway-oriented business volume in the area, it was necessary to establish the base of existing business and the relationship of the base to traffic.

In the study area, three primary sources of business were available to motels, restaurants, and filling stations. These sources were (a) travelers on US 31W, (b) Mammoth Cave National Park visitors, and (c) local residents. Basic to the central prediction was development of a method by which gross receipts could be allocated among these sources, and subsequently the portions attributable to each projected into the future based on changes in the quantity and composition of the independent variables—traffic volume, traffic composition, and Mammoth Cave Park visitation.

This allocation was based on relationships discovered in surveys of motorists, restaurant patrons, and motel patrons in the area. As an example, an attempt was made to determine what proportion of the patrons of motels and restaurants were (a) park visitors, (b) through motorists, or (c) local area residents. The proportions determined from the survey were found to vary by business type, day of the week, and community. The proportions determined had to be adjusted for seasonal variation. Because seasonal indexes for traffic indicated only minor fluctuations and local business was not found to vary seasonally, park visitation was the major factor causing the observed seasonal variation. The proportions determined for the various communities and the types of business within them were adjusted by applying a weighting factor which was the reciprocal of the index number for cave attendance in the survey month.

Gasoline sales were allocated among the three traffic segments by using per capita gasoline sales ratios from census data to determine sales to local customers and then relating the remaining volume to the proportion of motel and restaurant receipts attributable to park visitors and to through travelers. These allocation procedures appear logically sound although they could undoubtedly be refined by more adequate and more accurate data.

The additional data needed were those which would relate to the assessment of the deviations of the alternative routes from the economically neutral route. These differences in the deviations of each alternative route could then be measured in terms of potential highway-oriented business volume.

In the model used, location and access constitute the elements of all deviations; thus, it was necessary to identify the factors influencing business volume and to establish

their relationship to location and access quantitatively. Next, the qualitative, as well as quantitative, relationship between business volume and the characteristics of the business source (e.g., long distance traffic as a component of total traffic volume) had to be established. Last, qualitative relationships needed to be established between business volume and the access and locational characteristics that could cause each alternative to vary from "neutrality."

In the study in which this procedure was employed all data pertaining to qualitative study relationships were obtained from questionnaires and interviews surveys. The relationships postulated in theory and the relationships established in varying degrees by numerous economic impact and highway bypass studies were used as the basis for these surveys. However, the questions and therefore the study variables explored in the surveys were limited by the judgment of the researchers.

Quantitative measures were based on survey material coupled with published and unpublished data for traffic, gross receipts, population, and Mammoth Cave Park visitation.

### THE PREDICTION PROCESS

The predictions developed in the study are crude because they incorporated assumptions in the nature of "naive hypothesis." The points at which these assumptions operate will be indicated in the following discussion. Step by step, the prediction process follows these lines:

1. Initially it is necessary to establish the relationship between business receipts and the factors incorporated in the neutral model which will change quantitatively over time. In the I-65 study traffic volume, park attendance, and local population were involved.

2. To refine the neutral prediction, the qualitative relationships between business volume and characteristics of factors incorporated in the neutral model which will change over time must be established. As an example, park attendance although increasing rapidly also seemed to be changing in other significant ways. The proportion of out-of-state visitors to Mammoth Cave National Park was rising secularly and at a rate faster than total park attendance. Further, the proportion of visitors from Kentucky counties not located in the park area was rising similarly. These changes have connotations for area businesses, particularly for those providing lodging and food.

3. The quantitative and qualitative values of the factors incorporated in the neutral model are projected over time. (In the case of the study from which this paper is drawn, this was done by extrapolation of trends.)

4. Using the relationships from steps 1 and 2 with the preceding projection, prediction of the level of economic activity is effected. (In the I-65 study this involves a "naive hypothesis" because the relationships are assumed to be unchanging. Although quantitative and qualitative changes in the factors are assessed, their effects are based on established existing relationships. This could probably be refined if trend data were available. Even series of cross-section data could be utilized effectively.) As an example of the naivete of prediction, the length of stay for park visitors was not assumed to change by 1975 even though the interstate system by materially reducing driving times would make possible more frequent and lengthy side trips for long distance travelers.

5. The relationship with business volume of factors in the projected alternatives deviating from neutral is assessed in probability or proportional terms. As an example, the effects of reduced area information to tourists on the interstate highway by means of roadside advertising was weighed or evaluated on the basis of the proportion of the patrons of motels or restaurants basing stops on such information.

6. The direction and magnitude of deviation from neutrality by alternative routings is assessed on a basis of separate deviations which could affect projected growth of economic activity. The area under investigation was subdivided into "development areas" along community lines having similar trends and relationships to park visitation and highway traffic. Thus the various locations could affect the several "development areas" in different ways. The individual effects were then totaled for an "area projection."

7. The effects of the individual location and access deviations and their interactions are translated into changes in gross receipts based on relationships to business sources established in proportionate terms. A type of development area by development area and activity by activity breakdown is thus afforded as well as a total score. (Here again a naive hypothesis is employed because the relationships established in the present are projected unchanged into the future. In this particular case the problem of changed driver behavior is involved; but, although driver behavior on the Interstate System may well vary from established patterns, there is at present no way to assess how or to what degree deviations from existing patterns are to be expected.)

The method as employed is limited to predicting the effects of various locations because the completion of the facility itself is assumed to be an accomplished fact. However, the simple model could be changed to incorporate the facility itself as a factor, although the range of economic activities involved would have to be broadened. In the I-65 study the effects of the facility on local trade leakage to larger trade centers would have to be incorporated in the prediction and summed with the locational effects. The value of the facility itself injects a new benefit concept into the analysis because area trends would have to be extrapolated first without the facility's increased traffic.

The method is more easily employed in a rural area where the economy is fairly simple, but could be employed in an urban area. Such an application would vastly increase the complexity of the model because of the interaction of economic activities affected by the location and access elements, but the approach would not vary in concept.

The value of the method used is that it provides a procedure that allows (actually necessitates) step by step formulation of the predictions. The economically neutral road concept also provides a guide for thinking through the problem. It necessitates clear hypothesizing and theoretical evaluation of the study problem and variables before data are collected.

Such quantitative predictions of gross receipts as indicators of the area effects of an interstate highway or any other highway facility leave unanswered, as must any economic research, the manner in which user and nonuser benefit and differences in construction costs should be weighed and balanced in making a final policy decision.

#### ACKNOWLEDGMENT

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