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Economic Impact of Secondary Road Improvements

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This paper reports the methodology and analyzes some of the major conclusions drawn in a recent study of the economic impact of rural road improvements in a six-county rural Kentucky area. It examines the basic hypotheses made and tested, and attempts to suggest how and to what extent the analysis and major findings of the Kentucky study may be applicable to other rural areas.

The study was conducted over a relatively large and varied geographical area for the period 1950 to 1960 and relied heavily on data from field investigation. The area was large enough to allow comparison of market structures in instances where there had been substantial road improvements with market patterns in similar cases where few all-weather rural roads exist.

•A GREAT MANY land value studies have been made in connection with highway economic impact research, most of them in urban areas (1). There have also been a number of analyses of rural land value differentials associated with road improvements, distance from hard-surfaced roads, type of road on which a farm is located, and location with respect to trade centers. Such studies of the impact of rural road improvements on farm property values have recently been made in Washington, Minnesota, Michigan, and Texas. A comprehensive National statistical analysis of rural property sale price differentials has been made by Longley and Goley (2). These studies have contributed valuable insights into the price per acre differentials existing between properties by type of road surface, distance to nearest trade center, and type of farm operation.

The primacy of tobacco as a cash crop in much of Kentucky renders a study of increased land values through transportation improvements' increasing of farm incomes by improving marketing efficiency of doubtful value. Tobacco is a high-value crop marketed only once a year, and the farmer hauls it to market himself or contracts for delivery to an auction. On-the-farm purchasing of tobacco is rare. Further, the size of the tobacco base which a farm is allotted is an important institutional factor determining the productive value of land in the State. Indeed, acreage allotments are common and their effects on land values have been studied in many States.

One dimension of the economic impact of highway improvements in rural areas which has received little attention in recent research is the effect of improved rural roads on the trading patterns of rural residents. Insofar as rural road improvements change trading patterns of rural people, they indirectly alter retail trade areas and may lead to economies of scale. Higher rural standards of living may thus follow through real income increases. Such increases can result from lower prices and wider selection of goods and services.

Patterns of family purchasing and the opportunity to travel to other counties to purchase goods freely are changing rapidly in rural Kentucky. The State's rural population is decreasing rapidly. Per capita income in many rural, nonmining counties,

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though low, is increasing at a rate much above the average for the State. These rises are partially the result of losing underemployed and unemployed population, of farm consolidation, and indirectly of the postwar improvement of rural roads throughout the State.

Locally quite rugged terrain has made road improvements in rural Kentucky expensive and long delayed in coming. In addition, this terrain and the propensity of many Kentuckians to cling to family property have impeded the development of commercial agriculture by retarding the aggregation of farms into economic size units. These conditions have prevailed, particularly in the Cumberland foothills area and in the western coalfields, both areas of primarily small subsistence level farm units.

In 1960 the Bureau of Business Research of the University of Kentucky initiated a study, on which this paper is based, to investigate the degree to which the location of retail business, the extent of retail markets and purchasing patterns of rural families, and the distribution of goods at the wholesale level are visibly affected by over-all road improvements in underdeveloped rural areas. This paper reports the methodology and analyzes some of the major conclusions drawn in this investigation. It examines the basic hypothesis tested and suggests how the findings of the Kentucky study may be applicable to other rural areas.

A six-county area in northeastern Kentucky was selected for study. This area includes Bath, Carter, Elliott, Menifee, Morgan, and Rowan counties. The topography of these counties is varied. Many of the topographic problems of communication and transportation which have typified rural Kentucky in the past are found in these six counties. Most of the physiographic area classifications of Kentucky are exhibited. In general, the area is one of hill and bottom farming, much of it the subsistence type. Topography was a major determinant of settlement patterns, lines of communication and transportation, and community association.

These six counties are losing population at rates typical of most rural Kentucky counties outside the soft coal regions. They are also experiencing increases in per capita income.

Perhaps the most important consideration in the selection of this area is that the counties included are apparently only moderately influenced by major trade centers. A Kentucky market area study (3) reported out-of-county shopping goods business of the present study area divided between Ashland, Ky., to the east and Lexington, Ky., to the west. Traffic flow maps seem to substantiate further the hypothesis that the study counties constitute an area in which the market boundaries are fluid and for which the roles of the dominant and subordinate trade centers are in the process of being determined. It is believed that in such an area the effects of changes in transportation facilities and improved access to given trade centers might be more readily apparent than in more structured market hierarchies. Further, such effects might become apparent within a short period after the completion of road improvements.

STUDY METHOD

The basic assumptions underlying the methodology of this impact study are that (a) if there are identifiable economic impacts of rural road improvement, they are likely to show up in market structure changes; and (b) it is more productive to study improvements in rural road networks than to study isolated road improvements. With respect to the latter assumption, it is particularly appropriate to add that, although the effects of one secondary road improvement, or the improvement of a small section of such a road, may be small or at least so diffused as to defy identification, the effects of continued development of a secondary road network may be significant enough to be identified and to some extent measured.

To determine the effects of rural road improvements in the study area, and to compare the area with other areas, a three-pronged plan of investigation was adopted. Interviews were conducted with business proprietors in the study area to determine succession of business, changes in merchandise lines, and changes in open-country business location over an 11-year period back to and including 1950. These interviews covered all businesses operating in the six counties in 1960, and in addition those that had failed in the 11-year period.

It is the purpose of this part of the analysis to reconstruct locational patterns for retail business in the study area and to show how these patterns have changed. Secondary road improvements are related to these changes to see whether, and to what extent, their influence is apparent.

Second, the relationship of certain key variables to the dispersion of retail business is tested by a multiple regression analysis. Of particular concern is the relationship between changes in retail business dispersion and the proportion of farms on all-weather roads. Census of agriculture, census of population, and county income estimates for Kansas, Kentucky, and Iowa are used. This approach is aimed at getting a first approximation of the efficiency in the distribution of commodities in a rural area and the role of roads in such efficiency. It is assumed that greater geographical dispersion of retail business suggests less store specialization, few economies of scale, and relatively small market areas for any given store.

Third, interviews, conducted with roughly 10 percent of the farm operators in the six-county area, seek to determine where various types of commodities and services are obtained. This sample is stratified by location with regard to major trade centers, by county of residence, and by location in one of four physiographic classes. Analysis of the data is expected to show the influence of the type of access of farms to hard-surface roads, for example, on the purchasing habits of the farm family. In addition to farm-purchasing patterns, the interview schedule also covers the marketing of farm products.

RETAIL BUSINESS STUDY FINDINGS

Perhaps the most interesting and important inferences of this study are drawn from the analysis of retail business change over the study period. The following sections of this report are limited to this aspect of the over-all investigation. Adjustments in retail business in particular counties in the study area (Fig. 1) are illustrated by considering shifts in the location of retail business in Elliott County. Over-all retail business changes are shown by indicating what has happened to the various trade centers in the study area as a whole. The concluding section of the paper presents an attempt to measure the degree to which changes in retail business dispersion in rural areas, such as the one studied, are attributable to road improvements.

Changes in Elliott County

Martinsburg, known generally as Sandy Hook (Fig. 2), is the county seat of Elliott County and is its main trade center. However, its businesses serve only part of the county. Grayson, in Carter County to the north, is a strong competitor for the business of northeastern Elliott County in the area around Stephens, whereas residents of the northwestern part of the county make a large share of their purchases in Morehead in Rowan County. Topography rather than distance appears to be a principal factor limiting Sandy Hook as a competitor for the trade of the whole county. Road conditions also contribute to the relative isolation of some sections of the county from Sandy Hook. For instance, there is a 4.5-mi stretch of gravel road between Culver and Ky 32 which is difficult to negotiate. The existence of this poor road link helps to explain why residents adjacent to Ky 486 and its feeders trade in Grayson although Grayson and Sandy Hook are roughly equidistant from Stephens (Fig. 2).

In 1938, there were 73 businesses in the county outside Sandy Hook. The majority (47) were in isolated locations. Ten were in centers with 2 businesses, and 16 in centers with 3 or 4 businesses. Sandy Hook, itself, was very small with only 4 retail businesses. The county market was basically unstructured; i.e., no clear hierarchy of trade centers existed.

By 1950, Sandy Hook had grown substantially, and 24 businesses were located in or adjacent to the town's area of development. At this date only 59 businesses remained in out-county locations, and 38 of these were in isolated locations. Of the remaining 21, 12 were in centers with 2 businesses and 9 were in locations with 3 businesses.

The distribution of business openings and closings in this period related to distance from Sandy Hook is shown in Figure 3. It can be seen that closings are grouped in an area near Sandy Hook, and openings are located farther away.

Figure 1. Location of study area counties.

There were few open-country businesses which opened or closed in the period 1950-55. Only 4 new open-country locations were brought into operation; all, however, were at the junctions of secondary and feeder roads. Between 1955 and 1960, 12 businesses in out-county locations closed and 5 opened. With but one exception, the businesses closing were single isolated businesses.

The changes in location can be viewed graphically in two ways: (a) the area around Sandy Hook in which new businesses were opened in the periods 1938-50, 1951-55, and 1956-60, and (b) the distribution of businesses by distance from Sandy Hook in 1938, 1950, 1955, and 1960.

Figure 4 shows that the area around Sandy Hook in which new businesses were located has generally shrunk from period to period. Thus new business locations have been in more central or concentrated positions.

The distribution of businesses around Sandy Hook changed considerably between 1938 and 1960 (Fig. 5). In 1938, businesses were located in a pattern or grouping roughly approximating the distribution of population in the county. Two major concentrations of business from the standpoint of distance from Sandy Hook were found. The first was between 3 and 5 mi from the county seat. The second was between 5 and 8 mi distant.

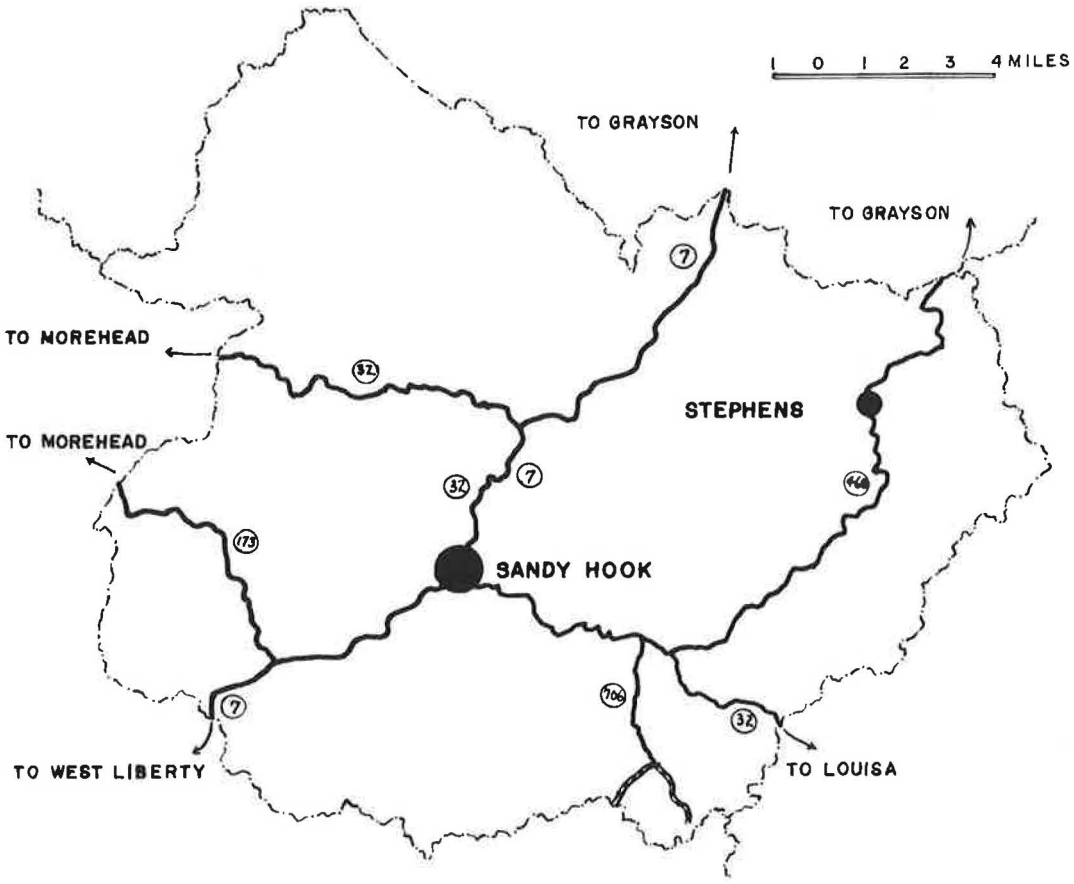

Figure 2. Major roads in Elliott County.

By 1950 this distribution had been altered considerably. The number of businesses in Sandy Hook was much larger than in 1938. This buildup was probably influential in shifting the location of the first exterior concentration of businesses from the 1938 position of 3 to 5 mi to a new position of from 3 to 6 mi, with the largest number in 1950 being 4 to 5 mi away as opposed to 3 to 4 mi away in 1938. In addition, the actual number of businesses in this area decreased from 16 to 11.

In 1950, a third area of concentration, not evident in 1938, was discernible: a buildup of locations 9 to 10 mi from Sandy Hook with twice the number of businesses that were so located in 1938. Of course, the number of businesses involved in this analysis is small, and shifts of small numbers one way or the other may lead to spurious conclusions. But in the periods discussed, locations related very well to new settlement and, in the case of contraction or centralization of activity, to presuppositions about the nature of preferable locations and experience in other study area counties.

In the period 1950 to 1955, the trend of 1938 to 1950 continued and, in a way, stabilized. Concentration of activity in Sandy Hook continued, and the two exterior concentrations of business remained in the same locations as in 1950. One difference is observable, however; the third buildup mentioned previously began to subside.

By 1960, the second and third buildups had merged, and there were only two buildups or concentrations within distance groups. The first was still located between 3 and 6 mi from Sandy Hook and contained 17 businesses. The third shifted outward and was located between 8 and 10 mi from Sandy Hook and contained 13 businesses.

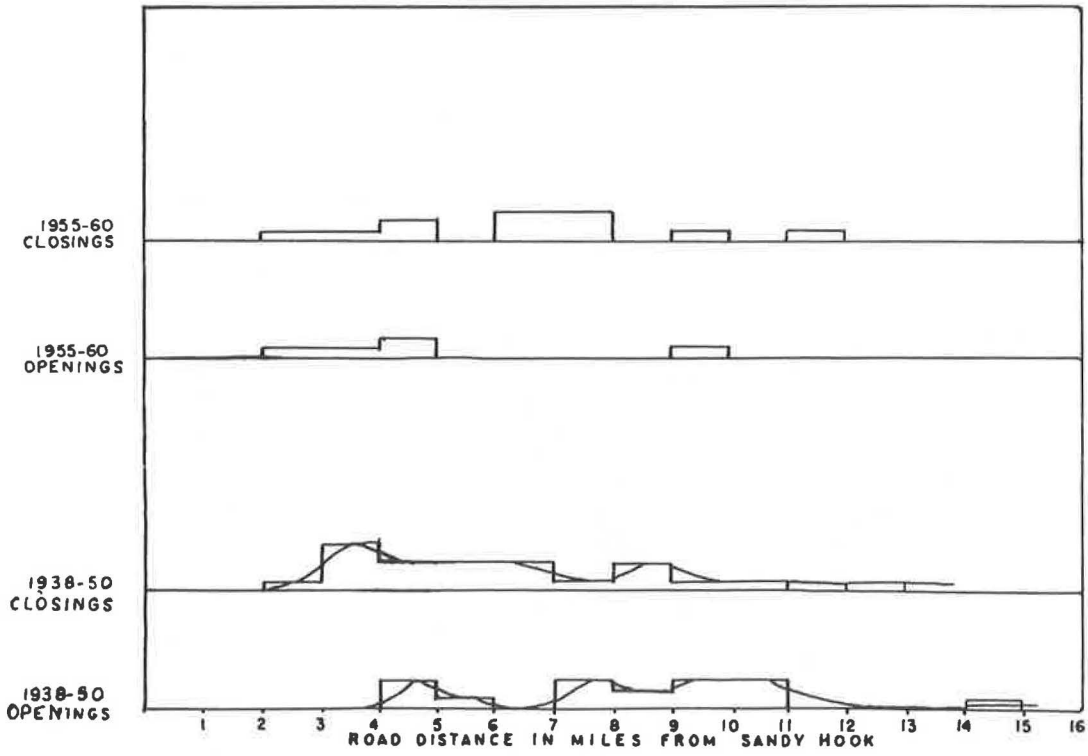

Figure 3. Business openings and closings by road distance from Sandy Hook, 1938-50 and 1955-60.

Road Improvements, 1938-60

How did road improvements in Elliott County in this period relate to observed changes in the location of retail business? Two major secondary roads were surfaced in the period 1938-50. Both of these roads—Ky 7 through the county and Ky 32 from its junction with Ky 7 at Newfoundland to the Rowan County line—are intercounty roads and their improvement could be expected to contribute to the concentration of retail business. Sandy Hook with its governmental functions and fairly central location provides an ideal focus for business centralization. Both these roads were paved in the late 1940's, and it is reasonable to assume that their long-run economic effects would appear to some degree in the 1950's.

Sandy Hook's business concentration grew phenomenally from 1938 to 1950. This growth was partially the result of World War II's effects on the incomes of commercial farms, but it was also the result of the two major road improvements facilitating inter- and intracounty travel. In the period 1951-55 after the improvement of these two roads and during Ky 173 and Ky 32 east of Sandy Hook were paved, openings of new businesses were confined to these improved collector roads, and to the northwestern portion of Elliott County which was not settled until the 1940's. Sandy Hook's business district grew substantially in this period. In the period 1955-60, during which time hard surfacing was mainly confined to short stretches of feeder roads, there occurred only a retrenchment along the four major road segments, and there was little business growth in Sandy Hook.

Study Area Business Failures

The Elliott County illustration emphasizes the general contraction in the dispersion

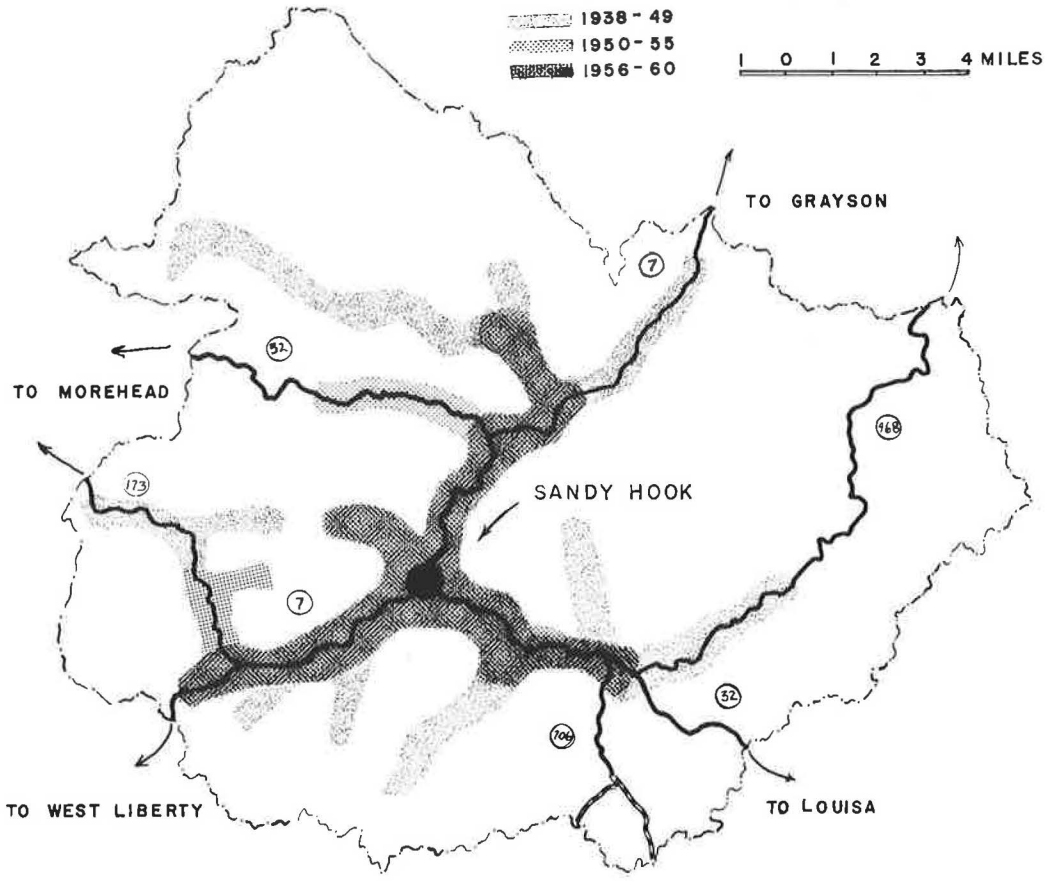

Figure 4. Location of new business near Sandy Hook.

TABLE 1

TIME LAG AFTER PAVING OF NEAREST HARD-SURFACED ROAD AND CLOSING OF OPEN-COUNTRY BUSINESS[1]

Timing	Type of Business Location					
	Single Isolated		Dual Isolated		Agglomerations	
	No.	%	No.	%	No.	%
Before	12	14	5	11	-	-
Same year	9	10	2	4	-	-
Years after:						
1	11	13	7	16	-	-
2	8	9	2	4	-	-
3	5	6	4	9	-	-
4	4	4	3	7	-	-
5	4	4	-	-	-	-
6	2	2	1	2	-	-
7	1	1	-	-	-	-
8	2	2	-	-	-	-
9	3	3	-	-	-	-
10 or more	24	28	21	46	14	100

[1]Source: Bureau of Business Research, University of Kentucky.

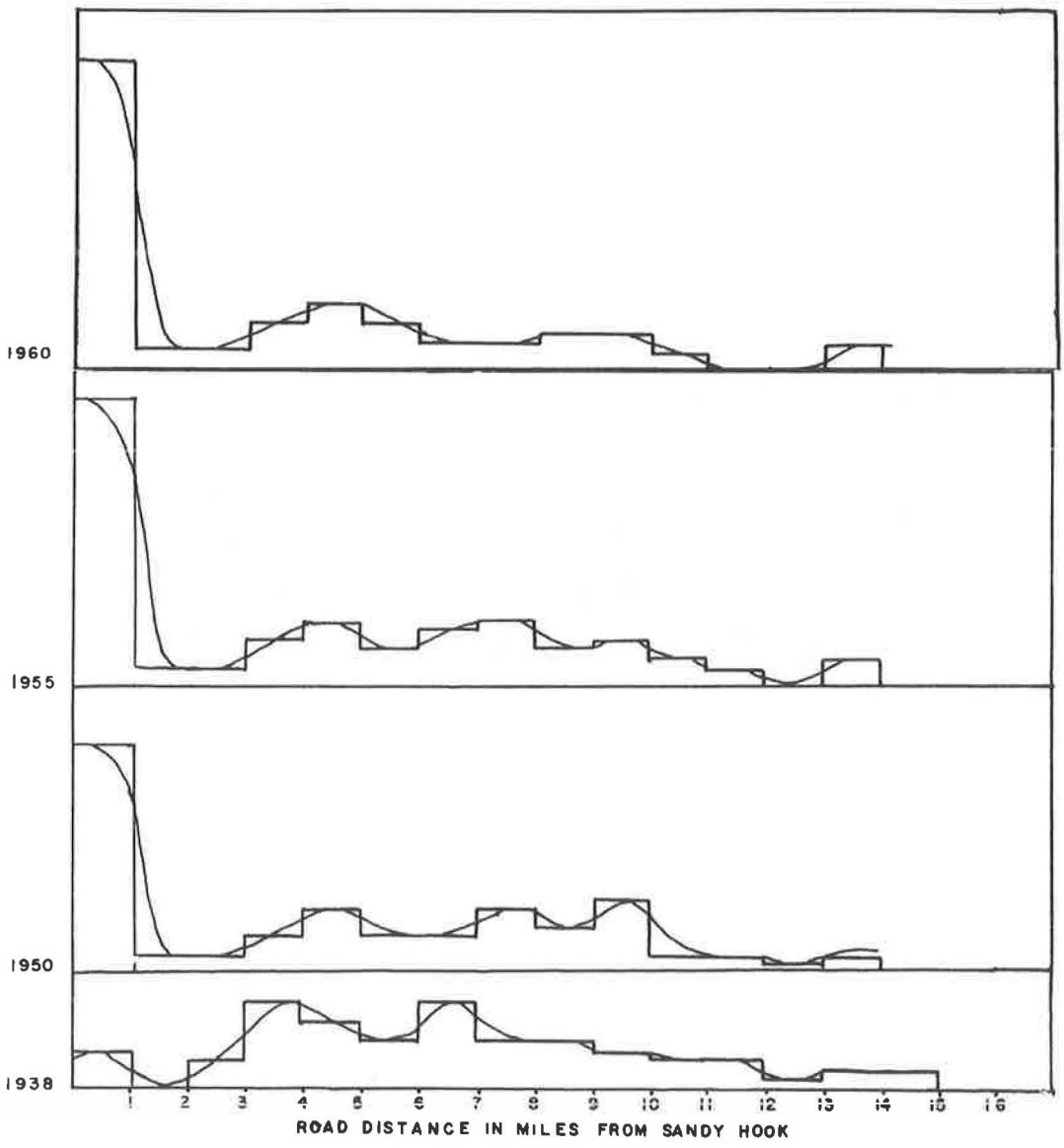

Figure 5. Business distribution by road distance from Sandy Hook: 1938, 1950, 1955, and 1960.

of retail business around the central trade center. This tendency is also observable in the study area as a whole. It is shown in a striking way by the record of business failures.

The survey of businesses in the study reveals a sufficient number of failures to warrant a classification of open-country locations into three groups: single isolated, dual isolated, and agglomerations. Using these three business location classes, failures are related to the nearest road improvement. The results of this analysis are given in Table 1, which shows that stores in single isolated open-country locations appear to be the most sensitive to surfacing of roads as is suggested by the preceding analysis of business concentration in Elliott County. Slightly under one-half the stores in such loca-

tions in the study area that failed closed within five years following the date when the nearest hard-surfaced road was paved.

The evident influence of such road improvements decreases as the degree of locational isolation of open-country business decreases. For example, of the open-country stores in agglomerated locations, all those closing failed ten years or more after the paving of the nearest hard-surfaced road. All the businesses so involved were located on an inter-county route or on an intracounty collector and were likely benefited initially by such improvements.

Changes in Study Area Trade Centers

The business interviews also provide data with which to trace changes in the number and types of retail business establishments located in study area trade centers between the years 1950 and 1960. These observed changes are compared with rural road improvements in the area to uncover such relationships as exist.

The growth characteristics of the larger centers are markedly different from those of the small ones. Over-all, the larger centers showed roughly a 40 percent increase in the number of operating businesses between 1950 and 1960. However, not all the larger communities grew at the same rate. Each trade center's location in relation to other centers and in relation to the larger centers of Lexington and Ashland outside the study area was influential.

In the smaller trade centers as well as in the larger trade centers, food stores as a group became proportionately less important as a component of the business picture. New businesses, other than grocery stores, were initiated in the trade centers of the study area during the period 1950 to 1960, but these were concentrated in the larger trade centers.

In the six larger trade centers, 10 types of businesses increased in number at a rate greater than the over-all number of businesses. Three of these business types were "highway oriented"—restaurants, gasoline service stations, and motels. The other business types, however, reflect increased specilization and concentration in services and durable goods. Personal service and repair shops both grew at high rates between 1950 and 1960. But the fastest growth rate was in "specialty shops"; i.e., jewelry stores, florists, and gift shops. The other retail lines that grew rapidly were home furnishings and appliances, automobile sales, lumber and building materials, and farm supplies.

The changes in the number of businesses located in the study area trade centers best indicate the form and substance of the adjustments in market structure evolving within this rural area. In 1950 the three largest communities—Morehead, Olive Hill, and Grayson—already contained large concentrations of business; Owingsville, Sandy Hook and West Liberty were not significantly larger than the other small trade centers which remained static in the period 1950 to 1960. West Liberty and Owingsville grew substantially in this decade, and by 1960 West Liberty was an important center in the southwest portion of the study area.

The most decentralized locations, those described in this report as open-country locations, decreased in number; and those open-country locations used were within smaller radii circumscribed about the county seat trade centers. The "small trade center" (i.e., under twenty businesses) remained fairly static. Its absolute trade position was altered only slightly but its relative importance decreased. The business communities of the larger trade centers, primarily the county seat towns, increased in the size and diversity of the goods and services that they offered.

In 1950 there were only 398 mi of hard-surfaced roads in the six study area counties. During the next five years only 120 additional miles of road were surfaced. But between 1955 and 1960 slightly over 350 additional miles of road were hard surfaced. This was almost a 70 percent increase over the mileage existing in 1956.

It is obvious that the larger centers enjoyed increases in the number of retail and service businesses during the period of greatest activity in road improvement (as measured by miles of hard surfacing). It is equally clear that the greatest decline in the number of open-country businesses occurred during this same period. But these observed changes in the types and locations of businesses in trade area centers as well

as other retail business changes in the study area might very well be explained wholly or partially by changes other than road improvements.

Aggregate Analysis of Changes in Retail Business Location

As a guide for assessing the changes in the geographic dispersion of retail business observed in the study area over the 10-year period an attempt is made to measure the relative influence of several variables on the dispersion of retail business in rural areas on a statewide basis. The technique used is multiple regression.

In the regression analysis the dispersion of retail business is taken as a measure of the degree to which a market is structured: the more structured the market, the less scatter of retail business expected. The scatter of retail business is used as the dependent variable.

The geographic dispersion of retail business is measured by the number of food and general stores per 1,000 population. It is believed that the number of general stores and food stores per 1,000 population gives an adequate approximation of the number of first-level or small consumer markets for the trade areas existing in a given political unit; in this case, the county.

A number of variables are considered in the analysis as determining the geographic dispersion of business:

1. Population density per square mile is used as an indicator of the potential population base for specialized and generally concentrated business.
2. Per capita income is used as a measure of the population's ability to buy and thus a further measure of the potential base for specialized and concentrated business activity.
3. The proportion of farms located on all-weather roads in a given county is used as an indicator of the "ubiquity" of a high level of transportation surface which could decrease time-distance factors in retail purchasing.
4. The proportion of commercial farms in a county is used as an indicator of the concentration of per capita income among consuming units.
5. The proportion of farm owner-operators in a county is used as an indicator of the familiarity of residents with local shopping alternatives and of possible neighborhood loyalty.

Before making the computations for the regression analysis, a forecast was made concerning the signs that the regression coefficients of each of the variables would have:

1. The sign of the regression coefficient for population density was expected to be negative because, all other things being equal, heavier population densities, should lead to specialization and thus to decreased dispersion of retail business.
2. The sign for per capita income was expected to be negative for the same reason.
3. The sign for the proportion of farms on all-weather roads was expected to be negative because increased ubiquity of a high level of transportation should decrease the influence of time and distance and thus lead to concentration of business. (The regression analysis does not distinguish between different types of hard-surface roads. The general study evidence strongly suggests that in a rural area improvement of roads to all-weather status is a more important determinant of the geographic dispersion of retail business than modernization of existing hard-surface facilities.)
4. The sign for the proportion of commercial farms was also expected to be negative because increased equalization in the distribution of income should make pressures for specialization more uniform and thus more effective in the location of retail business.
5. It was questionable whether the sign for the proportion of owner-operators was to be positive or negative, but it was forecast to be negative because income distribution and mobility were involved.

The multiple regression is assumed to take the linear form

$$X_1 = a + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 \qquad (1)$$

TABLE 2

RESULTS OF MULTIPLE REGRESSION FOR GEOGRAPHIC DISPERSION OF RETAIL BUSINESS BASED ON COUNTY AGGREGATIONS FOR 1940, 1950, AND 1960

Variable	Year[a]	Coefficient[b]	F-Test	t-Test
Population density	1940	0.026	2.48[c]	1.58
	1950	-0.019	1.33	1.15
	1960	-0.036	9.41[d]	3.07[d]
Per capita income	1939[e]	-0.029	1.51	1.23
	1950	-0.024	3.04[f]	1.74[c]
	1957[e]	-0.027	2.99[f]	1.73[c]
Proportion of farms on all-weather roads	1940	-0.041	7.10[d]	2.66[d]
	1950	-0.042	7.69[d]	2.77[d]
	1960	-0.027	3.81[f]	1.95[f]

[a]Standard error: 1940, 1.17; 1950, 1.44; 1960, 1.14.

[b]Of determination: 1940, 0.50; 1950, 0.44; 1960, 0.37.

[c]Significant at 10 percent level.

[d]Significant at 1 percent level.

[e]1940 and 1960 data unavailable.

[f]Significant at 5 percent level.

The regression equation using the cross-sectional county data for 1950 referred to previously is computed using standard methods and yields an $R^2 = 0.44$. The signs of all of the coefficients are negative, as expected, but only the first three variables are significant. Consequently, a second regression equation is calculated using only the first three independent variables. The R^2 is again 0.44. The results of this second analysis are summarized in Table 2.

The most important of the variables appears to be the proportion of farms on all-weather roads. Its importance lends support to the hypothesis that road improvement can have significant effects on market relationships and adjustments. The coefficient of determination (R^2) is high, considering the aggregation of the data on a county basis. First, the measure of population density used tends to obscure variations in the concentration and dispersion of population within a political unit. An attempt was made to substitute a form of "man-land" ratio other than population density. Population per acre in crops and pasture is utilized, but this measure overcompensates by treating dispersed small acreages as concentrated. Second, the per capita income figures employed are only estimates and contain imputed income values for the farm home as a residence and for the value of homegrown fruits, vegetables, milk, and meat. Third, and most important, the measure of the proportion of farms on all-weather roads is subject to some error. The census classes of farms on hard-surfaced roads and farms on gravel, shell, and shale roads are combined to prepare the estimate. There are undoubtedly a number of gravel, shell, or shale roads that are not "all-weather" roads, and the proportion of such roads in each county varies widely. In addition, topography imposes a great many barriers to free movement and exchange.

The development of market structures encompassing many counties and the emergence of a hierarchy of trade centers with distinct functions as inferred from the observations in earlier parts of this report should lead to the secular reduction of the operation of county units in Kentucky as convenience goods markets. County and other political boundaries should be blurred by increasingly available good transportation, and thus the evolving convenience goods markets should increasingly overlap county boundaries and take on configurations consistent with the patterns of dominant and satellite trade

centers as they in turn develop. If this type of evolution has been occurring in Kentucky, then a reduction of the correlation between the dispersion of grocery and general stores with personal income and available transportation should be expected secularly.

This possible trend is checked by the same type of cross-sectional analysis as that for Kentucky counties with 1950 data. Using the same dependent and independent variables multiple regressions are calculated using data for circa 1940 and circa 1960. It is postulated that if the inferred market adjustments are prevalent in the aggregate, the R^2 in 1940 should be higher than that for 1950 and the R^2 for 1960 should be much lower than that for 1950. Of particular interest is the reduction in the R^2 between 1950 and 1960 because the greatest activity in rural road improvement, as measured by number of miles hard surfaced, occurred in this period.

Analysis of data for 1940 and 1960 yields results in line with those previously hypothesized. The coefficients of determination (R^2) for 1940, 1950, and 1960 are 0.50, 0.44, and 0.37, respectively. Proportionately, as well as absolutely, the decrease is greatest from 1950 to 1960. The regression coefficient for the transportation variable in the equation is statistically significant for all three periods. The regression and correlation data for all three years are given in Table 2.

It is interesting that in 1960 the coefficient of population density is highly significant, and that from 1940 to 1960 the sign of the coefficient changes. Table 2 also shows that the signs of the coefficients of the other two variables remain negative throughout the period. One possible meaning of the change in sign of the coefficient for population density is that the period of business concentration in this rural Kentucky area was just beginning in the 1940's.

The reductions in the correlations observed over the 20-year period from 1940 to 1960 do not necessarily validate the role of road improvements as key factors in the market adjustments inferred from the retail business survey data. But there seems to be little doubt that the coincidence of road improvements and concentration of business into the larger study area centers is more than accidental.

SUMMARY AND CONCLUSIONS

The evidence of the investigation reported in this paper appears to validate the premise that road improvements in rural areas lead to market adjustments, specialization of enterprise, and concentration of business. The market adjustments in the study area are manifested in many ways. The number of stores in "open-country" locations has decreased, and in addition their dispersion geographically about the area—primarily county seat—trade centers has decreased secularly. Concurrently, the number of businesses in the trade centers has increased and many of the new businesses are specialized. Trade centers are also becoming differentiated by trade functions, and communities which twenty years ago were very similar have evolved quite differently. The differences in their evolution are definitely related to the location of road improvements, and also to the sequence of their improvement.

Analysis of the data shows that intracounty as well as intercounty market adjustments have taken place. Improvement of intercounty routes, and of intracounty "collectors" appears to be of primary benefit. Improvement of feeder roads providing access to the secondary system is also beneficial, but in general most of such benefit seems to come not from modernizing already hard-surfaced routes, but from upgrading roads to "all-weather" standards.

Perhaps the most significant aspect of the regression and correlation analysis is that the proportion of total variance in the geographic dispersion of retail business establishments explained by the regression equation has decreased secularly since 1940. This secular decline is interpreted as due to intercounty market adjustments which have decreased the validity of the county as an economic unit. The importance of the transportation variable in the regression equation supports the conclusion that such intercounty market adjustments are due in large part to the increased availability to rural people of good intercounty routes.

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Relation of Highway Accessibility to Urban Real Estate Values

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This paper covers portions of the empirical results from a study on the nature and value of highway accessibility. The data are drawn from the Washington, D. C., metropolitan area. The major source of accessibility information is the 1955 Washington Metropolitan Area Transportation Study. House prices are drawn from a list of sales provided by the Federal Housing Administration. Empirical relationships have been developed between: (1) job accessibility and distance to the CBD; (2) driving time to CBD and distance to CBD; (3) proportion of job trips to CBD and driving time to CBD; and (4) house prices and job accessibility, driving time, and distance to CBD. Most of the statistical results of the study are reported but the research possibilities of relating O-D data to data on the urban housing market are emphasized.

•RECENT STUDIES stimulated by the Bureau of Public Roads have generated considerable interest in the relation between highway improvements and land values[1]. Although conducted with care and statistical competence, these studies have not gone as far as economists would like in using land value information to solve some of the vexing problems of highway evaluation. Highway improvements have value because they increase the accessibility of the land they serve, with accessibility being defined as the reciprocal of the costs of moving people and goods between points in space. Because land buyers are willing to pay for savings in vehicle-operating costs, time, and the other components of accessibility, the value of these expected future benefits is capitalized into land prices. Thus, changes in land values over time or differences in land values at a point in time can be expected to reflect differences in accessibility, and it may be possible to use this information in estimating the value of highway improvements.

The study reported in this paper attempted to estimate the value that residents of the Washington, D. C., metropolitan area place on highway accessibility to job opportunities and to the central business district (CBD). The approach was to analyze through multiple regression a cross-section of sales prices of residential properties.[2] Variations in sales price are associated with differences in accessibility characteristics. To avoid some of the conceptual and empirical difficulties inherent in a time series approach, exclusive reliance is placed on cross-sectional variation. It is thus possible to hold constant the interest rate, other construction costs, population, and the level of prices and personal incomes. The value differences that emerge depict the structure of values rather than changes through time.

THE DATA

Particularly good data on both house prices and accessibility are available for the Washington area. The value data are a sample of house sales assembled by the District

Paper sponsored by Committee on Indirect Effects of Highway Improvements.

[1] A good summary of the bulk of this work—studies prepared for the report called for by Section 210 of the Highway Revenue Act of 1956 (70 Stat. 387)—can be found elsewhere (1).

[2] Both the theoretical and empirical approaches of this study are very similar to those used in a recent study by Mohring (2).

of Columbia Insuring Office, Federal Housing Administration, to assist FHA appraisers in their work. The sales took place during the first nine months of 1961. For each sale the following information is available: street address; sales price; style of house; square feet of house area; square feet of lot; percentage of house having basement; number of stories, rooms, bedrooms, and baths; exterior construction material; garage or carport; year built; type of water and sewer service; and such special features as recreation rooms, fireplaces, fences, and porches.

The sample has wide geographic dispersion, although most of the properties are in suburban areas where the real estate market is most active. The price, size and quality ranges are determined in part by the legal requirements for FHA financing, as all sales were made with the support of FHA loan insurance. The price range is from $8,000 to $30,000. Though high-priced properties are excluded, the disadvantage of incomplete coverage is more than offset by the close comparability of the data resulting from the uniform way in which they were assembled and the numerous constants introduced by the FHA requirements.

Three types of accessibility data are available: airline distance to the CBD, driving time to the CBD, and indexes of accessibility. The major source of data has been unpublished information from the 1955 Washington Metropolitan Area Transportation Study. Estimates of driving times were developed for each pair of the 400 origin and destination zones into which the study area was divided. These are offpeak driving times estimated from studies of vehicle speeds along key streets and highways in the metropolitan area. The set used is driving times between zone 35 (12th and F Streets) and the other 399 zones. A second set of times linking the CBD with zones outside the CBD was developed as a by-product of the 1959 Government Employee Parking Survey. Morning peak-hour driving times were calculated from answers given by government employees to questions on their trips to work. The survey was conducted on July 21, 1959. Some 55,000 auto drivers and passengers employed in the CBD filled out the questionnaires. Only uninterrupted trips were included in the data used in this study. Details on processing and analysis of the data are presented by Mueller (3).

As expected, the 1959 times are consistently higher than those from the 1955 study and differ from zone to zone somewhat less regularly. The accessibility indexes, developed from Transportation Study data, measure for each zone its accessibility to employment, retail sales, or population. The index is of the gravity type, varying directly with the number of people, jobs, or volume of sales, and inversely with the distance to them.

The employment index for any zone is calculated from

$$ {}_iA_e = \sum_{j=1}^{400} \frac{E_j}{\left(T_{i-j}\right)^{\alpha}} \qquad (1) $$

in which

${}_iA_e$ = employment index for zone i;

E_j = number of jobs in zone j;

T_{i-j} = travel time, zone i to zone j (the 1955 travel times adjusted for terminal time were used in these calculations); and

α = an empirically-determined exponent indicating the willingness of people to travel to jobs.

The exponent α is computed through an iterative procedure and is that power of T_{i-j} which best predicts the observed interchange of trips between zones. For the employment index, the exponent was about 2, and for retail sales, 4.5, indicating that distance (time) discourages job trips less than shopping trips.

A description of the development and use of the Washington accessibility indexes can be found in two recent articles by Hansen (4, 5).

These previously mentioned data were used in answering three questions relevant to the valuation of accessibility. The first was the question of how closely the major mea-

sures of accessibility (distance, driving time, and the job accessibility index) were related to each other. The second concerned the relation between accessibility to the CBD and the proportion of job trips that were made to the CBD. The final question was how house sales prices varied with accessibility, other characteristics being held constant.

ACCESSIBILITY AND DISTANCE

To test how driving time and job accessibility vary with distance from the CBD and whether there are significant directional differences in these relations, the regressions summarized in Table 1 were run. Each of the three measures (job accessibility index, 1955 driving time, and 1959 driving time) was regressed on distance from the White House expressed first in natural numbers and then in common logarithms. The sample consisted of 104 O-D zones selected systematically from those for which all three measures were available. Seven dummy variables were included to measure the differences in intercept among the eight directional sectors. (The Transportation Study area was divided into 68 origin and destination districts and these in turn were subdivided into the 400 O-D zones already mentioned. The districts may be aggregated into eight wedge-shaped sectors whose boundaries radiate from the CBD. If the study area is visualized as a circle divided into octants, the sectors are numbered, beginning at due north and reading clockwise: 3, 4, 5, 6, 7, 8, 1, and 2.) The calculated constant is the intercept for sector 3; coefficients of the other sector variables indicate the adjustment of this constant term that is appropriate for each.

Several inferences can be drawn from Table 1:

1. Distance is a surprisingly good predictor of all three accessibility measures, by itself accounting for between 84 and 94 percent of the variation in travel time and job accessibility, respectively.
2. The log of distance gives the better fit for the job index, whereas both sets of driving times are more closely related to simple mileage.
3. Although several sector coefficients are statistically significant, all are small relative to the value of the dependent variable calculated from the constant term and the distance coefficient, and in the aggregate they add little to the explanatory power of the equations.

These relations imply that accessibility may be measured in minutes, index points, or miles, and that the value estimates should be roughly similar whatever measure is chosen. A broader implication, which is not pursued here, is that the short-run route choices of drivers, the longer-run location decisions of residents, and the highway building and improvement programs of public agencies operate to equalize the accessibility structure of the city in terms of both direction and distance.

TABLE 1

COEFFICIENTS OF REGRESSIONS RELATING ACCESSIBILITY MEASURES TO DISTANCE FROM CBD

Variable	Job Accessibility Index				1955 Driving Time				1959 Driving Time			
	Regress. Coeff.	Std. Error	Regress. Coeff.	Std. Error	Regress. Coeff.	Std. Error	Regress. Coeff.	Std. Error	Regress. Coeff.	Std. Error	Regress. Coeff.	Std. Error
Constant	1,509	27	1,771	28	5.03	0.51	0.24	0.69	15.90	0.77	10.34	0.99
Miles from CBD	-119	4	-	-	2.37	0.07	-	-	2.73	0.11	-	-
Log miles from CBD	-	-	-1,349	34	-	-	26.21	0.86	-	-	30.24	1.24
Sector:												
1	12.3	37.9	-5.5	31.7	-0.76	0.71	-0.47	0.79	-2.95	1.08	-2.61	1.13
2	-10.1	27.7	3.5	23.1	1.04	0.52	0.84	0.58	-0.96	0.79	-1.20	0.83
4	-33.9	26.5	-5.5	22.2	-1.45	0.50	-1.99	0.55	-1.30	0.76	-1.92	0.79
5	-67.1	32.7	-31.6	27.3	-1.14	0.61	-1.80	0.68	-3.29	0.93	-4.06	0.98
6	-80.9	32.7	-34.3	27.2	-1.05	0.61	-1.99	0.68	-0.73	0.93	-1.81	0.97
7	- 0.1	27.8	52.3	23.2	-1.85	0.52	-2.87	0.58	-2.23	0.79	-3.40	0.83
8	-70.3	29.8	-23.4	24.9	0.04	0.56	-0.84	0.62	-0.74	0.85	-1.76	0.89
R^2	0.922		0.946		0.934		0.919		0.886		0.875	
R^2 on distance only	0.909		0.937		0.905		0.870		0.862		0.840	

ACCESSIBILITY AND CBD JOB ORIENTATION

The question of whether people choose residential locations systematically with respect to the location of their jobs is still to be satisfactorily answered. It would be expected that, as the CBD is approached, the proportion of all workers who have jobs in the CBD would increase. Two recent empirical studies document the tendency for workers' residences to be oriented to their work places. Kain (6) notes the tendency with respect to outlying employment centers in the Detroit area. Muth (7), in his work on urban density gradients, found that the concentration of manufacturing employment in the central city was highly correlated with the compactness of the associated urbanized area, implying that concentrations of residences accompany concentrations of jobs.

A different impression, however, is given by one of the tables from Silver's (8) excellent study of changing travel patterns in the Washington metropolitan area. His data suggest that distance from the CBD may have no consistent influence on the proportion of the labor force that is CBD oriented. Aggregating data by distance rings, he found that up to 2 mi from the CBD, 30.3 work trips per 100 dwelling units were made to the CBD; between 2 and 4 mi, 34.6 trips per 100 dwelling units; 4 to 6 mi, 37.4 trips; 6 to 8 mi, 29.2 trips; and 8 to 10 mi, 32.8 trips (8, Table 7). The constancy of CBD trips per dwelling unit suggests an irrational pattern of job and residence location that is at variance with the expected pattern and patterns observed elsewhere.

TABLE 2

COEFFICIENTS OF REGRESSION RELATING PERCENTAGE OF JOB TRIPS DESTINED FOR CBD TO TRAVEL TIME FROM DISTRICT OF ORIGIN TO CBD

Variable	Regress. Coeff.	Std. Error
Constant	69.70	3.23
1955 driving time	-1.27	0.15
Sector:		
1	7.01	3.22
2	11.03	2.86
4	-9.25	2.72
5	-10.27	3.22
6	-11.98	2.94
7	-19.70	2.82
8	-8.37	2.92
R^2	0.794	-

To explore with more precision the relation between accessibility and job orientation, the regression summarized in Table 2 was run. The dependent variable was the percentage of all home-based work trips destined for the CBD. This was regressed on driving time to the CBD and seven dummy sector variables. (The problem was run for 58 O-D districts outside the CBD. District 71 was excluded, as it comprises several military installations whose workers are housed on the base. District driving times were calculated by averaging the 1955 times for constituent zones.) From these results it is clear that CBD job orientation is not independent of accessibility. The differences between these findings and those in Silver's article result from differences in the level of aggregation and in the form of the variables used. Districts in the underoriented sectors to the south, 6 and 7, are on the average closer to the CBD than those in the strongly-oriented northwest. Silver's 8- to 10-mi ring contains primarily districts in sectors 2 and 3 and has none from sectors 6 and 7. Thus, in aggregating by distance rings, Silver's procedure weights the outer rings heavily with districts of above average orientation. In addition, his use of work trips to the CBD per 100 dwelling units results in relatively low estimates for the close-in districts where the total number of jobs per dwelling unit is lower than in outlying areas. Work trips (total) per dwelling unit vary between 0.96 in the inmost ring to 1.29 in the 8- to 10-mi ring (calculated from Tables 1 and 5 in 8).

Although the sector variables contribute substantially to the success of the regression, their very success raises some disturbing questions. Though the global irrationality that seemed to exist has been disposed of, it has been done so largely by localizing it. The variance among sectors in their degree of CBD orientation is truly impressive—more than 30 percentage points separate sectors 2 and 7. Two comments are in order.

These findings lend support to the sector theory of residential growth set forth by Hoyt (9) in the late 1930's. It is perhaps no accident that he was working and living in Washington when he developed it. They also warn that the pattern of accessibility values may depend on direction as well as distance.

HOUSE PRICES AND ACCESSIBILITY

The central statistical problem of this study was to isolate the component of house sales prices that is paid for accessibility. As accessibility is a component of the price of land, and land (graded and improved with streets and utilities) has been estimated to average between 16 and 18 percent of the selling price of a house, the job was to estimate the variation in a component that averages at most less than one-tenth of the price of the property.

The approach was to hold constant through least squares multiple regression the determinants of selling price other than accessibility. Because the house accounts for over 80 percent of average value, primary attention was given to identifying the significant structural variables and quantifying them in the way that has the greatest explanatory power. In arriving at the final regression equations, four sets of decisions had to be made: (a) defining the universe, in terms of age and style of house and geographic coverage, (b) choosing a sampling technique, (c) selecting the variables to be included, and (d) finding the appropriate form for measuring the variables.

The following procedure was followed: Systematically 286 house sales were selected from the basic FHA list of about 2,000 observations. All houses chosen were built after 1944 and all were located within the Transportation Study cordon. Four house styles were included: one story, one and one-half story, two story, and two story semidetached. For each house style sampled a single observation was chosen at random from each FHA data tract containing one or more eligible properties. Thus, the selection of observations was purposive in two senses: separate samples were drawn for each house style, and an attempt was made to achieve a wide and even geographic distribution of properties.

The estimating equation was of the form

$$X_1 = b_1 + b_2X_2 + b_3X_3 + \ldots + b_nX_n + U \qquad (2)$$

Eleven variables were chosen for inclusion in the final runs. Unless otherwise indicated the source of data was the basic FHA list.

X_1 = price. Selling price, adjusted where necessary for the value of nonrealty items included in the transfer.

X_2 = square feet of house. Square footage of the basic house. Because certain economies of scale are to be expected in construction costs, the logarithmic transformation of this variable was used.

X_3 = accessibility. Although several forms of the accessibility variable were tried, the measures included in the final runs were the job accessibility index, the log of distance to the White House, and the 1959 driving time to the CBD.

X_4 = square feet of lot. The logarithm of lot area was used as the value of space can be expected to increase at a decreasing rate.

X_5 = construction material. Dummy variable equal to one if house was built wholly or partially of brick; equal to zero if nonbrick.

X_6 = basement. Dummy variable equal to one when house had basement; equal to zero otherwise.

X_7 = number of bathrooms. As scale economies are to be expected in construction costs, the logarithmic form was used.

X_8 = extras. Dummy variable equal to one when house was equipped with one or more of the following: garage, carport, recreation room, central air conditioning, or more than 100 sq ft of finished area in basement or upper story.

X_9 = median income. Median family income in 1960 of the census tract in which the property was located.

X_{10} = age of house. Equal to 1960 minus the year in which the house was built.

X_{11}, X_{12}, X_{13} = style of house. Three dummy variables used to distinguish among one story, two story, one and one-half story, and semidetached houses.

The results of three regressions using this set of variables are given in Table 3. Selling price was the dependent variable in each problem and the independent variables other than accessibility were identical. The fit of the equation is good and the level of significance of the coefficients is high—11 of the 12 independent variables have t-ratios exceeding 3.0. Although the behavior of all the independent variables is of interest, primary concern is with the values attached to the accessibility measures. The coefficients may be interpreted directly as the change in the selling price of a house per unit change in its accessibility, the other characteristics held constant. One hundred points of job accessibility index are worth $2.33, one minute less of driving time adds $63.68 to the price of a house, and one unit of log distance is valued at $3,552. Translated into miles, the log distance coefficient implies a premium of $444 for houses 3 mi from the CBD over those 4 mi away and a premium of $206 for 7 over 8 mi. Although job accessibility shows the highest t-ratio and R^2, both time and log distance are clearly adequate measures.

Two other value calculations developed in the study are worth mentioning. When the dependent variable was run as the logarithm of sales price so that the value of accessibility could be expressed as a percentage of sales price, 10,000 accessibility index points added 1.1 percent to sales price, other characteristics remaining the same. (Though the computations were done in common logarithms, the percentage interpretation requires that the coefficient of accessibility be converted into natural logs. The coefficient must be multiplied by 2.303 and then by 100 in order for it to be read as a percentage.) With an accessibility range in sample of about 90,000, the variable can thus account for a difference of 10 percent in sales price of two houses located at the extremes.

The second calculation was made to test whether the degree of CBD job orientation affected the observed accessibility rent gradient. Because the O-D sectors exhibited such a wide range of percentages of all jobs located in the CBD (Table 2), the basic sample was divided into two subsamples on the basis of sectoral CBD orientation. The

TABLE 3

COEFFICIENTS OF REGRESSIONS RELATING SALES PRICE TO ACCESSIBILITY MEASURES AND OTHER INDEPENDENT VARIABLES, POOLED SAMPLES

Building Type	Variable	Job Accessibility Index		1959 Driving Time to CBD		Log of Distance to White House	
		Regress. Coeff.	Std. Error	Regress. Coeff.	Std. Error	Regress. Coeff.	Std. Error
1-story	X_2	24,465	1,549	24,682	1,568	24,520	1,553
	X_3	2.33	0.47	-63.68	15.69	3,552	748
	X_4	1,208	711	973	716	1,126	712
	X_5	1,551	234	1,541	237	1,562	235
	X_6	1,192	282	1,230	285	1,225	282
	X_7	5,082	915	5,130	928	5,038	919
	X_8	797	195	781	198	766	196
	X_9	0.337	0.065	0.335	0.066	0.326	0.065
	X_{10}	-81.11	26.44	-77.31	26.78	-84.08	26.65
2-story	X_{11}	-1,632	298	-1,601	302	1,628	299
1½-story	X_{12}	-2,345	315	-2,345	319	-2,338	316
Semidetached	X_{13}	-3,885	400	-3,932	408	-3,960	403
R^2		0.868		0.864		0.867	

"overoriented" sample comprised the 100 observations in sectors 1, 2, and 3. The "underoriented" sample included the 186 observations in sectors 4 through 8, each of which averaged below sectors 1 through 3 in the percentage of job trips made to the CBD. (The division into two samples was made on the basis of the coefficients of the dummy variables given in Table 2.) The samples were run separately to determine whether they would exhibit different accessibility coefficients. The job accessibility coefficient for the heavily-oriented northern sectors was 2.28 (1.35); for the rest of the metropolitan area it was 2.69 (0.61). Clearly the slopes are not significantly different.

The result is not surprising in view of the earlier findings. It was clear from the computations summarized in Table 1 that the accessibility-distance relation was not significantly influenced by differences in the degree of CBD job orientation. Sectoral differences in the driving time vs distance intercept were negligible in comparison with differences in sector proportions of job trips made to the CBD. The critical ratio here is not CBD job orientation, but rather the ratio of peak-hour CBD vehicle trips to highway capacity. Either the high percentages of CBD trips from the northern sectors were not associated with large absolute volumes of trips or the supply of highway facilities was sufficient to accommodate them at speeds equal to those elsewhere in the city. Under these circumstances, differences in the slope of the accessibility gradient could result only from barriers that prevented land market competition between the sectors. Political boundaries, different sets of zoning regulations, or marked differences in income, if they corresponded to sector boundaries, might bring about differences in the value gradient. There is no evidence that such barriers exist in the present case.

ACCESSIBILITY VALUES AND HIGHWAY BENEFITS

Detailed application of these results to the highway planning process is a major research undertaking in itself and is beyond the scope of this paper. It is worthwhile, however, to sketch briefly their possible role in evaluating proposed improvements.

The most straightforward application is to use the value of job accessibility. Highway improvements, by reducing travel time, will increase the indexes for properties in the area they serve. Assuming that changes in the job index reflect changes in accessibility in general, the appropriate calculation is of job accessibility "with" and "without" the project in question. Increases in the index weighted by the number of residences affected provide a physical measure of benefit to which the value findings of this study may be applied. Multiplied by the unit value reported in Table 3 ($2.33 per hundred index points), the aggregate increase in the index will measure one component of the value of the improvement.

One complication that affects the valuation of increases in job accessibility should be stressed. The formula (price times incremental quantity) for estimating the value of increases in supply is applicable only when the increment to supply is sufficiently small not to affect the unit price. When a transportation improvement is massive enough to affect the general level of accessibility values, the appropriate unit price lies between the "before" and "after" values. There is considerable support for using the arithmetic mean of the two (10, p. 41).

A second application of the findings is in estimating the value of driving time. Highway planners increasingly recognize that the value of time saved is legitimately included in highway benefits, but little evidence or consensus exists on what the unit value is. Several figures have been recommended for use in benefit calculations and several others have been suggested by recent research, most of which fall in the range of $1 to $2 per vehicle-hour (2, 11, 12, 13, 14).

The travel time coefficient developed in this study was $63.68, which may be interpreted as the present value of expected savings in time and operating costs per minute of peak-hour driving-time. To convert this capital sum into a value for current driving time, it is necessary to put it on an annual basis, divide by the number of trips per year, and adjust for the associated savings in vehicle-operating costs. This last adjustment is necessary because the capitalized value of all components of accessibility will be reflected in the coefficient of the time variable and ignoring the non-time elements leads to an overestimate of the value of driving time. Using a discount rate of

10 percent the annual value is $6.37, which when spread over an estimated 500 trips yields $0.0126 per minute per trip. Adjustment for the associated saving in operating costs requires (a) conversion of minutes to miles, (b) selection of an appropriate average speed, and (c) determination of the outlays for gas, oil, tires, etc., at that speed.

A factor for converting minutes to miles can be derived from the mileage coefficient of the 1959 driving time regression reported in Table 1. The distance coefficient (2.73) was divided by 1.20, a factor commonly used to convert airline miles to road miles (15, p. 90). It is equal to 2.28, indicating that a difference of 1 min in driving time at the margin is associated with 1/2.28 = 0.44 mi. Thus, the saving of 1 min simultaneously saves the operating costs of driving 0.44 mi. This relation also indicates that average speed at the margin is 26.4 mph. Joseph (16) has calculated average operating costs to be $0.0312 per mi at 25 mph, and Winfrey (11), in an independent calculation, arrives at an estimate of $0.0368. (Winfrey explicitly includes an allowance for depreciation attributable to mileage, which may account for the difference between the estimates.) It is clear that the estimated value of $0.0126 per min does not even cover the saving in operating costs and implies a zero or negative valuation of driving time.

These calculations indicate that Mohring's conclusions would have been very different from what they were if he had taken account of savings in operating costs. His rent gradient is remarkably close to the one presented here. If his coefficient (2, p. 427) is converted to a per-lot basis, the capitalized value of time is $71.24 per min. The driving time estimates he used are most comparable with the 1955 Transportation Study times, which yielded a coefficient 10 percent higher than the 1959 figures. Therefore, an estimate equivalent to Mohring's of just over $70 is obtained. It thus appears that adjustment for operating cost savings would also absorb all of Mohring's gradient.

The reasons for this unexpected conclusion are not obvious. One might argue that house buyers are ignorant of locational differences in commuting time or operating costs, that they in fact place no value on time, or that they act irrationally in bidding for housing. None of these hypotheses is convincing. The care, time, and effort that buyers and sellers put into real estate transactions and the almost universal distaste for congested commuting argue strongly against such facile explanations. Nor is there any reason to question the estimates of operating costs that were used. The explanation must therefore lie either in the coefficient itself or in the series of adjustments that converted it into dollars per minute.

Considering first the adjustments, two possibilities are worth noting:

1. The 10 percent discount rate may be too low. Two factors tend to restrict the time period over which buyers would expect to receive the benefits of superior accessibility. The first is uncertainty about future transportation improvements, particularly freeway building and the much discussed mass transit plan for the Washington area. Secondly, much of Washington's population is notoriously transient. Both of these factors may influence buyers to discount future accessibility advantages very heavily.
2. The estimate of 500 trips per year may be too high. Washington has probably gone farther than any other metropolitan area in the development of car-pooling arrangements. Reducing the estimate to one round trip per week substantially lowers the adjustment for operating expenses. Car-pooling does not, however, lower the time cost of commuting; by increasing the circuity of travel, it probably increases it. The calculated value of time would therefore remain low.

A more basic question is whether the accessibility coefficients measure what they are intended to measure. Because accessibility is highly correlated with distance from the CBD, the coefficients will reflect the value of whatever else is correlated with distance and not included in other variables in the equation. Such factors as the presence of contaminants in the air, noise, and crime are examples of "distance-related" factors. Because they are undesirable and generally positively correlated with accessibility, their presence would cause the coefficients to understate the value of access. In view of the industrial structure of the Washington area and the geographic coverage of the sample, it would be expected that the value effect of these particular nuisances would be relatively small.

Accessibility is also correlated with two other factors that would tend to depress

values—the age and density of housing. (The simple correlation coefficient relating accessibility and age of house was 0.24; between accessibility and square feet of lot, it was -0.35.) Though both age and lot size are explicitly included in the equation, the behavior of their coefficients is not inconsistent with the hypothesis that the accessibility coefficient is picking up some of their influence on price.

CONCLUSION

This study was prompted by gaps in knowledge about the value of transportation improvements. The findings have shown that sales prices set in the urban real estate market do reflect accessibility differences and that sales data can be used for estimating accessibility values. The value of job accessibility may have direct application in highway evaluation, but a test of its usefulness requires the calculation of "with" and "without" indexes for a specific improvement. The case for using these findings in evaluating savings in driving time is weaker, a major reason being the critical series of assumptions that must be made to convert the time coefficient to a value for driving time. Until more is known about the demand for trips to the CBD and how the urban land market discounts future benefits, this approach will have limited application.

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Area Development and Highway Transportation

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With the passage of the Area Redevelopment Act of 1961, the Federal government expanded and clarified its commitment to assist economically distressed communities and regions. This paper is concerned with the effects of highways on distressed or redevelopment areas, especially in relation to objectives of the new ARA program. Particular attention is given to the past and anticipated effects of the Interstate Highway System on distressed areas.

The first section of the paper identifies the major types of distressed areas, such as the textile cities of New England, the mining regions of Pennsylvania, West Virginia, and Kentucky, and the marginal farming territories scattered in a broad belt across the Appalachian Highlands and the South. In each case, different effects can be anticipated as a result of the construction (or lack of construction) of improved highways.

The paper then examines some of the most important implications of the location and construction schedule of the Interstate Highway System. Examples drawn from experience in the Appalachian Mountain Region and in several parts of New England are used for illustration.

The final section summarizes findings, makes tentative recommendations for action, and suggests areas for further research in regard to the utilization of highways to assist in programs dealing with economically-distressed areas.

•HIGH-QUALITY highways are one of the most important elements in economic development in modern American communities. Although good highways alone are not sufficient to insure economic improvement in competition with other areas, they are a necessity to any area seeking to insure its attractiveness to new industry, its ability to retain existing industry, and its overall efficiency as a place to live and work.

Highway transportation has become more important to the local and regional economy as construction of the Interstate Highway System and the extension of the ABC system has progressed. At the same time, another significant phenomenon of American life has gained greater recognition: the fact that many parts of the Nation have not shared fully in the general prosperity that has characterized the Nation as a whole in the post-World War II period. Despite periodic recessions that have resulted in temporary declines in the Gross National Product, and despite the fact that in recent years the National economy has suffered from higher rates of unemployment than are consistent with growth-rate objectives, the past decade and a half have been years of significant gains in the American economy. During this same period, a number of areas have experienced unemployment rates well above the National average and have seen their traditional economic bases eroded.

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These areas, which have frequently been referred to as depressed or distressed areas[1], became the subject of special concern by the States and the Congress in the late 1950's. Federal legislation, the Area Redevelopment Act of 1961, provides special assistance in the form of loans, grants, and other aid to help such areas in improving their economies. The Area Redevelopment Act, which reflected an increasing degree of concern for such areas by the States as well as the Federal government, established official criteria for "redevelopment areas" and clearly stated a Federal responsibility for assistance to such areas.

It is not the purpose of this paper to examine the specific nature of the Federal Area Redevelopment program and the potential effectiveness of the wide variety of means that have been marshalled by the Area Redevelopment Administration and other Federal, State, and local agencies to help localities and regions in the transition to a sounder economy. Rather, the aim is to consider the extent to which highway transportation, and particularly the Federally-aided highway system, can be an effective instrument in assisting the kinds of economic development sought in area redevelopment efforts. Toward this end, the bulk of the paper is devoted to an analysis of the major varieties of distressed areas that exist in the United States and the role that highway transportation can play in solving the problems faced by each. For the most part, the analysis is based on previous work done by the authors as consultants to State, regional, and local agencies.

This analysis is intended more as a first than as a last word on the subject. The precise ways in which new highways can assist in area redevelopment will undoubtedly continue to be a subject of interest to persons concerned with the theory and practice of economic development for many years to come. In addition, the Federal and State programs in this field are still in the developmental stage, and the degree of utility of any specific form of aid is still largely a matter of conjecture, rather than of precise measurement.

MAJOR VARIETIES OF DISTRESSED AREAS

The significant differences among distressed areas have a vital bearing on the prospects for a solution to their problems. The role that highway transportation can play in the solution of the economic problems of distressed areas is also related directly to these differences. In the following sections of the paper, three main varieties of distressed areas are discussed: manufacturing centers, mining areas, and agricultural regions. A fourth section also considers briefly another set of distressed areas which are less widespread and are generally less significant in terms of their effect on the National economy.

This three-way division is relatively crude and generalized. Many regions of the Nation, and even areas as small as a single county, depend on manufacturing, extractive industry, and farming. In general, however, one of the three is the dominant element of the economic base.

Distressed Manufacturing Centers

Changes in the structure of the National economy that have not seriously impeded overall growth have had serious impact, in some cases amounting to near disaster, on particular urban centers.

An example of this is the continuing employment declines that the New England textile industry has experienced since the 1920's, declines which have arisen in part from automation and relocation and in part from international competition. An overall National employment decline in the textile industry has been complicated by a shift in location of textile manufacture, from New England to the upper South, and more recently

[1] The description of such areas has been a sensitive subject. Federal legislation has generally used the term "redevelopment areas"; other words used have included "underdeveloped" and "labor surplus." The term most frequently used in this paper is "distressed area," which has a somewhat less unpleasant connotation than "depressed area" and at the same time indicates that the paper is concerned with a more generalized phenomenon than that dealt with in Federal legislation relating to "redevelopment areas."

from the upper South States such as North Carolina to South Carolina and Georgia or Puerto Rico. The combination of employment decline and locational shift has resulted during the past decade and a half in drastic deterioration of the economic base of a number of New England cities, of which Fall River, New Bedford, Lowell, and Lawrence, all located in eastern Massachusetts, are examples.

Manufacturing centers dependent on other industries have also suffered sharp reverses, either as a result of the overall employment declines that often accompany technological advances and improved management techniques or from a shift in the location of industrial plants. New England shoe and leather centers such as Haverhill and Brockton have experienced serious job losses as their dominant industries declined; predominantly single-industry communities such as Gloversville, N. Y., have experienced similar declines. Some of the largest metropolitan areas have suffered from job losses in their dominant industry as a result of a combination of automation and production shifts to other areas. Pittsburgh, where the steel industry has sharply reduced its manpower needs, and Detroit, where the automobile industry has cut back employment, are the two largest metropolitan areas that have been classed as "redevelopment areas" under the Area Redevelopment Act.

Highway transportation has not been an important causal factor in the problems that have beset these manufacturing communities, although in many cases unfavorable transportation costs have played some part in the decline. For example, the desire for proximity to sources of raw material supply and to final markets has been a factor in the decline of the shoe and leather industry in Massachusetts. Intranational locational shifts in the steel and automobile industries have also been related to job declines in Pittsburgh and Detroit. In general, however, highway transportation, as such, has not played a significant part in creating distressed manufacturing areas.

Highway transportation can play a vital role in the economic improvement of some distressed manufacturing centers. This improvement usually requires a combination of a replacement of the former mainstay of the local economic base by other types of manufacturing industry, together with considerable improvement in many of the elements of the economic substructure. In addition, other action is generally needed to renovate neglected facilities and services. Retraining of the local labor force, provision of adequate utilities and structures for industrial development, renewal of blighted areas of the community, and a variety of other programs frequently are necessary before a distressed area can be made attractive to new manufacturing industries. An important element in the economic substructure is a good highway transportation system for the movement of goods and people within the area and between it and other urban centers.

This is, of course, a requirement that is not unique to distressed urban manufacturing areas; it is as valid for Boston and San Francisco as for Pittsburgh and Detroit. In the case of some distressed manufacturing centers, however, improved highway transportation can play a dramatic role in economic improvement. This can be seen clearly in the case of two economically troubled urban centers of the Merrimack River Valley in Massachusetts: Lowell and Lawrence. These former textile cities lie about 25 miles from the center of the City of Boston. The small metropolitan areas centered on the two cities abut the boundaries of the Boston metropolitan area.

In recent years, radial expressway connections have been completed linking Lowell and Lawrence to Mass. 128, the circumferential highway that circles Boston at a distance of about 10 to 15 miles. Now under construction is US I-495, the outer circumferential highway of the Boston area, which will pass directly through Lowell and Lawrence.

This recent improvement in highway connections has had two effects. First, the radius of easy commuting by automobile for workers living in the distressed cities has been significantly increased, enabling them to find jobs in the burgeoning electronics and research operations along Mass. 128 and in other locations inside the circumferential. Secondly, the improved highway system has made industrial sites in the Merrimack Valley more attractive to manufacturers in the electronics and other advanced industries who want to tap the sizable labor pool in the Valley but who also wish to retain close physical proximity to the many assets of the Boston area. The Massachusetts Institute of Technology and a large supply of skilled scientists and engineers are among the more

prominent of these assets. To a considerable extent, new sources of employment have offset the Merrimack Valley's heavy losses of textile jobs. Though the effects of highway transportation in this situation are difficult to isolate and measure with precision, one major indication of the contribution of expressways to economic improvement can be seen in the fact that, during the hearings of the Senate and House committees on area redevelopment legislation in the 1950's, the Lawrence area was frequently cited as being typical of the kind of area the bill was designed to benefit. By the time the bill became law in 1961, however, the economy of the Lawrence area had improved to the point where it was no longer eligible for assistance as a "redevelopment area" (1, 2, 3, 4).

An interesting contrast to the effect of new highways on the Merrimack Valley can be seen in the case of two other distressed Massachusetts cities: Fall River and New Bedford. These also were former textile centers, and have also been linked to the Boston area by radial expressways (Mass. 24 and 140). However, they lie 40 to 50 miles from the central city, roughly twice the distance that separates Lawrence and Lowell from Boston. This greater distance has diminished the spillover of industries and suburban residents and other favorable impacts of the larger metropolitan area. Commuting is possible, but arduous, between the Fall River-New Bedford area and the Boston area. The distance between the growth areas along the western and northern segments of Mass. 128 and the Fall River-New Bedford area is an obstacle that good highways can only lessen, but not overcome. The situation is made more difficult for Fall River and New Bedford by the presence of a large number of potential industrial sites closer to Boston and Mass. 128. Another factor that might have benefited Fall River and New Bedford is their proximity to the larger Providence metropolitan area; however, the Providence area itself suffers from severe employment problems. To date, industrial development and other economic improvement efforts of the Fall River-New Bedford area have been noticeably less successful than those of the Lawrence-Lowell area (5, 6, 7).

To summarize, good highway transportation is at least as important in distressed manufacturing centers as in any other urban area; in addition, there are a number of instances of smaller urban centers so located that their economies can be directly stimulated by an improvement of their connections to a nearby, larger metropolitan area with a stronger, more diversified economy. Improved highway transportation is a potentially vital factor in combating the effects of economic decline in this major type of distressed area.

Distressed Mining Areas

A second major variety of distressed area is the community or region dependent on mining for its economic base. The mining of bituminous and anthracite coal is characteristic of most of these areas, but communities dependent on other types of mining are also included in the distressed area category, such as the iron ore region of northern Michigan and lead mining centers in the Southwest. Areas depending on other types of resource extraction, such as forestry, can also be included in this category.

The problems that have befallen mining and forestry areas arise in some instances from resource depletion, in others from competition with other raw materials (coal vs gas and oil, for example), and, almost always, from the effects of increased mechanization and automation on the demand for labor. Coal employment in West Virginia and Kentucky, for example, has been drastically reduced by mechanization even though the annual volume of coal produced by these States has not declined significantly and in some places has increased.

It has become painfully clear that even sharp gains in the consumption of the raw materials produced by distressed mining areas will not begin to resolve their labor surplus problems. A shift to a different economic base appears essential if a reduction in population through outmigration is to be avoided. In most instances, the new economic base that offers the best prospect of meeting the requirements of such areas is manufacturing, and in the growing National competition for the relatively small number of new manufacturing establishments seeking locations each year, the mining areas are seriously handicapped. Other economic bases, such as forestry or tourism,

cannot provide jobs in the numbers that are needed. Many mining areas, including those in eastern Kentucky and West Virginia, face serious problems in improving accessibility, due to their mountainous topography. In addition, most of these mining communities are small, and lack many of the urban facilities and services that are considered essential to modern manufacturing industry. Scattered successes in attracting plants have only served to highlight the difficulty of resolving the economic problems of most distressed mining areas short of a readjustment in the relationship between job opportunities and labor force (8, 9, 10).

To a limited extent, improved highway transportation can assist in the redevelopment of mining areas, but in the vast number of cases the role that can be played by better highways is limited, as is the potential of almost any other kind of capital investment. The key problem that must be faced by most mining areas is that their economic possibilities are reduced by competition from the many alternative places for investment elsewhere in the Nation, where problems of accessibility and the lack of urban facilities and services are far less evident.

A word of caution is necessary, however. As with manufacturing centers, there are significant differences among mining areas. In some, such as Scranton and Wilkes-Barre (which also have substantial amounts of manufacturing employment) in the anthracite belt of eastern Pennsylvania, the fact that the cities are located within reasonable proximity of the major east coast belt of metropolitan development indicates that improved highway connections can play a considerable role in helping to resolve their economic difficulties. Distressed mining areas that offer a reasonably complete and sound urban community structure and are close to major metropolitan centers have substantially better prospects for economic development than isolated mining hamlets.

Thus, there are selected instances of distressed mining areas where highway transportation can be a major factor in reducing economic distress. In a greater number of cases, however, the large investments involved in pushing expressways through mountainous terrain offer the prospect of small return. Other types of assistance appear to be necessary. It may in fact be necessary to give serious consideration to programs designed to aid the population of such areas in voluntary relocation to places where their job prospects are greater. Difficult as acceptance of this fact may be for the residents of many mountain mine towns, the clear evidence of population migration data for the northern Appalachian mining region is that the harsh reality has already been accepted by many people. What appears needed in such areas is a greatly expanded program of assistance in improving human resources, such as is foreshadowed by the Federal Manpower and Training Act of 1962 (11, 12).

Distressed Agricultural Areas

The third major variety of distressed area is composed of territory dependent on agriculture for its economic base. There are two main causes for the distress that is characteristic of some of the Nation's rural areas. The principal reason is related to the astonishing success of American farmers in increasing productivity through the use of mechanization and advanced techniques of farming. Growing surpluses of produce in almost every sector of the agricultural economy can be created by fewer farmers. A concomitant of this success story is the fact that many farmers, unable by virtue of poverty or lack of training to keep up with the pace of change, have lost their chance for obtaining a reasonable livelihood from agriculture.

A second, and parallel factor, has been the inability of whole regions to remain competitive in the National agricultural economy. The hill country of the southern portion of the Appalachian Region, including portions of Kentucky, West Virginia, Virginia, Tennessee, and South and North Carolina, is characteristic of this category. The land in such areas is useful for forestry and grazing but is not as adaptable to mechanized farming as is the more level, fertile territory of the Midwest. Because a large agricultural population is attempting intensive cropping, this region is characterized by low incomes and severe economic distress (8, 9, 10).

The prognosis for marginal agricultural areas is at least as poor as that for most mining areas. If such areas are to sustain their populations at anything approaching the National per capita income level, they require sweeping changes in their economic

base that appear extremely difficult, if not impossible, to achieve. The alternative is a continuation of rural poverty or even higher rates of outmigration and population decline than have characterized such areas in the recent past.

Only a very small role can be played by improved highway transportation in meeting the enormous needs of distressed agricultural areas. These areas generally have very low densities, small urban centers, and frequently, topographic obstacles to accessibility; as a result, only low benefit-cost ratios can be found for expressways in such territory. Improved access roads built to less than expressway standards may, however, be worthwhile undertakings in some of these areas.

Again, as in the case of the distressed mining areas, there are exceptions to the general rule. Some predominantly agricultural areas near metropolitan centers have good prospects for economic development as centers of manufacturing or tourism. Parts of the Great Valley of the Southern Appalachian Region are in this category. But the number of these areas is small, and the remaining marginal agricultural areas appear to need other kinds of assistance which is directed more at aiding the displaced farm population than at creating a new economic base.

Other Varieties of Distressed Areas

In addition to the three main types of distressed area already discussed, there are a number of less widespread varieties. One of these consists of communities formerly dependent on the railroad industry whose economies have declined as that industry has cut its employment requirements or shifted operations. Another group is made up of communities that relied heavily on a military or other government installation which was subsequently closed or experienced cutbacks in employment. Indian reservations constitute a special class of distressed area identified in the Area Redevelopment Act. There are a number of resort and recreation centers which provide employment for local residents for only a few months of the year.

Each of these minor varieties of distressed areas has its own peculiar problems, but all have in common an urgent need for adjustment to a new economic base, which may or may not be associated with an alternate form of growth.

The importance of highway transportation, either as a causative factor, or a potentially ameliorative factor also varies. It is unlikely, in the case of the railroad community or the resort center, to be a sufficient stimulus to development to replace the former economic base, but good highways may play a part in aiding a transition to a new situation. Nor do better highways offer any necessary aid in either replacing a closed government installation or relieving the dire poverty characteristic of most Indian reservations. These are problems whose solution requires a wide range of techniques, which may or may not include highway improvements.

ROLE OF HIGHWAY TRANSPORTATION

The problem discussed in this paper—the need to find solutions to the problems arising from economic decline in distressed areas—is not new to the United States. Although the principal pattern of this country has been one of growth and new development, history offers numerous instances of communities that have been faced with the need to find a new economic base to replace one outmoded by economic change, transportation developments, resource depletion, or population shifts.

Some successful transitions have been made in the past. For example, the city of New Bedford, which grew as a center of the whaling industry, made a highly successful transition to reliance on the textile industry. With the decline in local textile manufacturing it is now faced by the need to make another major transition. Cumberland, Md., has passed through periods of reliance on coal mining, the railroad industry, and textile production, and is presently once again seeking a new economic base.

In other cases, no transition has been possible. Ghost towns of the West, which boomed in gold-rush days, stand today as mute witnesses to testify that economic transition is not always possible. Overgrown town sites in New England, not yet reached by the spread of the suburbia which may yet redeem their early promise, offer the same sort of testimony.

With the apparent acceleration of the rate of change in the structure of the National economy which has been characteristic of the postwar period, the need has arisen for more serious consideration of the distressed area problem than was the case earlier in the Nation's history. The scope of the problem, and the range of possible solutions that must be tested, is far broader than can be considered within the framework of transportation analysis. It requires no less than an examination of National and private goals and aims. This need was seen by the President's Commission on National Goals (13, p. 11) whose statement on "Technological Change" included the following comment:

> Public and private leadership are required where whole areas are economically distressed. Measures to encourage industries to move to such communities and relocation programs for individuals are justified. Consideration should be given, where necessary, to state and federal government participation in loans and grants to aid community efforts and to underwrite support for programs of retraining.

The true significance of the Area Redevelopment Act of 1961 and of successor measures, including the Manpower Development and Training Act and the Public Works Acceleration Act of 1962, lies in the recognition they give that area redevelopment is a National as well as a community responsibility and one to which the United States must address itself.

In this broad drama, of which only the first act has as yet been seen, highway transportation is certain to play an important and controversial part. There have been, and will be, many calls to provide high-quality highways for areas where the prospects of economic development and redevelopment are small indeed. Some of these requests, accompanied by political pressures and evidence of urgent need, will be difficult to resist.

What is called for, as suggested in the foregoing analysis, is a realistic appraisal of the validity of providing new and improved highways as an economic stimulus. Where there is serious evidence that the request for better highway transportation is based on a real prospect of economic improvement, it may be necessary to relax somewhat the strictures of benefit-cost analysis so that intangible benefits as well as the more obvious costs are weighed. But if the value of highways as an element in economic improvement programs is to be realistically assessed, it should be measured against the need for other types of programs, including programs that take into account the fact that the fundamental concern must be for people, rather than for geographic areas or property values. Within a comprehensive, human resource-oriented framework it may be possible to avoid serious errors of priority allocation or expenditure. A major step in this direction can be made through use of the kind of analysis called for in the Overall Economic Development Program required by the Federal Area Redevelopment Act. Another means for making this kind of analysis is through the use of comprehensive planning for land use and transportation. Studies of this type can be conducted under the Urban Planning Assistance Program of the Housing and Home Finance Agency and the planning programs of the Bureau of Public Roads. The cooperative approach of these agencies is a major advance in placing transportation analysis and planning within a broader context.

Although these, and many other types of research effort that can be undertaken with public or private funds, offer no guarantee of a solution to the varied problems of the distressed areas, they can and should provide a framework within which honest and realistic decisions can be made about the role of highway transportation, in conjunction with other programs, in developing solutions to the problems of each of the distressed areas.

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Parkways, Values and Development in the Washington Metropolitan Region

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Parkways in the Washington Metropolitan Region, because of their dual function as commuter roads and as tourist routes, and because of an aesthetic emphasis in their layout and design, are associated with somewhat different land value patterns than non-parkway roads are. This paper presents the land value patterns for selected roadways—parkways and non-parkways—in the Washington area for 1950 and 1961. An analysis of the changes in these patterns through time are presented. The purpose is to identify those patterns and changes that seem peculiar to parkways in this region.

In conclusion, the paper presents a factorial analysis of land value variations to demonstrate the significance of location with respect to a roadway in explaining observed variations.

•THE SIGNIFICANCE of the roadway network to the development of urban regions is appreciated by most students of the urban scene. To say that it is appreciated, however, is not to say that it is completely understood. Questions have been raised concerning specific roadways in particular places. The work (1) on which this paper is based was undertaken within such a frame of reference. In this case the specific roadways are the National Capital Parkways; the particular place is the Washington Metropolitan Region, frequently referred to as the National Capital Region.

The National Capital Region, for the purposes of this paper is the standard metropolitan statistical area (SMSA) of Washington, D.C. It includes the city of Washington, coterminous with the District of Columbia and constituting the central city; Montgomery and Prince Georges Counties, Md.; and Arlington County, Fairfax County, and the City of Alexandria, Va. Numerous smaller entities are also part of the SMSA. This list, however, indicates the major components.

The 1960 census reported a population in excess of 2,000,000 for this region. This is a considerable increase from the 1,461,000 reported in 1950. More than 1,200,000 people live in suburban areas where 660,000 persons were found in 1950. The population of the central city has declined in this time period. The suburban shift of population is similar to other large cities of North America and underscores the pressures placed on regional transportation systems.

Along with the suburban shift in population, Washington has experienced a suburban shift of some employment centers. The Pentagon, the Bureau of the Census, the Atomic Energy Commission, and the Central Intelligence Agency are some of the better known examples of this trend. Decentralization of population and employment centers has created multiple focuses for urban growth. Distinct identities of components of the area are reinforced by the physical and political structure of the region.

The National Capital Region is compartmentalized by nature and by an unnatural political structure. Physiographically, the site of Washington is described as a fall line location—the place where the Potomac River emerges from the steeply rolling piedmont by a series of falls and rapids into the more gently rolling coastal plain. It is not generally appreciated that the major portion of the City of Washington occupies

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a peninsula between two rivers—the Potomac and the Anacostia. Suburban Virginia is separated from the central city by the Potomac River and gorge. Portions of suburban Maryland are separated from the central city by the Anacostia River. A large portion of west Washington is separated from the rest of the city by Rock Creek Valley. These are some examples of the manner in which the site of Washington is compartmentalized by physical features. The river valleys provide aesthetic possibilities for parkways, however, and such roadways are associated with many of the rivers.

The political structure of the region is unnatural in the sense that no overall authority exists in the region. Not only are the U.S. Congress, two State governments, and four county governments directly involved, but, as well, numerous city and town authorities have their areas of local responsibility. Several quasi-public bodies, such as the Suburban Sanitary Commission, contribute to further compartmentalization of the region.

The roadway network of the National Capital Region displays some of the same natural and unnatural compartmentalization characteristics typical of the region as a whole. River obstacles limit the number of entrance and exit points to the central city; routes must cross these barriers on bridges and viaducts. Federal, State and local highway authorities, though cooperating extensively, face the problems inherent in their being so many.

One segment of the regional roadway authority is represented by the National Capital Region of the National Park Service which administers the National Capital Parkways. By official, albeit paraphrased, definition, "a parkway is an elongated park area which contains as its principal feature a limited access roadway connecting elements of national, scenic, historic and scientific significance. The design criteria for a parkway roadway are based primarily on recreational, interpretative, and preservative factors associated with the area, rather than on traffic demands." It is the phrase, "rather than on traffic demands," which has stimulated considerable controversy in the region, a controversy beyond the scope of this paper and related to the part parkways should play in the regional roadway system.

Growth in the region, since World War II, has engulfed considerable portions of the parkway system. Roads designed with the presentation of features of national signficance (such as Mount Vernon) in mind are burdened with the more prosaic task of channeling a very heavy commuter traffic to and from the central city. This is a use and a role for parkways which their designers were not always able to envisage. As well, the parkways are used for their "official" purpose by many thousands of visitors every year. Estimates place the average daily influx of tourists to Mount Vernon in excess of 20,000. The apparent conflict between parkway use and parkway purpose raises the question whether the dual role played by the National Capital Parkways affects values and developments so that it is possible to distinguish parkways from other kinds of roadway in the region.

Within the National Capital Region, as in most urban regions, a variety of roadway types may be found. These range from the neighborhood access street to the controlled-access superhighway. Each type plays a part in the regional transportation system; each is supposed to have an effect, direct or indirect, on regional growth and change. This effect may be related to the design of the roadway and to the role the roadway plays in the regional system. This paper is addressed to only two of the many possible questions that might be raised about parkway effects:

1. How do parkways affect value patterns for adjacent residential properties?
2. What development characteristics differentiate parkways from other kinds of roadways?

To these ends, three roadways are considered:

1. The George Washington Memorial Parkway (Mount Vernon section). This parkway follows the course of the Potomac River southwards from the City of Alexandria. Throughout most of its length, it is developed on the west side only, the river lying close to the east.
2. The Baltimore-Washington Parkway. This parkway connects the cities of Baltimore and Washington. The area studied extends from the central city outwards about 5 miles. Developments occur on both sides of the right-of-way.

3. Shirley Memorial Highway. This controlled-access highway serves as a bypass of the City of Alexandria. Study of this area focuses on interchanges. The function of the non-parkway is to provide some basis of comparison for evaluating the observations of parkway study areas.

A brief comment on the extent of the study areas is desirable before considering the findings. The selection of study areas was limited somewhat by a need to consider roadways in a number of different contexts. Thus, roadways in Maryland, Virginia, and the District of Columbia were selected for the original study. Because of differing dates of construction, ranging from the 1920's to the 1950's, a before-and-after type of comparison was not made. It was felt that conditions in the region were so different for different points in time that a more useful approach would be to consider variables such as value through the decade 1950-61. The study areas were limited to nine properties or 2,100 ft outwards from the right-of-way, whichever occurred first. Interchange areas are those within ½ mi of an interchange. Data were collected and organized about parcel units. Not all parcels within the study areas were considered. Use was made of random sampling procedures in the selection of those parcels for which data were collected. All data were recorded on standard 80-column IBM cards and these cards were the basis of subsequent analytical procedures.

The measure of value used was the assessed value of land and improvements, adjusted to eliminate discrepancies resulting from different assessment practices in different assessment jurisdictions. The method of adjustment was straightforward: the sum of the assessed values for land and improvements, if any, was obtained, and this sum multiplied by the reciprocal of the appropriate assessment ratio. In all cases the adjusted values were expressed in dollars per square foot.

PARKWAY EFFECTS ON VALUES, 1950-61

Inasmuch as the predominant land use type associated with parkways, almost to the exclusion of any others, is single family residential or vacant but intended for this kind of development, subsequent references to value, though including all forms of residential use and vacant land, exclude from consideration any other uses.

The plotting of the value patterns for 1950 and 1961, and of the changes in value in that time interval, is suggestive of the nature of the influence of a roadway on value. In this connection the work of Carroll et al. (2) is of interest.

The first example is the north portion of the study area delimited about the George Washington Memorial Parkway. The distance to the 14th Street bridges and the District of Columbia is somewhat more than 10 miles to the north (Fig. 1).

The orientation of isolines of change is, for the most part, at right angles to the right-of-way. This is suggestive of an influence emanating from the central city and operating outwards along the right-of-way with diminishing effect. The absence of parallelism in the lines of change suggests that no influence operates outwards from the right-of-way. The spacing of the isolines is regular, suggesting regularity in both amount and direction of change.

The southward dip of the (plus) 500 line along the parkway is interesting. This is a southerly extension of a fairly completely developed area to the north. For a distance of about one mile, single family homes flank the right-of-way to a depth of about three properties. Land immediately west of this remains undeveloped. Access to this prong does not appear to be convenient, access points being shown in Figure 1.

The second example is a portion of the study area delimited about the Baltimore-Washington Parkway. The central city is about 3 mi south of this section (Fig. 2). The pattern of value change in this case is quite different from that of the previous example.

Figure 2 shows the second basic pattern of change observed for parkways in the region. The isolines of change parallel the right-of-way and cross it infrequently. This is suggestive of an influence operating latitudinally from the parkway. Greatest positive changes in value are observed at points further removed from the right-of-way. The orientation of these lines does not suggest an influence emanating from the central city and operating with diminishing effect outwards along the right-of-way.

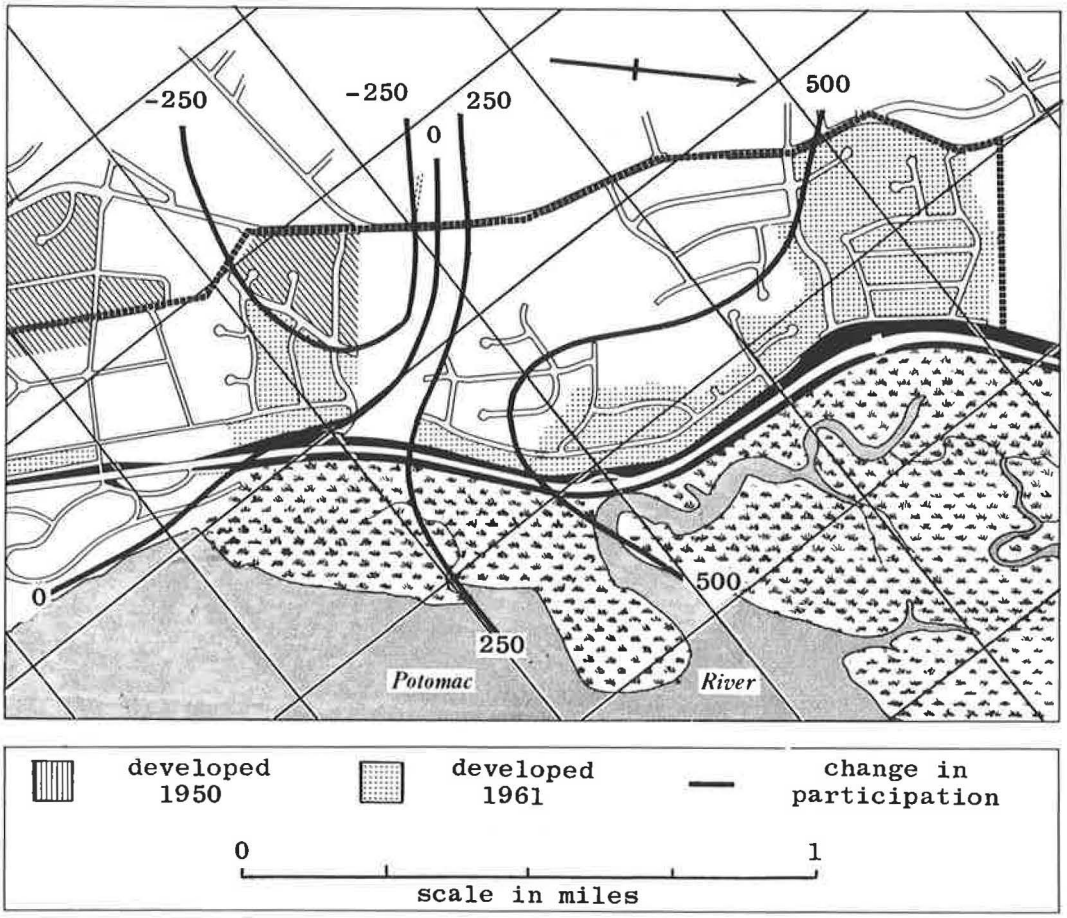

Figure 1. Development and participation changes, George Washington Memorial Parkway, north portion.

A complete explanation of value changes in the vicinity of these major roadways must consider a larger, regional, frame of reference. Regional demands for housing have a major bearing on value determination and change. In the case of these roadways the nature of development in 1950 can be demonstrated to have had an effect on value changes. The tracing of many possible value influencers was beyond the scope of the problem treated here, where the focus is narrow, concentrating on value parcel and roadway. The previous portrayal is preliminary evidence of variations in value about a roadway. As such, it is suggestive but not conclusive.

One might observe that, in general, the result of value changes has been the creation of a more homogeneous pattern in 1961 than existed in 1950. Two basic patterns of change, perpendicular and horizontal, suggest two possible influences on value. The questions may now be raised as to what variations in value may be attributed to the location of a parcel with respect to the roadway and the central city and how value varies as distance from the right-of-way and central city varies.

For the George Washington Memorial Parkway and the Baltimore-Washington Parkway, answers to these questions have been sought through the use of a mathematical model construct. Attribution of variations in value to measures of location is made on the basis of statistical significance at the 5 percent level. The model used is a factorial model that tests the extent to which variations in value may be attributed to distance from the central city in miles, distance from the right-of-way in feet, and distance from

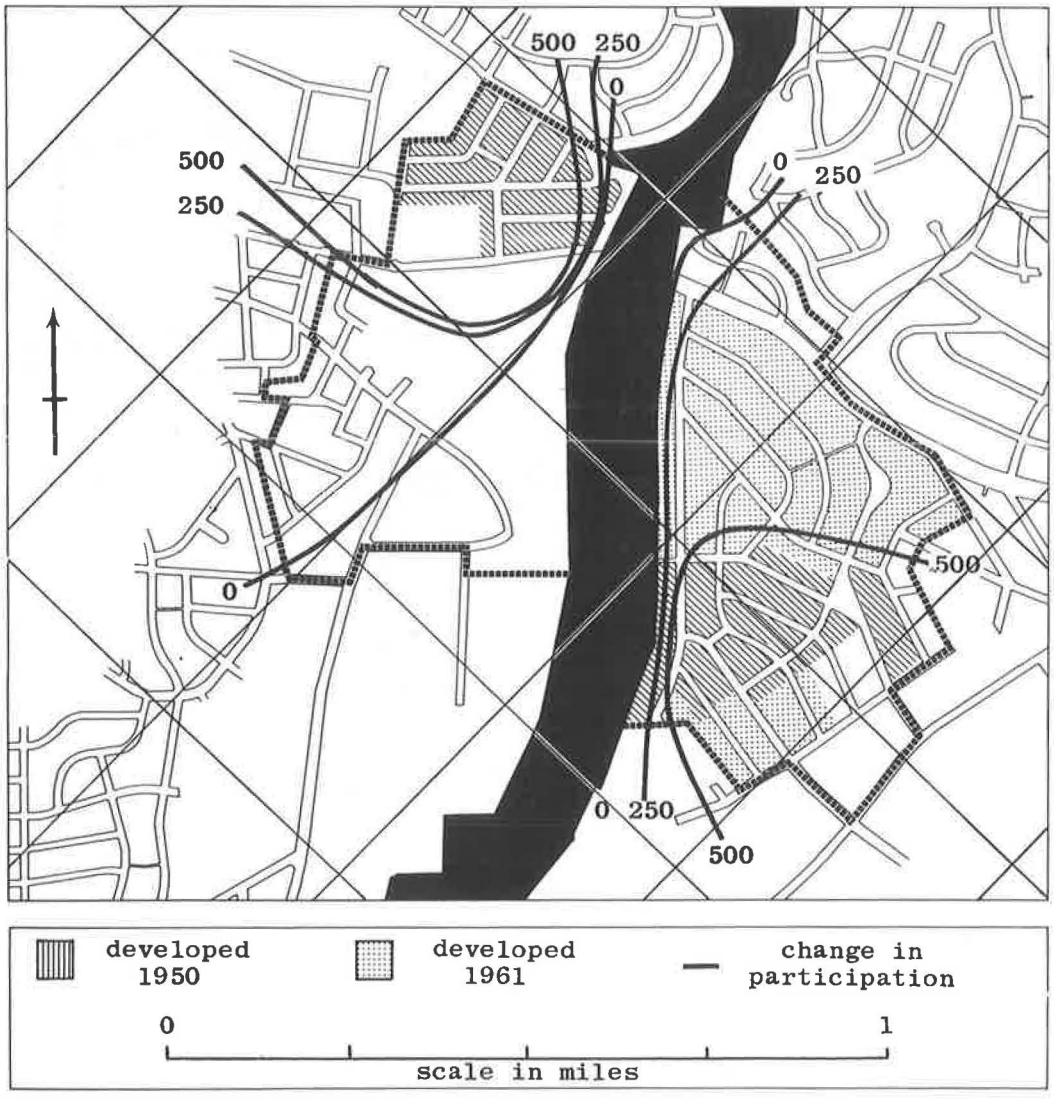

Figure 2. Development and participation changes, Baltimore-Washington Parkway, urban area.

the right-of-way in properties. Value, again, is the adjusted value of land plus improvements for 1961.

The simplified form of the model is

$$Y_{ijk} = m + D_i + N_j + (DN)_{ij} + d_{jk} + (Dd)_{ijk} + e \qquad (1)$$

in which

Y = adjusted value of land and improvements (parcel);
D = distance from central city;
N = number of properties distant from right-of-way;
d = number of feet distant from right-of-way;
m = mean effect; and
e = error term.

This is a model for a factorial experiment. A significance among the D_i implies that values differ for varying distances from the central city. Significance among the N_j implies that values differ as the number of properties from the right-of-way changes. A significance among the d_{jk} implies that values differ for varying distances in feet from the right-of-way. The combined terms of the model, $(DN)_{ij}$ and $(Dd)_{ijk}$, indicate interactions. It is recognized that some part of the variation in value is attributable to a combination effect of the variables. A significance among the interaction terms will indicate this.

The application of this model to data from the two parkways provided the results in Tables 1 and 2. Briefly, distance from the central city is a significant source of variation in value for both parkways. Recalling the patterns of change (Figs. 1 and 2), one might have expected this result for the George Washington Memorial Parkway, but there was no clear indication of it in the case of the Baltimore-Washington Parkway.

The number of properties from the right-of-way is a significant source of variation in value in the case of the Baltimore-Washington Parkway, as the maps of change suggest. Here one may conclude that values do differ as the number of properties from

TABLE 1

SIGNIFICANCE OF VARIABLES ON VARIATIONS IN VALUE, GEORGE WASHINGTON MEMORIAL PARKWAY

Source[1] Due to	Degrees of Freedom	Sum of Squares	Mean Sum of Squares	Significant at 0.05
D_i	3	15.50	5.17	Yes
N_j	3	0.18	0.06	No
$(DN)_{ij}$	9	8.47	0.94	Yes
d in N_1	1	0.03	0.03	No
d in N_2	2	0.10	0.05	No
d in N_3	1	0.05	0.05	No
d in N_4	1	0.09	0.09	No
$(Dd)_{ijk}$	15	2.11	0.14	No
Error	196	97.60	0.28	

[1] In which i = 1, 2, 3, 4; j = 1, 2, 3, 4; k= 1, 2, 3, 4, 5, 6; D_1 = 1.9 to 2.4 mi from central city (straight line); D_2 = 2.5 to 3.0 mi from central city; D_3 = 3.1 to 3.8 mi from central city; D_4 = 3.9 to 5.0 mi from central city; N_1 = 1 property from right-of-way; N_2 = 2 and 3 properties from right-of-way; N_3 = 4 and 5 properties from right-of-way; and N_4 = 6, 7, 8 and 9 properties from right-of-way.

TABLE 2

SIGNIFICANCE OF VARIABLES ON VARIATIONS IN VALUES, BALTIMORE-WASHINGTON PARKWAY

Source[1] Due to	Degrees of Freedom	Sum of Squares	Mean Sum of Squares	Significant at 0.05
D_i	2	0.24	0.12	Yes
N_j	3	0.58	0.19	Yes
$(DN)_{ij}$	6	0.23	0.04	No
d in N_1	3	0.05	0.02	No
d in N_2	1	0.05	0.05	No
d in N_3	2	1.10	0.55	Yes
d in N_4	1	0.02	0.02	No
Error	493	0.27	0.035	

[1] In which i = 1, 2, 3; j = 1, 2, 3, 4; k = 1, 2, 3, 4, 5, 6; D_1 = 1.6 to 2.9 mi from central city (straight line); D_2 = 3.0 to 3.9 mi from central city; D_3 = 4.0 to 5.7 mi from central city; N_1 = 1, 2, and 3 properties from right-of-way; N_2 = 4 and 5 properties from right-of-way; N_3 = 6, 7, and 8 properties from right-of-way; and N_4 = 9 properties from right-of-way.

the right-of-way varies. Although the number of properties is not of itself a source of variation in value along the George Washington Memorial Parkway, there is a significant interaction effect of this variable, with distance from the central city.

Distance in feet from the right-of-way was not indicated in either case as a significant source of variation in value. (There is one exception to this generalization in the 6th, 7th, and 8th property tiers of the Baltimore Parkway.)

An advantage of the application of the factorial model to spatially distributed data is that one may plot graphically the variations in value against the significant factors. The patterns so plotted for the George Washington Memorial Parkway are shown in Figure 3.

Considering first the variations in value outwards from the central city (D-factor) at different property tiers from the right-of-way, one may observe that a regular decrease in value outwards from the central city exists. As distance from the central city increases, value decreases in a regular manner in properties adjacent to the right-of-way. The actual value decrease was from a high slightly under $2.50 per sq ft to

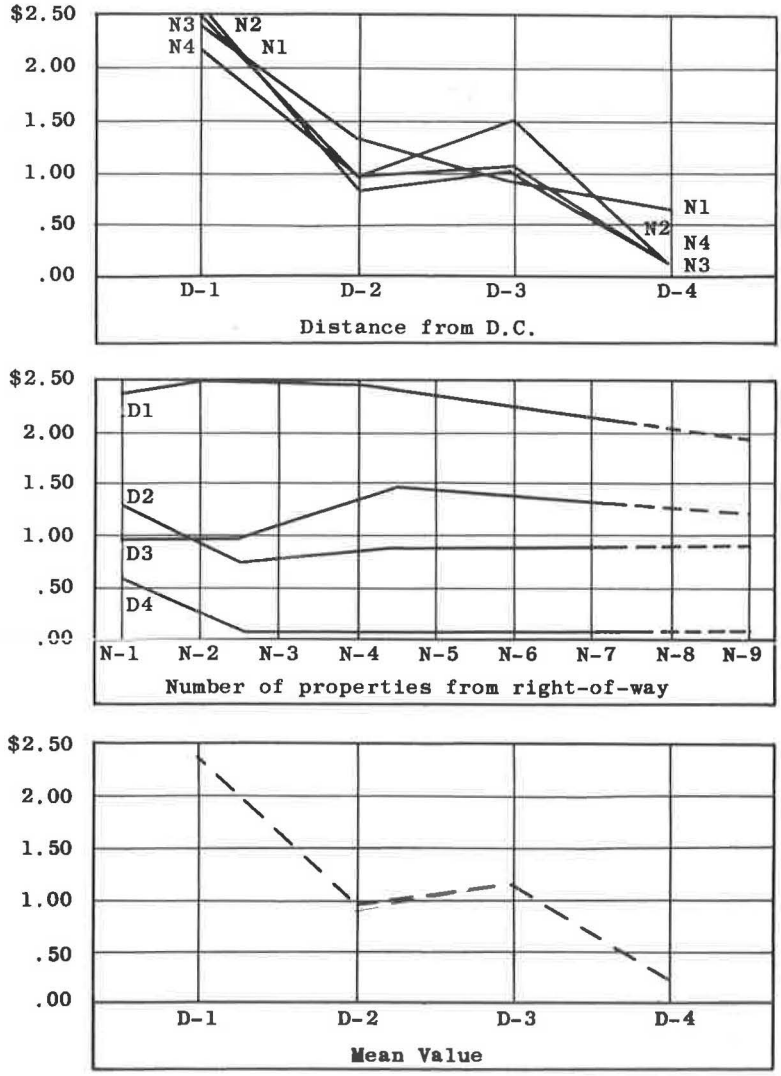

Figure 3. Variations in value, George Washington Memorial Parkway.

a low of about $0.60 per sq ft. The high is not so high nor the low so low as in properties farther removed from the right-of-way.

The behavior of values in the first property tier is markedly different from that of values in more remote tiers. For these the pattern of variation is essentially the same no matter how far away they may be. A steep decrease is followed by a leveling or slight rise, followed by a further decrease to a common low value. If the pattern of the first property tier is attributed to proximity to the parkway, as seems reasonable, this effect is highly localized and not evident in other property tiers.

Turning next to variations in value outwards from the right-of-way, one observes that at any given distance from the central city little variation outwards occurs. The combination effect of this variable (N) with distance from the central city (D) is indicated by the crossing of the lines. Slight appreciations in value, as well as even slighter depreciation in one case, are not significant variations in the statistical sense.

Considering next the behavior of values in the Baltimore-Washington Parkway study area, some differences and some similarities may be observed. The patterns for this area are shown in Figure 4.

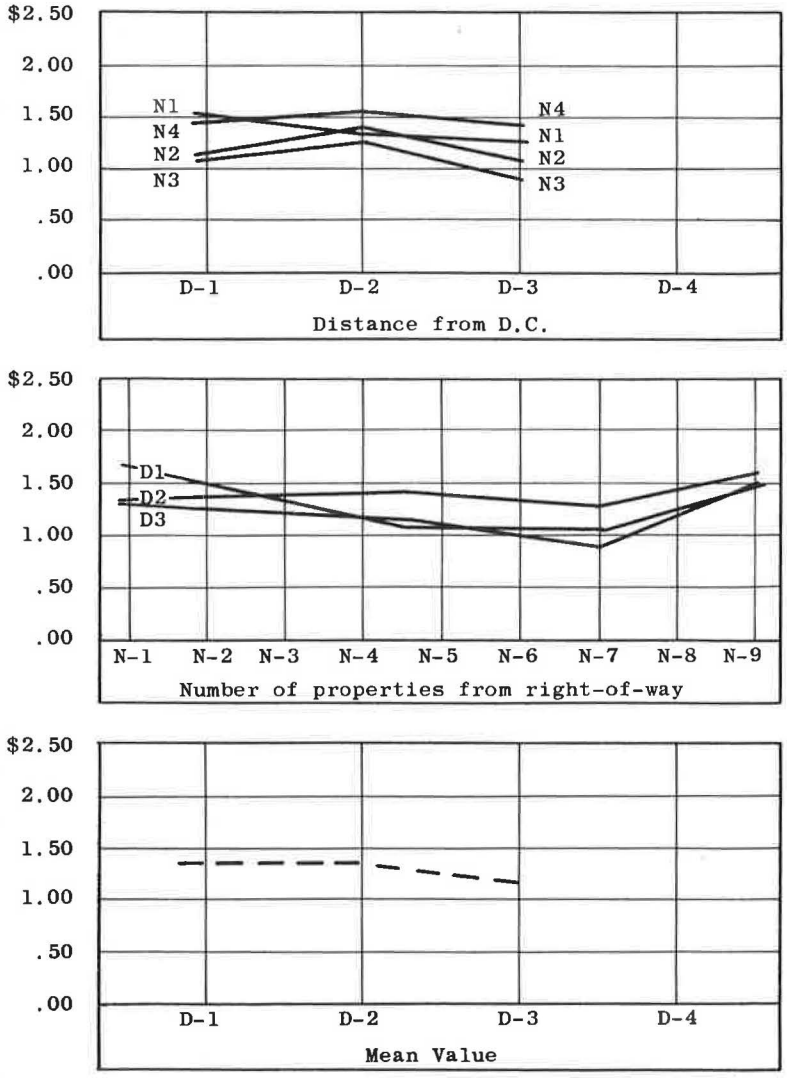

Figure 4. Variations in value, Baltimore-Washington Parkway.

As for variations in value as distance from the central city increases, properties adjacent to the right-of-way behave differently from those farther away. In those properties adjacent to the right-of-way, values decrease regularly as distance from the central city increases. In this instance, the highest values are adjacent to the right-of-way and closest to the central city. In other property tiers, values increase slightly, then fall slightly. The experience for all is similar, although the level may differ. Again, if the pattern of variation in the first property tier is ascribed to the parkway, it is a highly localized influence.

As for variations in value as the number of properties from the right-of-way is increased, one may observe an appreciation of value adjacent to the right-of-way in two out of three cases. The different case (D_2) might plead extenuating circumstances. This slight depreciation has been identified with a large tract of land that was vacant at the time the data for this experiment were collected. This tract is now being built up with apartment units and the effect of this will be to make an appreciation adjacent to the right-of-way for D_2 as well.

For all the profiles, values decrease to minimal points in the 7th, 8th, and 9th property tiers. At this point, it is suggested that properties are falling into the zone of influence of another roadway, and there may be some justification for terminating the influence area of the Baltimore-Washington Parkway in the 7th property tier.

Distance in feet from the right-of-way did not prove a significant source of variation in value except in the 7th, 8th, 9th property tiers. Because this is believed to be a zone where another roadway influence is being felt, this source of variation is not considered sufficient evidence to conclude that distance in feet from the right-of-way has an effect on value.

To summarize the findings in the case of these two parkways, the following generalizations seem possible:

1. The behavior of values in properties adjacent to the parkway is markedly different from that in other property tiers, changing more regularly and displaying narrower ranges between high and low.
2. Generally, values decrease outwards from the parkway, but the changes are not always significant.
3. Distance in feet from the parkway did not prove a significant source of variation very often, which suggests that the number of properties from the right-of-way is a more useful measure than straightline distance.

Comparison of these parkway effects with a highway of similar design and carrying capacity (Shirley Highway) has only been made with respect to the effect of increasing distance from the central city. Developments along Shirley Highway favor large tracts of land and apartments and precluded comparable treatment of the distance in property and distance in feet factors. Insofar as distance from the central city is concerned the observed pattern of change was different from that for the two parkways.

In the case of Shirley Highway, values close to the central city may be likened to a plateau, dropping precipitously to a plain of low values. The change is abrupt and is related to the abrupt termination of development on the north side of the Route 7 interchange. Thus, though values may be said to decrease outwards from the central city, they do so in one brief interval of space, quite unlike the pattern observed along the parkways.

Having viewed in some detail the value variations about two parkways, overall changes in the region as they relate to these merit some consideration. The different degrees to which parkways and a non-parkway share or participate in total area development constitute a major differentiating feature.

PARTICIPATION IN REGIONAL DEVELOPMENT

Average values per square foot for the Washington region, its major components, and three roadway study areas are given in Table 3. For the entire area, average adjusted value has increased from $0.11 to $0.25 per sq ft between 1950 and 1961. In this time period, both the lowest average values (representative of undeveloped land) and the highest have advanced. The lowest value per square foot in 1950 was $0.01; in 1961, it was $0.10. The highest values (average) per square foot were $1.96 in

TABLE 3

AVERAGE ADJUSTED VALUES PER SQUARE FOOT IN WASHINGTON METROPOLITAN REGION[1]

Political Unit	Average Value ($)	
	1950	1961
Washington SMSA	0.11	0.25
City of Alexandria	0.89	1.20
Arlington County	0.44	1.39
District of Columbia	1.96	2.43
Fairfax County	0.01	0.14
Montgomery County	0.04	0.15
Prince Georges County	0.02	0.10

[1] Source: Assessment figures for all political jurisdictions and assessment ratios obtained by direct contact with respective assessment jurisdictions.

1950 and $2.43 in 1961, both cases in the District of Columbia. It is against this overall pattern of change that study areas associated with the different roadways are viewed.

To facilitate comparisons among the different roadways and to relate these to changes in the region as a whole, values have been expressed in terms of indexes of participation (3). The index is a simple ratio which measures the extent to which a given value exceeds or fails to exceed the regional average. It is the regional average value per square foot divided into the average value per square foot observed in a study area. A value of 1.00 indicates a value equal to the regional average—an average participation in regional development. A value of 2.00 indicates participation twice the average; a value of 3.00 indicates three times the average participation; 0.50 indicates participation one-half the average. These index values for various areas and their absolute and percentage change from 1950 to 1961 are given in Table 4.

TABLE 4

PARTICIPATION OF SELECTED PORTIONS OF WASHINGTON METROPOLITAN REGION IN REGIONAL DEVELOPMENT, 1950 AND 1961

Unit	Index		Absolute Change	Percent Change
	1950	1961		
Average index	1.00	1.00	-	-
City of Alexandria, Va.	8.10	4.80	-3.30	- 40
Arlington County, Va.	4.00	5.56	+1.56	+ 39
District of Columbia	17.82	9.72	-7.10	- 40
Fairfax County, Va.	0.09	0.56	+0.47	+522
Montgomery County, Md.	0.36	0.60	+0.24	+ 66
Prince Georges County, Md.	0.18	0.40	+0.22	+122
George Washington Mem. Pkwy.	1.67	3.27	+1.60	+ 95
Baltimore-Washington Pkwy.	3.60	5.50	+1.90	+ 53
Shirley Memorial Highway	3.73	2.97	-0.76	- 20

Some preliminary conclusions from the overall relationships between the roadway study areas and the portion of the region in which they are situated are possible:

1. The participation of each of the roadway study areas exceeds the regional average. The roadways have attracted larger than average shares of regional development.
2. The relative share of regional development, as measured by value of land and improvements, has increased in the case of two parkways, but it has decreased in the case of the non-parkway.
3. All three roadways are associated with study areas whose participation in regional development exceeds that of the portion of the region through which they pass. Thus, for example, the Baltimore-Washington Parkway study area had an index of 5.50 in 1961, as compared to an index of 0.40 for Prince Georges County through which it passes.

Considering the absolute change in the index of participation, one may observe that the two parkways have increased their relative shares, whereas the non-parkway has experienced a decrease in its share of total development. The non-parkway has a smaller slice of a larger pie. As the measure of value embraces improvements as well as land, one must conclude that development has proceeded more rapidly along the parkways than along the non-parkway. Parkway developments are associated with single family residential units; non-parkway, in this case, with apartment units. It seems reasonable to suppose that the relative market demands for these two kinds of housing have operated in the 1950-61 period to favor the development of parkway areas.

The final column in Table 4 expresses the absolute changes in the index of participation as percentages of the participation in 1950. Plus and minus signs indicate the direction of change. The rate of change in the index, as well as its direction, adds a further dimension to the comparisons. Thus, though the absolute change for the District of Columbia is quite different from that of the City of Alexandria, in terms of percentage change they are the same. The rate of change along Shirley Highway is less than that along the parkways, but in the opposite direction. A greater rate of change characterizes Fairfax County than the George Washington Parkway study area. This is a reflection of the degree of development in the two areas. The parkway study area is more completely developed than the county through which it passes. This raises the question of what the level of participation might be for these two areas when both are completely developed. Comparisons have been made with non-parkway portions of the region. These suggest that, assuming relatively complete development, the level of participation about parkways will be significantly higher than that of the region through which they pass.

By way of conclusion to this paper, some tentative statements may be made. In such a study as this, of necessity partial and restricted in scope, numerous questions arise that could not be answered satisfactorily. These, too, merit mention, however brief.

CONCLUSIONS

It is believed that the study just reported substantiates the hypothesis that parkways have effects on values and development that differentiate them from other kinds of roadways. It was not possible to specify what it was about a parkway that contributes to this differentiation. The question of what specific attributes of a certain kind of roadway create these effects remains unanswered in this case.

It would seem implicit in a hypothesis that different roadways have different effects that the areas about the different roadways would be demonstrably different. Ought not different effects produce different areas? In the present case an attempt was made to characterize the study areas in terms other than use and value. Such measures as lot size, family size, income, and condition of structure were tested by standard analysis of variation procedures and, where appropriate, an attempt was made to develop discrimination models. That the attempt failed suggests that the variables selected may be inappropriate—nondiscriminating, or that the areas used were too gross. The possibilities of this approach seem promising but only a glimpse of the prospect was gained in the study of parkway effects in the Washington Region.

With respect to the methodology used to identify and describe roadway effects, the

experience of others with variations of the participation ratio is confirmed here in the light this measure sheds on the problem. The factorial model functioned satisfactorily for the purposes of the present study. Through it, significant sources of variation have been identified. That not all were considered is indicated by the size of the error terms obtained. Other significant sources of variation exist, although the experience here suggests that distance in feet from the right-of-way is not significant. The identification of these other sources of variation might be attempted through further applications of this technique. It has proved its value for this purpose in studies in other fields. Hopefully, a useful predictive model might be derived more easily when significant variables are identified and their behavior known.

ACKNOWLEDGMENTS

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Highway Development: Community Attitudes and Organization

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This paper has three major divisions: (a) social characteristics; (b) attitudes; and (c) community complexity.

"Social characteristics" presents an overview of population changes in the three study areas with which the Pennsylvania State University impact project has dealt. Relative to dates of highway improvement, characteristics of migrants to the areas can be compared with those of persons of longer residence. Also included are materials that relate social characteristics, occupation, income, amount of education, etc., to residents' use of the improved highway facility.

"Attitudes" deals with a variety of questions related to highways in the study areas. These include community leaders' and other citizens' degree of acceptance of the facility at the time of construction and after construction, conception of the purpose of the highway, responsibility for construction and maintenance costs, and benefits and disbenefits incurred. The expressions of attitudes could be related to selected social characteristics and degree of use.

"Community complexity" relates highway development to changes in the number of local government functions. The governmental changes considered are those that occurred during the 1950's in one or more of the 39 communities considered in the Monroeville study. They include such functions as planning, zoning, subdivision control, and annexation. These developments are of interest to protection of right-of-way and traffic flow and are examined in that light.

•THIS PAPER is but one from a number of completed and projected papers based on data gathered and analyzed by members of the highway impact research staff of Pennsylvania State University. The research, initiated by a land economist, has been continued by him along with a transportation economist and a sociologist. The major objectives of the research, as set forth in the original proposal in 1958, include the following:

1. The measurement of economic and social changes in selected areas of the Commonwealth where highways are being constructed or improved, including changes in (a) value of real property and capital worth of business establishments, (b) land use and tenure, (c) volume of production and retail sales, (d) farm enterprise organization and farm income, (e) commercial employment and wages of hired labor, (f) real estate taxes, (g) population, (h) levels of living and community values, and (i) community organization.
2. The determination of which changes are attributable, wholly or in part, to highway improvement.
3. The correlation of changes with distance from the highway, traffic volume, and other selected measures of road service.

Paper sponsored by Committee on Indirect Effects of Highway Improvements.

4. The determination of principles and standards for objective economic evaluation of new highway improvement projects.

To date, research has been carried out at three sites in Pennsylvania—Monroeville, Blairsville, and four interchanges in the vicinity of York. Each of these sites has contributed to the variety found in the overall research task (Figs. 1, 2, and 3).

This report deals almost exclusively with selected aspects of population, community attitudes toward highway development, and changes in community organization (objectives 1g, 1h, and 1i).

Highway Developments

During the 1950's, Monroeville experienced three major highway changes: (a) completion of the Pittsburgh Interchange of the Pennsylvania Turnpike, 1951; (b) the Penn-Lincoln Parkway East opened to through traffic, 1959, providing a 4-lane, limited-access thoroughfare into Pittsburgh although not located within the borough limits; and

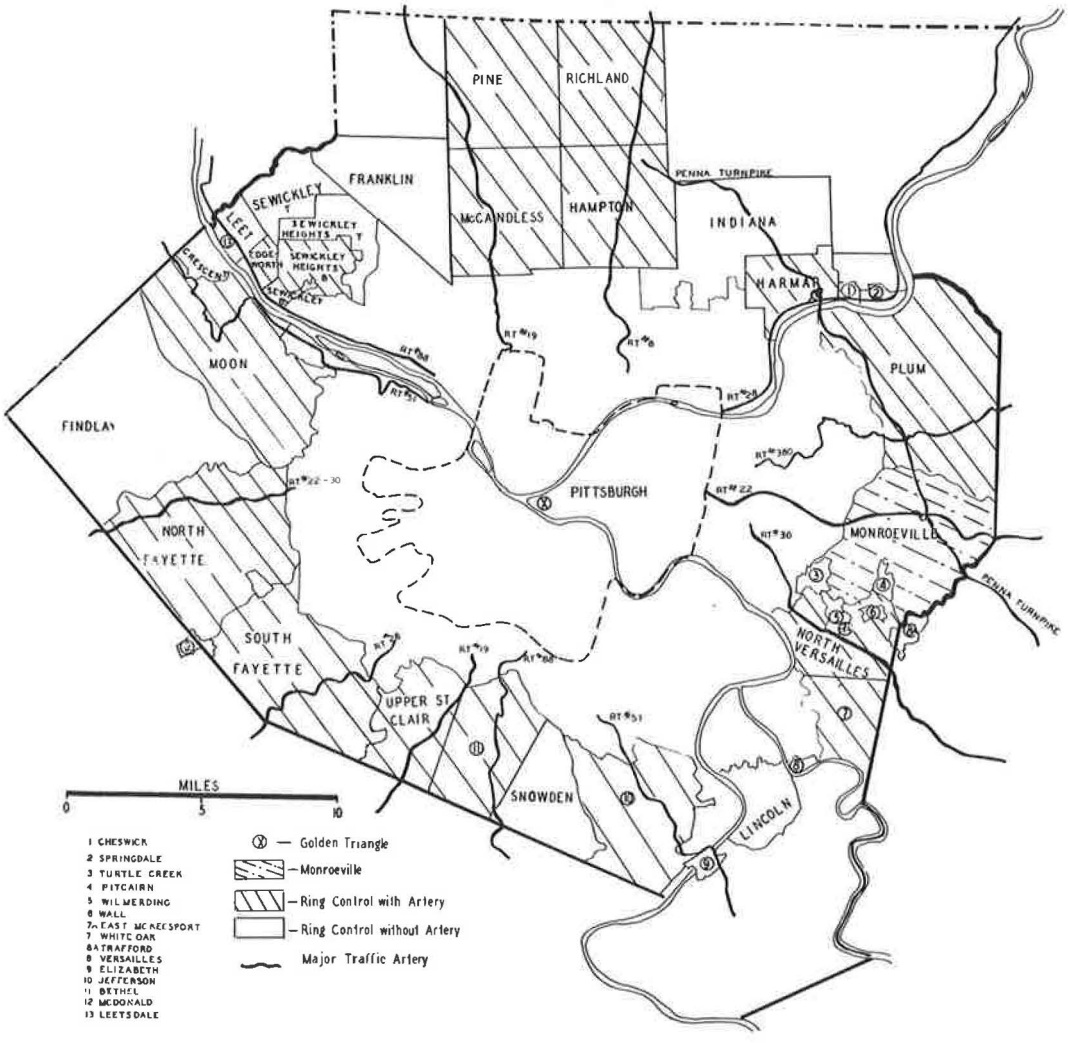

Figure 1. Monroeville and ring control communities, Allegheny County, Pa.

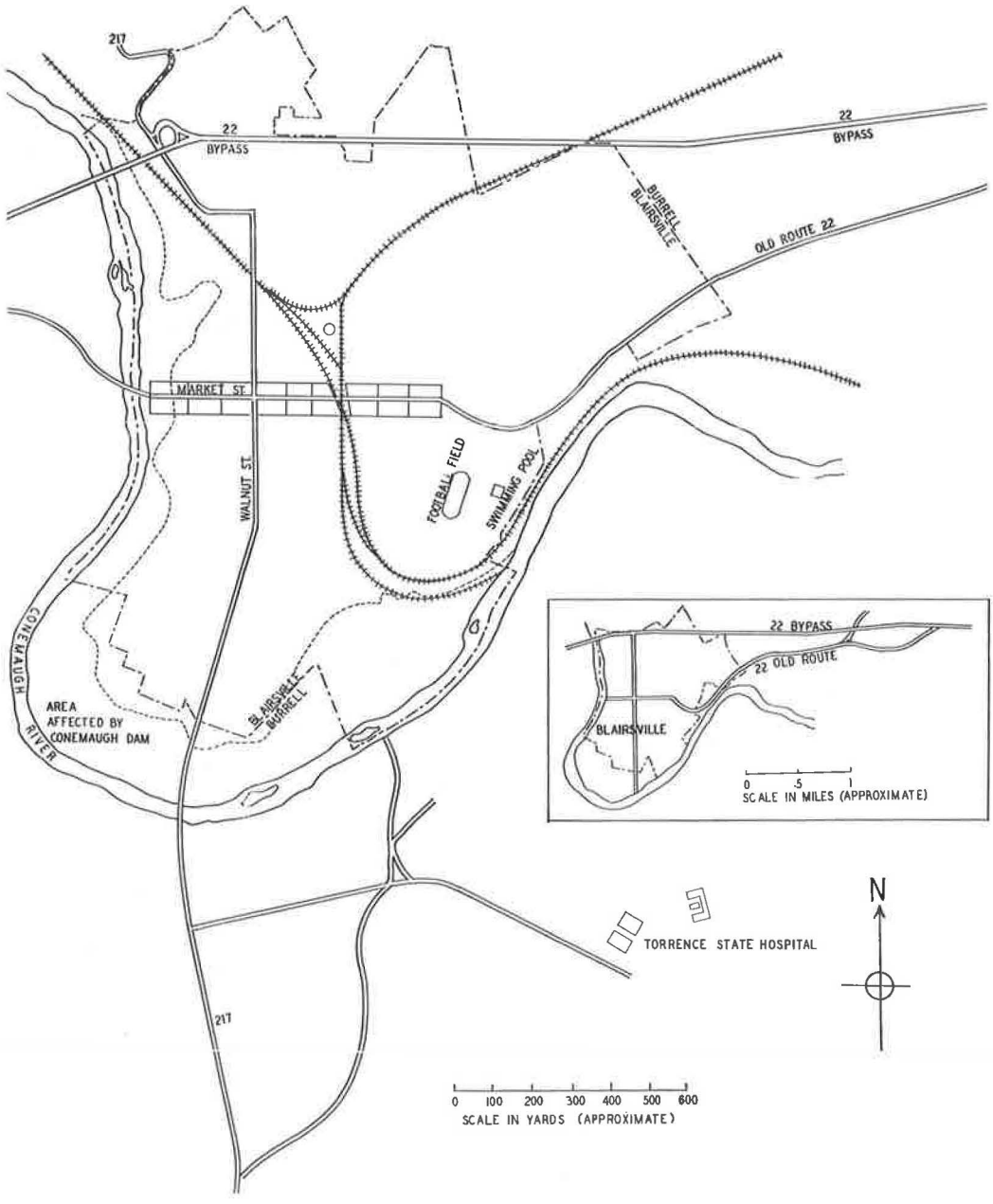

Figure 2. Blairsville, Pa., and vicinity.

(c) US 22 through Monroeville was widened from 33 to 50 ft. The widening was completed in 1957. Beyond these completed events, Monroeville, at the time of the research fieldwork, immediately faced construction of the Penn-Lincoln Parkway Extension which would allow through traffic to bypass the community's business district (6).

Blairsville's highway development was completed in 1953. It consisted of the relocation of US 22, which formerly had traversed the community through the business district. Relocated as a four-lane highway, US 22 now crosses the northern end of the

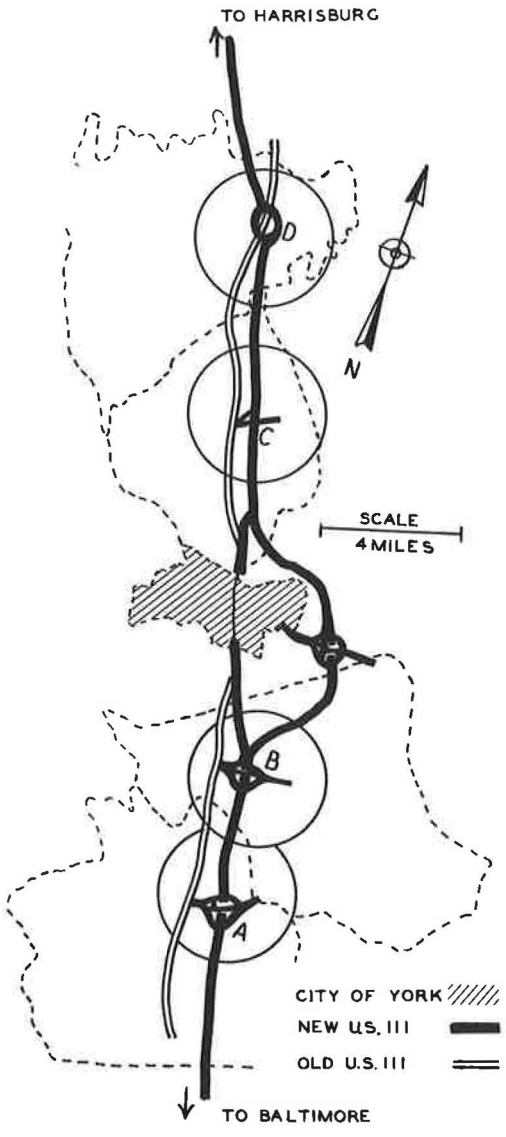

Figure 3. York, Pa., area interchange communities.

borough. Officially, however, the old roadway through Market Street is retained as an alternate route (11).

The major highway change in the York area was the construction of Interstate 83. to supersede US 111, the Susquehanna Trail. Various sections of the new route were opened in 1956, 1957, and 1958. The development included a bypass to the east of York City and several interchanges. Four of these interchanges, excluding the ones on the bypass, constitute the impact research team's third site.

Unfortunately, the completed changes had all occurred before research was undertaken in the areas. The first two sites were studied as historical "crash" programs and served two major functions: (a) to add to the growing fund of knowledge relative to highway impact, and (b) to acquaint the researchers with the specific data necessary for impact analysis. With this background, the researchers were prepared to undertake a program of considerable intensity, one projected tentatively for a five-year period. This latter effort is now under way at the York area interchanges.

Location and Population

Before launching into any detail concerning community attitudes and organization, it may be well to place the research sites in geographic perspective and to offer some description of their populations. Location may indicate that a community lies within the "sphere of influence" of a more dominant center. Population size or change may indicate needs that can be satisfied only by organizational change.

Monroeville on US 22 lies approximately 14 miles east of Pittsburgh, in Allegheny County and therefore within the Pittsburgh SMA. The borough grew from 7,841 in 1950 to 22,446 in 1960. Its growth, both numerically and on a percentage basis, was greater than that of any other civil subdivision equidistant from downtown Pittsburgh. Further, for the period under study, 1950-58, the growth of communities on major arteries leading to Pittsburgh was significantly greater than that for those equidistant communities not so located. Increase for the former was 39 percent; for the latter, it was only 3 percent (6).

Blairsville is also on US 22, about 45 miles east of Pittsburgh. The community suffered a loss of 70 people (1.4%) according to 1950 and 1960 census figures. Its change was not significantly different from that of seven neighboring communities with which it was compared. Intercensal estimates indicate that Blairsville's population decline may be at least partially attributable to Federal acquisition of about 800 properties for flood control. However, Indiana County, in which Blairsville is located, experienced a loss of 2.3 percent during the decade.

The York area interchanges on US 111 (Interstate 83) are all within 8 miles of downtown York. Two of the interchanges are to the north of York and two to the south. This site includes all or part of seven civil subdivisions. The population increase for these communities was nearly 60 percent, from 13,438 in 1950 to 21,464 in 1960. The county showed an increase of 17.6 percent while the city's population declined 9.1 percent. To the extent that York County grew and the city of York declined, the directions of population trends for the research site were similar to those at the Monroeville site. There the county also grew while the metropolitan center declined. In any event, in Allegheny and York counties, the research communities themselves grew, evidence of a potential for receptivity to change. In fact, it may be assumed that the recent migrants to the areas, at least those whose migration had been voluntary, had intentionally sought change and had not moved haphazardly into just any community.

Yet changes in sheer numbers, growth or decline, probably do not provide the total setting of population facts to substrate an understanding of change or its acceptance. At least one other question must be answered: what the characteristics are of the migrants to the communities under study. This question is partially answered by referring to a few characteristics—occupation, income, education, and age. Here, the findings are comparable to those of many other studies dealing with migrants.

On the whole it can be stated that migrants to the study areas raised somewhat the communities' occupational levels. Incomes of migrants averaged higher than did those of non-migrants. Migrant formal educational achievement was also higher. The average age of migrants was generally lower. Thus migrants could be expected to be those with the work experience and financial ability to deal with change, the education to view change rationally rather than emotionally, and the youth and energy to carry through a proposed adaptive program. Further, in some instances, youth may be the only worthy opponent of abstract, hidebound tradition.

ATTITUDES

Many believe that attitude studies must be taken with the proverbial "grain of salt." It is argued that the findings of such studies do not guarantee that respondents will behave in a particular way, actually support or oppose a specific issue when the time for action arises. The faux pas of the political pollster are frequently cited as evidence to justify such a belief. Relative to highway-related attitudes, Kelly (7) recognizes opinions as "an indication of public reaction"; but he also cautions that opinions are expressions of the respondent's attitude at the time of the interview and do not necessarily result from considered thought. Kelly's reference is to opinions concerning homesite selection but may be considered pertinent to opinion surveys generally. There is perhaps the suggestion that the responses are an unimportant "reaction," that opinions may be fleeting, or that they are given merely to satisfy the investigator.

Nonetheless, there is evidence to support the deduction that, in the absence of corroborating facts, such attitudinal expression is the best available indication of subsequent behavior or of the immediate behavioral milieu. If this deduction is accurate it is possible, at least relatively and qualitatively, to estimate the existing degree of acceptance of past and ongoing change. Perhaps it is also possible to infer the potential acceptance and implementation of future change in a given locale. The triteness of the statement that attitudes do not exist in a vacuum need not be argued. Attitudes expressed about highways may very well reflect sentiments regarding economic, political, and social facets of local community life. Because these areas of activity are important to a community and because highway development can affect them, highway development assumes a place of concern in community affairs.

A paper by Vidich and Bensman (13) exemplifies a combined economic and political measure of a community's interest in roads, and contends that roads and issues related thereto "constitute the central area of decision making on the town board. . . . interest in roads is indicated in the town tax structure and budget." In their research community, in 1957, expenditures exclusive of State funds, for local roads constituted approximately one-fifth of the town's budget.

By this measure, Monroeville and Blairsville both exhibited greater interest in that same year. Expressed in similar fashion, the average of expenditures for local roads

in the York area communities was about 43 percent of total expenditures. This average hides considerable intercommunity variation which existed. The two boroughs, small in area, spent smaller proportions on streets and highways than did the large townships. The range was from 4 to 85 percent. Compared to the 43 percent of total expenditures spent by the communities for streets and highways, these seven civil subdivisions had the following major expenditures: general government, 18.5 percent; fire protection, 6.5 percent; police protection, 2.3 percent; and building regulation, planning, and zoning, 2.3 percent. On the whole, the York area communities, as evidenced by their expenditures for streets and highways, can be classified as road conscious.

In the subsequent presentation of the findings of the attitude surveys in the three research locations, usually three different attitudinal comparisons are made: (a) community leaders are compared with a sample of other citizens of the community; (b) leaders are compared on an intercommunity basis; and (c) citizens are compared on an intercommunity basis. To an extent, the York area data mar the neatness of design; rather than deal with each of seven individual communities separately, leader samples have been aggregated. The various citizen samples have been treated similarly.

In Monroeville, researchers drew a judgment sample of 25 respondents representing local government, newspaper, school, church, and business interests. The government officials were intentionally selected to include those who had been in office as township officials at the time of the construction of the turnpike interchange and those in office, as borough officials during the community's period of rapid growth. The latter, it was felt, were and had been immediately involved in any decisions related to problems thought to stem from highway change and would thus be actively concerned. The sample of 216 Monroeville citizens was randomly drawn from the Monroeville School Census Roster which includes all persons 21 years of age or older.

Selection of Blairsville's leaders was determined by frequency of appearance of their names in the local semiweekly newspaper over a period of approximately 10 years and by frequency of identification of their names by other interviewees. Forty-two interviews were conducted, 26 with local businessmen. The Blairsville citizen sample of 100 respondents was drawn randomly after stratification based on residential land use; i.e., single dwelling, multiple dwelling, and mixed residential-commercial.

Leaders in the York area interchange communities were chosen from a list of "selected" leaders (reputational approach) named by respondents from the sample of households in the area. Subsequent interviews with "selected" leaders led to duplication of names on the original list. An effort was made to elicit names of persons other than those who always or usually agreed with the respondent. Twenty-one interviews were conducted: 8 respondents were professionals, and 13 were farm proprietors. Of the 21, 15 held elective or appointive offices, including township supervisor, township treasurer, member of school board, and member of planning commission. Some were engaged in political interest broader than those limited to the community level. The sample of 397 citizens was selected in a manner similar to that used for Blairsville.

The distributions of responses include only those that the analyst considered to be definite responses; thus, the total numbers of responses frequently do not equal the total sizes of the samples. Throughout, the χ^2 test was used to determine for statistically significant difference. Using this test, χ^2 values of 3.841 and 5.991 indicate significant differences for tables of four and six cells, respectively, The arbitrarily selected level of confidence of 5 percent to which those values pertain means that values of that size or greater would have a probability of occurring by chance no more than five times in 100.

The research dealt with attitudes related to the following items: the purpose of the major route through the community, whether recent highway construction had been beneficial or detrimental, preconstruction approval or disapproval, the amount of money spent on highway construction locally, and the responsibility for financing highway construction locally.

Purpose of Major Route Through Community

With reference to the appropriate Federal route number, respondents were asked what they believed the purpose of the major thoroughfare through the community was.

For statistical analysis, responses were classified as universalistic or particularistic. Universalistic responses included "a major East-West route," "a major expressway," "military route," and "Interstate route." Particularistic answers included "access to Pittsburgh" (in the case of Monroeville residents) or "fastest way to York" (for the York area interchange community residents), "the way I go to work," or other responses of a local focus.

Table 1 shows that as to the purpose of the major route, there were no basic attitudinal differences between the leaders and other citizens in each of the three communities. Because this table provides sufficient illustration and because most other leader-citizen comparisons are similar, subsequent tabular presentation of these distributions is omitted.

Intercommunity comparisons in Table 2 give evidence of differences. The majority of Monroeville leaders gave locally-oriented responses. Majorities in Blairsville and the York area expressed broader purposes for the local major routes.

Intercommunity comparison of citizens shows pronounced differences. All Monroeville responses were particularistic, as compared to 32 percent in the York area and 17 percent in Blairsville.

Table 2 and additional statistical testing showed that the attitudes of Monroeville's leaders differed significantly from those of leaders in Blairsville and the York area. Leaders in the latter two communities were more inclined to think alike. It has been suggested to the researchers that the use of different techniques for selecting community leaders may have led to the differences reported here. Though such may be the case, differences of the same magnitude were not revealed regarding either attitude toward recent or proposed highway changes.

As to the purpose of the respective thoroughfares, Monroeville citizens were more "provincial" than were those in the York area and Blairsville; further, York area

TABLE 1

PURPOSE OF MAJOR ROUTE THROUGH COMMUNITY: ATTITUDES

Test Area	χ^2		Interview Type	Attitude		
	Value	Range		Universalistic	Particularistic	Total
Monroeville	3.13	$0.10 > p > 0.05$	Leader	2	18	20
			Citizen	0	66	66
			Both	2	84	86
Blairsville	0.119	$0.80 > p > 0.70$	Leader	17	2	19
			Citizen	53	11	64
			Both	70	13	83
York	0.035	$0.90 > p > 0.80$	Leader	16	6	22
			Citizen	190	88	278
			Both	206	94	300

TABLE 2

PURPOSE OF MAJOR ROUTE THROUGH COMMUNITY: ATTITUDES

Interview Type	χ^2		Test Area	Attitude		
	Value	P		Universalistic	Particularistic	Total
Leader	25.70	< 0.001	Monroeville	2	18	20
			Blairsville	17	2	19
			York	13	8	21
			Total	32	28	60
Citizen	120.48	< 0.001	Monroeville	0	66	66
			Blairsville	53	11	64
			York	190	88	278
			Total	243	165	408

TABLE 3

RECENT LOCAL HIGHWAY CONSTRUCTION:
CITIZEN ATTITUDES

Test Area	Attitude[1]		
	Beneficial	Detrimental	Total
Monroeville	204	2	206
Blairsville	74	16	90
York	372	25	397
Total	650	43	693

[1] $\chi^2 = 30.44$; $0.70 > p < 0.001$.

citizens were more locally oriented than those of Blairsville. The explanation lies perhaps in a degree of dependency, the need to commute to the nearby metropolis. Blairsville has no metropolis nearby, at least not on the route under consideration. Beyond this, the major route had in fact become Monroeville's main business street, sufficient condition for existence of locally-oriented statements of purpose.

Recent Highway Change

There is little question as to whether recent highway construction was favorably received by residents of the communities studied. Substantial majorities of both leaders and other citizens reported that recent changes had been beneficial. Twenty of 21 leaders in Monroeville, 22 of 27 in Blairsville, and 18 of 20 in the York area felt recent construction had benefited their local areas. Among York area leaders, even the two who noted some detriment reported that basically they approved the changes. In all three study areas, the citizen group likewise expressed very general favor: 95 percent reported benefit in Monroeville, 82 percent in Blairsville, and 94 percent in the York area. As with the York area leaders, a few citizens in the York area noted some detrimental aspects but on the whole approved the recent changes. Table 3 gives the distributions; differences are statistically significant.

Blairsville citizens were more mixed in their feelings than citizens in the other two areas were. A reasonable explanation of the differences appears related to what the citizens conceived as the intent of the changes. In Monroeville, for example, changes appear to have been thought intended to benefit the local citizenry. More traffic meant more business; through traffic meant easier access to the central city; widening meant alleviation of congestion. To York area citizens, the new highway was thought intended to remove through traffic, especially large trucks, from their local roadways and to provide them better access to the city of York or possibly even to Harrisburg or Baltimore. The intent in Blairsville, however, was interpreted as different. Local residents were split in their perceptions. To most, the relocation of the major route meant alleviation of congestion, better access to the business district, and safer intracommunity travel. To the minority, it meant bypass, loss of transient trade, and an eventual "ghost town." Nonetheless, even in Blairsville, where, early in the research, antipathy had been sensed, the majority favored the recent highway development. This finding came as somewhat of a surprise to the researchers.

Proposed Highway Change

The most comparable developments in the three areas were the bypass situations. Monroeville was soon to be bypassed, and Blairsville and the York area communities had to an extent already experienced such a change. Monroeville residents were asked to express their sentiments about the forthcoming change; others were asked to recall

TABLE 4

PROPOSED HIGHWAY CHANGE:
CITIZEN ATTITUDES

Test Area	Attitude[1]		
	Approval	Disapproval	Total
Monroeville	169	9	178
Blairsville	44	13	57
York	287	19	306
Total	500	41	541

[1] $\chi^2 = 21.31$; $p < 0.001$.

TABLE 5

HIGHWAY EXPENDITURES:
CITIZEN ATTITUDES

Test Area	Attitude[1]			
	Too Much	About Right	Too Little	Total
Monroeville	8	130	41	179
Blairsville	15	40	6	61
York Area	18	211	52	281
Total	41	381	99	521

[1] $\chi^2 = 29.88$; $p < 0.001$.

their feelings at the time of proposed construction. Again, in all instances the expressions of leaders did not vary markedly from those of other citizens; and favorable expressions considerably outnumbered the unfavorable. Eighteen of 20 Monroeville leaders, 20 of 24 in Blairsville, and 18 of 20 in the York area responded in favor of the proposed change. For the citizens, however, there were intercommunity differences. The distributions are given in Table 4. Once more, mixed feelings in Blairsville are evident.

Generally speaking, attitudes toward highway construction improved through time. Only time will tell whether Monroeville will perceive its bypass as beneficial, but it is known that in the other communities under study slightly more responded favorably after completion of the proposed changes. None of the differences was found statistically significant; however, the data do support the notion that highway changes in the three areas were initiated and concluded in a reasonably favorable attitudinal climate.

Highway Expenditures

The citizen samples in each case were asked to express their feelings about the amount of money spent locally on highway development and who should be responsible for the costs involved. It must be assumed that few actually had knowledge of the amounts spent, but beliefs may frequently be a basis for action even in the absence of facts. Table 5 shows that nearly three-quarters of all respondents felt that the amount had been about right and that nearly one-fifth thought too little had been spent. Blairsville

was the only community in which those who felt too much had been spent outnumbered those who felt expenditure had been too little. Because the Blairsville project was smaller than those in the other two areas, the analyst is almost forced to conclude that local publicity, along with the previously expressed idea of intent, must have had some influence. Concerning this item of amount spent, Monroeville and the York area were similar; each differed from Blairsville.

Responses placing responsibility for highway costs were classified as universalistic or particularistic. The former included "everyone," "the people of the State," "the United States," and other broad-base responses. Particularistic included "citizens of the community," "users" (specifically truckers), and other more specifically-oriented answers. There were no real differences from one community to another. Universalistic responses were given by 84 percent in Monroeville, 85 percent in Blairsville, and 89 percent in the York area. Monroeville, "provincial" in viewing the purpose of the highway, was quite prone to suggest that payment for the thoroughfare should be widespread.

Although the preceding data offer some evidence of attitudes toward highway change, they may also indicate community receptivity to other changes that frequently accompany highway development and its concurrent changes in population and social composition.

COMMUNITY ORGANIZATION

In studying data gathered during the Monroeville field work, it became evident that a number of changes in community organization had occurred during the period under study. The most common changes, and those for which data were most readily available, concerned a movement toward comprehensive community planning. Local communities had added a number of formal functions and made other changes which added to the complexity of overall local government. Subsequently, two questions were raised: how these changes could be measured and whether highway communities differed from those not on major arteries.

An index that provides some indication of relative complexity and with which relative change can be quantified simply was developed as a measuring instrument. This Index of Community Complexity weights each of 11 changes, one or more of which occurred in Monroeville and the other 38 civil subdivisions roughly equidistant from downtown Pittsburgh. Weights were assigned and then slightly modified on advice from the University's Institute of Public Administration. The weighting is as follows: master plan, 7; planning commission, 6; zoning commission, 5; land subdivision control, 4; school district change (formation of jointure or amalgamation), 3; building code, 3; sewer authority, 3; water authority, 2; annexation, 2; parking authority, 1; and classification change, 1. Thus, the maximum index score possible is 37. As of 1960, none of the communities had attained the maximum; but, interestingly, Monroeville with its three recent highway changes had a score of 33, highest for all of the communities on the ring. It was followed closely by Cheswick Borough with 32 and McCandless Township with 31, both on major arteries to Pittsburgh. At the end of 1949, the average index score for communities not on major arteries was 7.3 and reached 14.9 in 1960. By way of contrast, communities on major arteries exhibited an average score of 13.5 at the beginning of the period and increased to 21.3 in 1960. Highway communities, then, were more complex at midcentury and at the end of the subsequent 10 years. Using the proposed index, it can be suggested that complexity in the highway communities preceded that in the non-highway communities by approximately a decade. It may be remembered that population was greater and increased more in highway than in non-highway communities; and it may be expected that changes in an index, composed of the items just listed, would parallel population growth. Generally such an expectation would be very reasonable, but analysis of the York area data tends to indicate the absence of a one-to-one relationship.

After having examined the Monroeville data, the index items and weights were applied to each of the seven civil subdivisions in the York study area. It was not expected that those communities would be found to be as complex as communities in the Pittsburgh area. York County is more rural than is Allegheny County, and the study communities

reflect the historical dominance of agriculture. Yet some change is occurring as evidenced by the index scores.

The study period for the York area communities is 1956-62. As of the first date, the average index score for the seven civil subdivisions was 4.57; by the summer of 1962, the score had increased to 10.57. The low scores substantiate prior expectations regarding the relative simplicity of communities in less urbanized areas. The rather small difference in the before-and-after score is no doubt partially attributable to the shorter length of the study period than that examined for the boroughs and townships in the Pittsburgh area. It is hoped that the York area communities may eventually be studied for an equal period, at least through 1965.

The researchers observed that the degree of change was not comparable throughout the area and sought to "explain" the intercommunity variation. For this purpose, four communities, accounting for 84 percent of the total population of the seven study communities, were selected. Each of these townships is located at a different interchange in the York study area. They thereby offer evidence of the receptivity to change in each of the interchange impact areas. Because field work at these interchanges is continual, the civil subdivisions are here known only as A, B, C, and D; and population figures are not detailed.

Townships B and C are the two largest of the four. Likewise, they were largest in 1950 and showed the greatest growth, both in raw figures and in percentages, during the subsequent 10 years. Township B had an index score of 9 in 1956 and by 1962 had reached 21, highest in the study group. Township C started the period with a score of 8 and attained a score of 20 by 1962. To this extent, population size and growth matched the increases in index scores, but the correlative relationship did not hold for the remaining two communities.

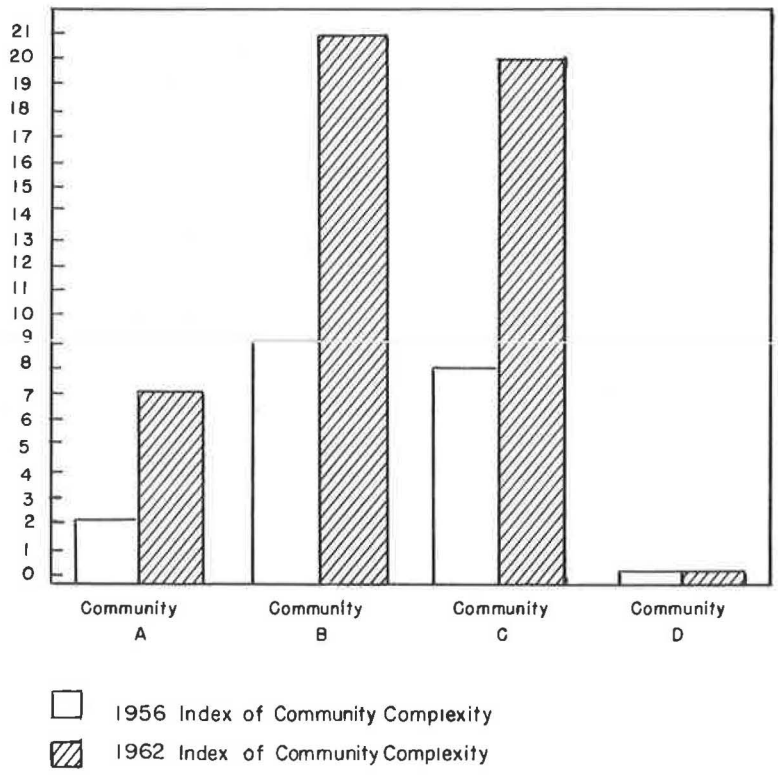

Figure 4. Indexes of community complexity, selected York study area communities.

Township A was smaller than D in 1950 and 1960. Its numerical and percentage growth was also considerably less, but A's change in complexity score exceeded that of D. The score for A was 2 in 1956 and 7 in 1962. Township D had a score of 0 in 1956 and did not change throughout the six-year period (Fig. 4). Population change, growth, alone apparently did not explain change as measured by the index.

Subsequently, another attempt to account for variations in changes in community organization hypothesized a relationship between degree of change and social class composition. With modification, the technique suggested by Bell and Meier (2) was used to quantify three socio-economic variables. Respondents were then classified as upper, middle, and lower class. Using the Edwards classification, occupation was weighted from 13 for professional to 1 for laborer. Income was weighted from 10 for over $25,000 per year to 1 for less than $2,000. Education was weighted from 8 for collegiate graduate study to 1 for no formal education. The social class rating for each respondent was established by adding his weights on each of the three variables. The possible range is from 31 to 3. The range for all respondents in the four interchange impact areas was from 27 to 5. The cutoff points used in this study were upper class, 27-21; middle class, 20-11; and lower class, 10-5. Figure 5 shows composites of social class ratings of interchange area respondents. The figure points up the "superiority" of migrants; but more crucial to the explanation sought, it illustrates rather vividly that change was more likely to have occurred in areas with high average social class ratings. Comparing Figures 4 and 5 shows the apparent interrelatedness of complexity and social class scores.

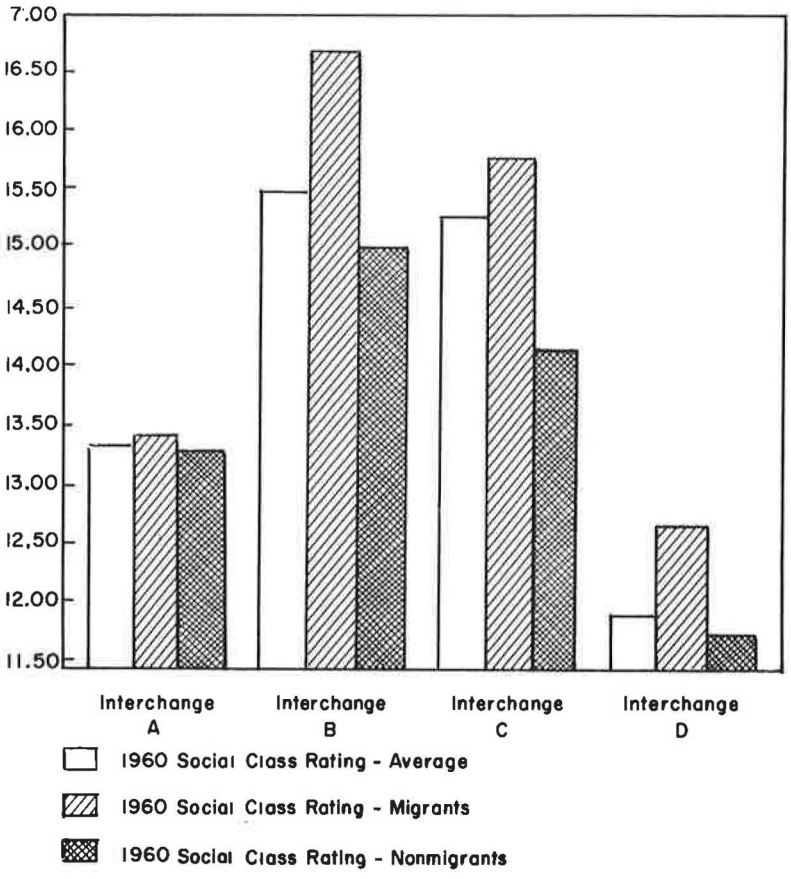

Figure 5. Social class ratings, York study area.

As previously mentioned, the data for changes in community organization in the York interchange areas represent a period of only about six years. Whether additional changes can be expected, perhaps, in the near future may best be determined by turning to the opinions of local leaders.

Sixteen of the 21 leaders interviewed did not favor a change in the classification of their civil subdivisions. They contended that it was not necessary and would be too expensive. None saw an immediate need for a parking authority. The majority (12) felt that no annexation was necessary. They were about evenly divided on the need for a water authority; 11 felt that such an authority was not necessary.

The remaining seven items of the index had majority support. Fifteen felt that a sewer authority was needed; some pointed out that, should the population density reach a given point, the State through its health department would no longer permit septic tanks. The leaders unanimously favored building codes; specific comments were made regarding the need to protect property values. Thirteen favored some form of school merger; those opposed felt that it was not necessary or was too expensive. All favored land subdivision control; although 17 favored zoning, 20 were favorable toward a planning commission. Nineteen believed that a master plan was necessary; reasons included "better community development" and "the protection of property values." If these leaders are influential in the area, it appears that the communities' complexity scores will rise. The weights of the items on which there are clearly favorable majorities total 30. The present range of scores is 0 to 21. Further, the County Planning Commission is extremely active. This extracommunity influence has already proved effective in some of the communities.

The researchers are aware that the complexity index does not measure community organization as a whole and that changes in index scores do not begin to measure all changes in community organization. Yet each of the items in the index is an aspect of organization, and change in a township's index score is evidence of effort to exert control over local destiny. Additionally, it may be inferred that implementation of such changes is evidence of a social climate conducive to the acceptance of other changes.

ATTITUDES AND ORGANIZATIONAL CHANGE IN CONTEXT

As previously stated, attitudes (in this case, attitudes about highways) may reflect sentiments toward other aspects of community life. Organizational change must likewise be viewed in broad perspective. Besides the changes in population and organization analyzed in this report, the communities under study were dynamic in many other respects. Governmental costs were rising, and school enrollments were increasing. Land use changes were occurring; and, in most cases, a new leadership was emerging. Industrial changes also influenced the study communities. For example, in a decade, Monroeville added 13 manufacturing concerns; Blairsville had a net loss of two. Seventeen manufacturing firms entered the York study area between 1956 and 1962. Similar changes are evident in other business enterprise.

Thus, though migrants may bring new attitudes to an area, overall local attitudes are conditioned by ongoing economic and political events. Change is not wrought solely by population changes or by migrant-non-migrant variations per se; for these are, in turn, influenced by pervasive community conditions.

Economic conditions, as set forth in the research objectives, are subject to considerable attention from the Penn State impact research staff. Traffic volume and patterns are being studied and integrated with other findings. The latter will permit a greater understanding of urban-suburban interdependence relative to employment and to recreation and other leisure-time activities.

A major undertaking is the development of a simultaneous systems model for the study of interchanges throughout the State. This model incorporates such variables as type and age of interchange, topography, availability of water and other utilities, distance from population centers and other interchanges, distance from other transportation facilities, and prior existence of settlement at the interchange site. From a conceptual model it is hoped that a predictive model will result. Knowledge of community attitudes and organization can contribute to the predictive analysis.

SUMMARY AND INTERPRETATION

It is to be expected that the introduction of a major change into a community will be met by responses that vary from opposition to acceptance. Further, it may be expected that change fostered by an outside agency could be considered an invasion. A State Highway department is an example of such an outside agency, one that prefers community acceptance of its programs. Reciprocally, acceptance of highway development is essential to community well-being. Thiel (12) has stated:

> A highway needs to not only facilitate the transport of goods and people but to be generally acceptable to residents of the area through which the facility passes. Without this acceptance, a highway can result in such harmful effects as lowered land values—since land values depend in such an important way on how people feel about property and the surrounding area—and general community blight.

Acceptance of any change may be related to the rapidity with which that change seems to bring favorable results. Nelson (10) and his associates state, "The source of change most easily grasped is that of swift and radical alterations in the environment of the community." Following presentation of examples of changes of that nature, they go on to say, "Somewhat more slowly comes the change which follows from altering the route of a major highway, but it still occurs rapidly enough to be seen within a single person's experience." Highway changes, as such, in the study areas were readily seen in a short period of time; without question, most felt the effects had been beneficial. The general acceptance of highway development is now a new finding. Even when losses occurred in an area of development, Young (16) found that only a minority of businessmen attributed losses specifically to construction of the freeway. Further, Thiel recently summarized other studies that illustrate general satisfaction.

On an intercommunity basis, the tenor was one of comparable acceptance. Differences found were only in degree of acceptance; majorities in all three areas favored recent changes. A minority in Blairsville obviously felt that the community had been dispossessed of through traffic on its main business street and had suffered through loss of the business that traffic implied.

Invariably leaders and other citizens were in accord, favorable toward the changes. The data tend to substantiate Washburne's (14) thesis that psychologically, leaders of a group tend to be those members who are aggressive, but whose ideas are essentially the same as those of the rest of the members of the group.

Findings here tend to reiterate those of Westby and Wiley (15) who studied three Michigan communities. They concluded that the theme running through their findings was the general favorableness of opinion and the relative lack of variation between and within communities.

Knowledge of the attitudes of local leadership is especially important. According to Washburne (14), "...in critical situations men will be inclined to accept the suggestions of leaders and propagandists if they seem to provide an adequate interpretation of the problems facing them."

Education of the leadership seems particularly appropriate to mitigate any discontent among them. As Vidich and Bensman (13) point out:

> The rural non-farm population which commutes to work to the nearby industrial centers is, of course, as dependent upon roads as the farmers. When road issues arise, they will follow the lead of any group which has a gripe and is willing to express it.

Other changes are obviously concomitants of highway change. In a 1961 publication (3) it was contended that changes in population, political boundaries, zoning, planning, and land use would be influenced by ongoing highway development. The Monroeville and York area data for community complexity validate these notions.

Highway communities in the Pittsburgh area appear, on the whole, to be more complex than non-highway communities. The York area communities, where major highway change has been more recent, exhibit community complexity of a lesser degree but

moving toward increased complexity. The findings show differential adoption of organizational changes, related not only to population size and change but also perhaps to variations in social class composition.

For many, at least for community leaders, most governmental changes treated in this research are considered improvements. These improvements have occurred in a social climate conducive not only to highway change but also to organizational change. Frey (4) has warned that the presence of a highway does not guarantee community improvement, and that only by means of local planning and adequate controls can communities assure an orderly, stable, and more satisfactory growth and land use pattern. He and his associates (5) have discussed some of the problems that can arise from the location of major highways in the absence of planning: congestion, ribbon development, and neighborhood bisection. Barnett (1) in discussing the location of free-flowing arterial routes says that these routes are best located when, in addition to satisfying the fundamental needs of traffic, they divide one neighborhood from another.

The reciprocity of highway and community interests is self-evident. There is need for knowledge about the goals and attitudes of both. A highway facility is equally available as asset or liability to a community's future. The community does have an opportunity to participate in highway planning. Open hearings permit citizens both to teach and learn. To cope with increasing highway demands, members of highway departments must continue to learn something of the communities involved.

Moses (8) states:

> Our parkways, turnpikes, expressways, thruways, and other roads, which are being multiplied and improved to keep pace with the output of cars and the demands of the traveling public, will increase enormously the pressure on our highway system and promote mutual attraction and gradual unification of the country and the town.

Few would argue that this unification can be accomplished without foresight and intelligent planning on the part of both highway planners and community residents. Commitment to a mutually satisfactory relationship is important. If one would perceive the highway-community relationship as systemic, one in which there is reciprocal impact, some suggestions from Loomis and Beegle (9) may be appropriate:

> The greater the felt need for a cultural item, for example, the easier it is to relate a proposed change to the ends of the system involved. Further, the better a cultural trait is understood, the easier it will be to introduce the change.

Or perhaps it should be said that the better a cultural trait is understood, the easier it will be to introduce the change if that change is accepted; i.e., felt to be beneficial.

Highway changes in or near the communities studied were generally found to have been accepted; and, seemingly, local leaders and other citizens have made some move toward adaptation to those changes. Through those efforts they may in fact be effecting a protection for the road facility. One could readily question whether highway protection would ever arise as a community goal in an atmosphere of hostility, rejection, or even suspicion of highway objectives.

The limitations of these findings, relative to generalization about acceptance of highway change and willingness of any community to participate in its own reorganization, is not argued here. Each community is a different case. Moses (8) suggests:

> In studying any particular community, there is no quick, smooth categorical answer to the never-ending challenges of growth and change. Intelligent citizens should study the main forces at work, the pulls and pressures. Much depends on the traditions of the town, on its special interests, on types of leadership and the strength of advocates of conservative improvement as against radical and revolutionary uprooting.

Radical and revolutionary uprooting may best be prevented by advance highway and com-

munity planning. Nelson (10) recognizes the multiplicity of factors involved in such planning:

> Community development programs must be sensitive to changes in the composition of the population and must anticipate changes that may result from economic or social forces.

Rather than economic or social forces, "it might be preferable to say economic and social forces."

Within the broader framework of economic and political conditions, knowledge of population and population change, social characteristics, and attitudes of community citizens and their leaders is necessary to the understanding of the relationship between highway development and community change. Such knowledge may be the key to a reciprocal relationship that is mutually beneficial.

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