

# Measuring the Economic Impact of a Limited-Access Highway on Communities, Land Use, and Land Value

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Research in the field of highway economics has long been recognized as an essential part of the highway planning task. One branch of this research is of comparatively recent origin; namely, that specifically concerned with the economic impact of various forms of highway improvement. This new research emphasis stems from: (a) an urgent need for information which can be used in the appraisal aspects of right-of-way acquisition programs of highway departments; and (b) the fact that data are needed for predicting what a proposed change in the routing of a highway, such as bypass which sends traffic around rather than through a town, may do to the economic health of a community.

In November 1957, the Bureau of Business and Social Research of the University of Denver undertook a study—sponsored by the Colorado Department of Highways in cooperation with the U. S. Bureau of Public Roads—of the economic impact of segments of limited-access highways (U. S. 85 and 87) on business activity of bypassed communities, and on land value and land use. These highways were appropriate subjects for study because of the variety of uses of the land abutting them and because they are representative of other highway projects planned for the state.

The primary aim of this paper is to discuss the techniques developed in the Bureau study to measure the economic impact of the highway on bypassed communities and on land value and land use. A collateral aim is to present some findings from the Colorado study which illustrate applications of the technique.

The first part of this paper deals with the influence of US 85 and US 87 on business activity of certain bypassed Colorado communities. The second part discusses the subject of impact of segments of various highways in the 85-87 complex on land value and land use.

The findings of both phases of the study are preliminary in nature. The influence of the subject highways cannot be fully measured until sometime after the links through Denver, Colorado Springs, and Pueblo are finished, and more time following completion of certain portions has elapsed. Similarly, with respect to methodology, some of the techniques employed must be regarded as tentative in their applicability to studies of this kind. Being conscious of the need for methods which provide, not only indications of what impact the highways have had, but also methods which might have predictive value, considerable effort was devoted to finding ways to explaining why certain types of impact have taken place.

● THE BIRTH of a community is brought about in many ways: as a trading center for a large agricultural region, historically important as a rendezvous for Indian fighters,

and as the hub of extensive mining activity. Whatever the size of a community, it has had a hand in shaping the economic and political development of the state of which it is a part. Seven communities—Brighton, Sedalia, Castle Rock, Larkspur, Palmer Lake, Monument, and Fountain—were selected for the Colorado study because each, within the past 10 years, has been bypassed by north-south US 87 running through the state (Fig. 1).

Each of these communities has had rail service since early days of the state. With the advent of the automobile, the need for good roads became apparent. As the highway network began to develop, these communities became junction points and centers of

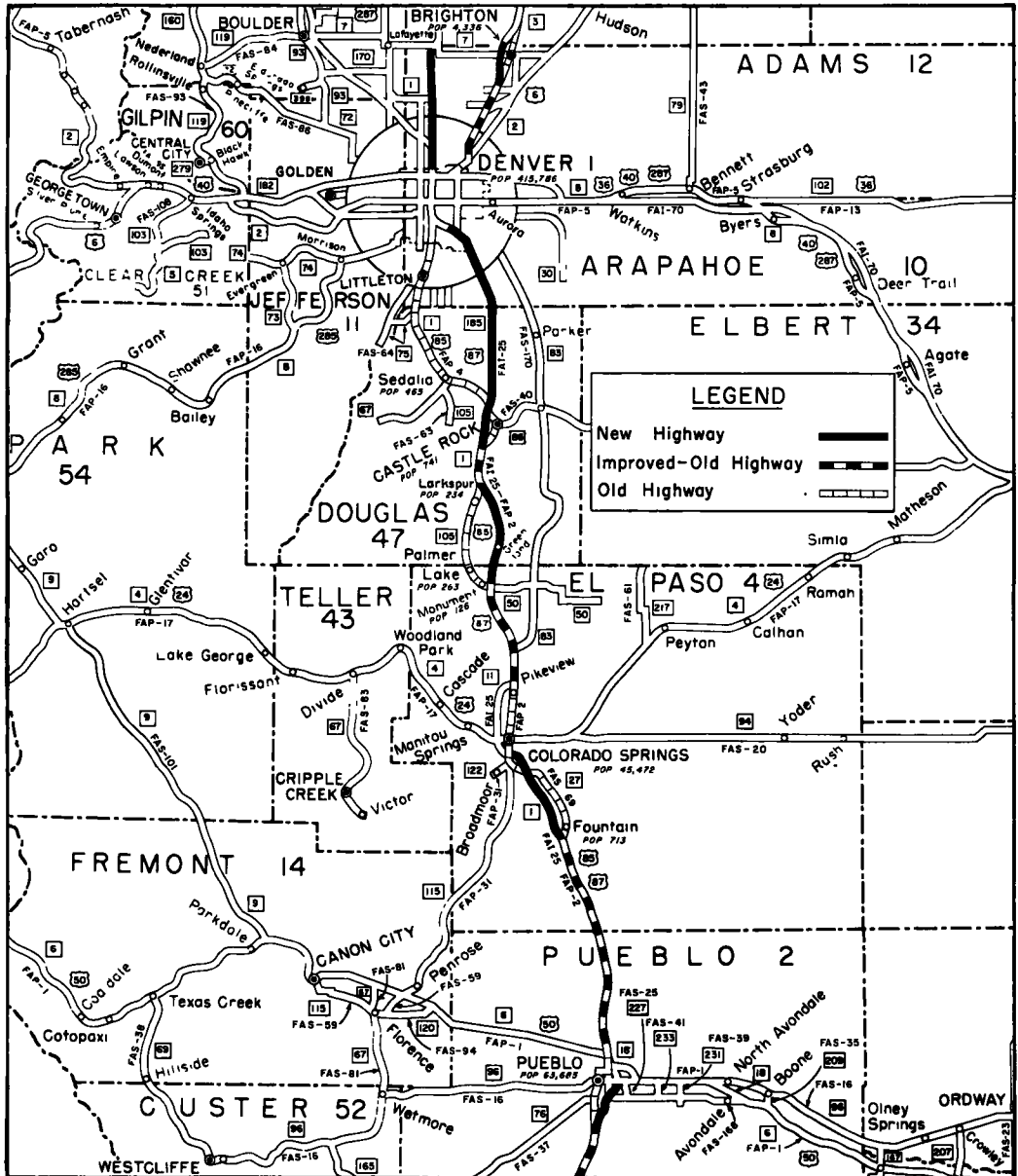


Figure 1. Subject highway network showing bypassed communities and their 1950 populations.

business activity on the principle north-south route through the state. Pressures of population growth and business expansion in the past two decades created demands on the highway network to eliminate points of congestion so that larger traffic volumes and increased speed could be accommodated. In December 1949, US 85 was changed and rerouted from north of Larkspur to Monument resulting in Larkspur, Palmer Lake, and Monument being removed from the main stream of traffic on one of Colorado's busiest thoroughfares. During the period 1952-1956, Brighton, Sedalia, Castle Rock, and Fountain were bypassed by new 4-lane limited-access highways.

In 1954, an area east of Colorado Springs was selected as the site for the United States Air Force Academy. This event has exerted, and will continue to exert, further changes on the economic development of the surrounding areas.

The economic motivations which explain the existence of these communities are a matter of history and bear little or no relation to the sustenance on which they now depend for their livelihood. The economic origins of these communities were completely divorced from any business activity to be generated by the modern highway; but to an unknown extent they have come to depend on it. A community suddenly cut-off from sources which contribute to its normal growth does not perish immediately. It is difficult to predict what the ultimate outcome will be. It does seem clear, however, that when a major disruption of this flow of activity occurs it will result almost immediately in changes in the normal level of business activity. The extent of this disruption may be interpreted as a reflection of the community's dependence on the affected activities as economic assets.

People of a community become deeply concerned about the possible effect that a bypass might have on their economic well-being when the bypass is first proposed; likewise, planners of highways. No objective information is available which can be used can be used to justify or to relieve this concern.

To what extent is the nature and volume of business activity affected when these communities are passed by the major stream of traffic which formerly went through them? How can this effect be measured? The methods employed in the Colorado study to answer these questions are examined in the following sections. Based on this methodology some of the findings with respect to Brighton are reported.

### MEASUREMENT OF IMPACT ON BYPASSED COMMUNITIES

The study rests almost entirely on an analysis of sales tax collections as a measure of business activity for each of the seven communities over the years 1946 to 1957. Such data provide not only measures of the amount of business activity year-by-year, but give insight into changes in the composition of this activity if sales tax collections are analyzed according to type of business.

If changes in the level and composition of business activity are to be related to the highway, then some guide or standard of comparison is needed against which the significance of the changes can be evaluated. Sales tax collections covering the entire state would seem to provide an appropriate base for comparison. These data would be almost entirely independent of any effects brought about by the bypass highway, but they still would be sensitive to statewide economic changes which would be felt by the communities as well.

Gathering of information necessary for such a program entailed dealing with month-by-month reports of sales tax collections from individual businesses in each of the communities studied.

Since the second quarter of 1954, sales tax statistics collected by the Colorado Department of Revenue for the state as a whole have not been kept by individual business classes (for example, drugstores, filling stations, motels, etc.). To make comparisons between the state and the community, estimates of sales tax collections had to be derived for each business class by quarter for the years 1954 to 1957. Details of this step are given in the Appendix.

#### Business Classes Studied

By agreement with the Colorado Department of Revenue, no data are reported which

would tend to reveal the sales of an individual business. The agreement of non-disclosure was met in two ways: (a) if the number of firms in a given business category was less than four in any year, no analysis was made for this category; and (b) by not reporting sales tax figures for any category of business. As a consequence, the relative importance of each business class in a community over the years 1946 to 1957 is not given. Such an analysis would be valuable because it would reveal more definitely what changes take place in the composition of business activity of a community due to the bypass. Nevertheless, reference will be made in the discussion to statistics compiled for this purpose, even though no specific identifying figures will accompany the reference.

An analysis of at least the total sales tax collections for every community was possible, because the number of businesses in operation in each of the communities was four or more in each of the years 1946 through 1957. It was possible in certain instances, using this "rule of four", to single out certain business classes for special study. The following groups were chosen because they include firms associated with the kind of business that is generated by highway traffic:

1. Apparel group—including boot and shoe stores, clothing stores, and dry cleaners and laundries.
2. Automotive group—including stores selling automobiles, bicycles, and automotive accessories; filling and service stations; garage and repair shops.
3. Food group—including grocery stores, motor stores, meat markets, bakeries, poultry stores, restaurants, taverns, cafeterias, hotels, cottage camps and resorts.
4. Furniture group—including appliance stores, furniture stores, radio sales and service shops, and upholsterers.
5. General merchandise group—including department, drug, hardware, jewelry and sporting goods stores.

Separate tabulations were also prepared, when there was no danger of disclosure, for certain businesses within each of these groups. Such tabulations permit tracing the impact of the highway bypass directly to the businesses affected.

Only in the case of Brighton was a detailed program of analysis possible for a variety of business groups. Accordingly, the approach used in assessing the effects of the highway bypass for this community is quite representative of the approach used for the other communities. This does not imply that the findings for Brighton are typical of those for the other communities.

#### Graphs Showing Business Activity

Some discussion is in order as to the construction of the graphs shown in Figures 2-10. The dashed lines shown for Colorado and Brighton connect the plots of actual sales tax collections from one quarter to the next. The heavy solid line running through the dashed lines is a "centered four-quarter moving average." This moving average represents the general pattern of tax collections when cyclical variations from quarter-to-quarter and other random fluctuations are ironed out. Based on the moving average, it is possible to examine more easily the main effects that have taken place in the movement of business activity in a given community. This concept is explored further in the Appendix.

The scale chosen for the figures is a semi-logarithmic one. This scale allows direct comparison of the moving average of Colorado sales tax collections with that of the given community in terms of percentage changes over a period of years. If, for example, the general movement of the moving average for Colorado, as approximated by a straight line, were parallel to a line drawn similarly through the moving average for a community, then the rate of change in business activity year-to-year for the state and the community would be identical. In other words, the community would be keeping pace percentage wise with the state. A good example of this relationship is shown in Figure 5, for 1949-1954, where total sales tax collections from filling and service stations in Brighton are compared to those of the state.

On the other hand, if the slopes of these lines are somewhat different, then it can

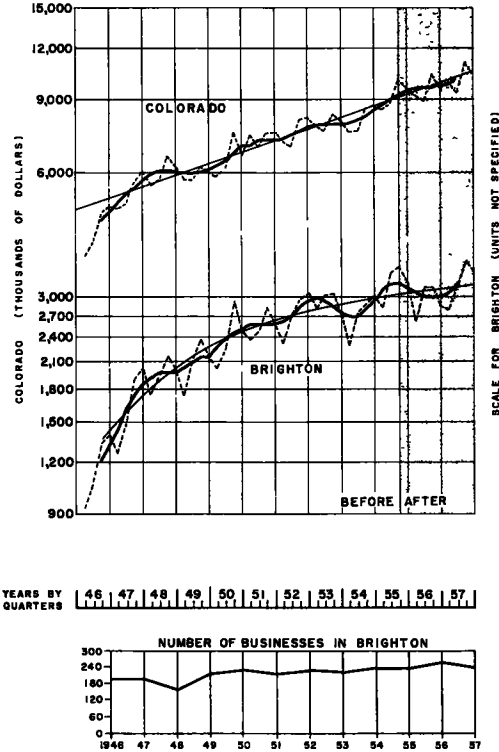


Figure 2. All business groups: comparison of Brighton and Colorado (ratio scale).

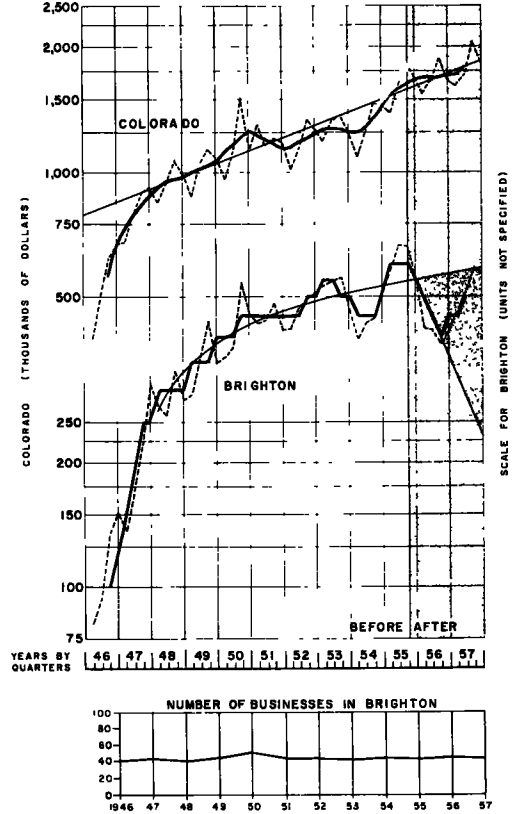


Figure 3. Automotive group: comparison of Brighton and Colorado (ratio scale).

be said that the rate of increase of the series represented by that line with the steepest slope is greater than the rate of increase of the other series. A good example of this situation is shown in Figure 6. Here, the rate of increase in sales tax collections from the food group for Brighton is somewhat less over the period than that for Colorado. The important characteristic of these charts, then, is not a comparison of magnitude of the changes that take place but, rather, rates of change. This characteristic property of semi-logarithmic charts applies equally well to comparisons that might be drawn between periods of years for a given series. For instance, from the middle of 1950 to the middle of 1953, Colorado's total sales tax collections increased from about \$6,600,000 to \$7,970,000, or \$1,370,000, approximately 21 percent. From the middle of 1953 to the middle of 1956, the change is from \$7,970,000 to \$9,700,000, or \$1,730,000, a 22 percent increase. Here, there is a large dollar difference between the two periods, but the percent changes are almost identical. These two periods would straddle the same straight line passed through the moving average curve.

Each chart is shaded so that the post-bypass period may be compared easily with the pre-bypass period. Dates used for this purpose are those on which traffic first flowed around the community in question. Thus, this date might be the opening to traffic of the bypass with only two lanes in operation instead of the ultimate four-lane divided highway. The bypass around Brighton was opened to traffic in July 1955. (Dates on which the bypass was first opened to traffic for the other six communities are as follows: Larkspur, Monument, and Palmer Lake—December 1949; Sedalia—August 1952; Castle Rock—December 1955; and Fountain—November 1956.)

No numbers are shown on the scale for Brighton because, under certain circumstances,

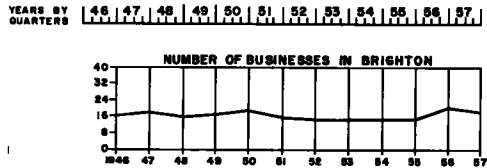
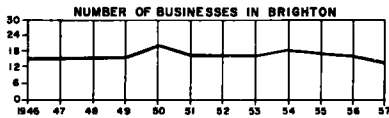
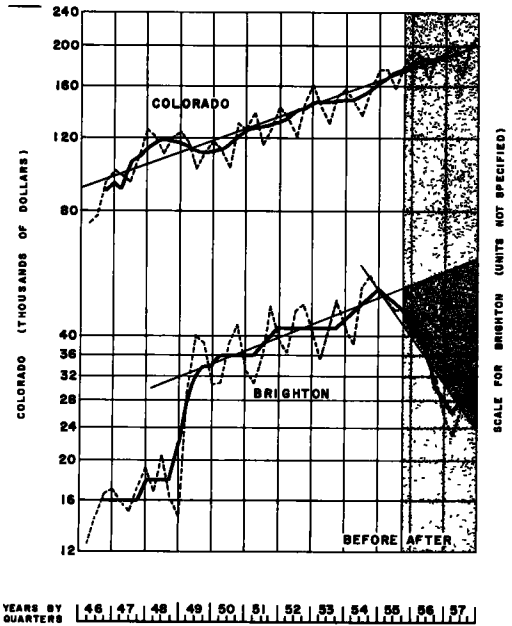
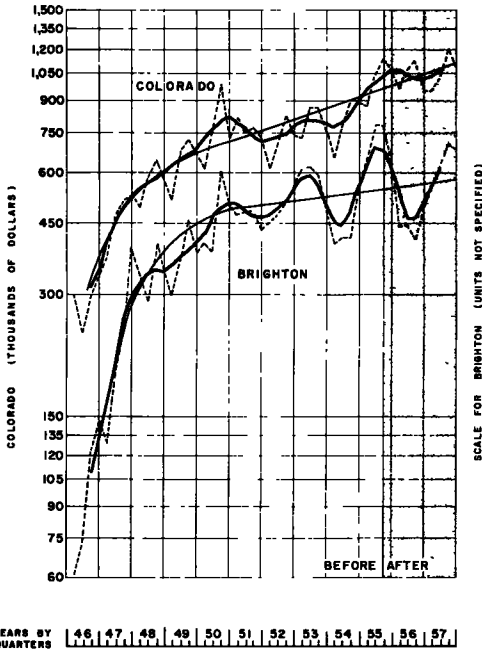


Figure 4. Automobiles and bicycles: comparison of Brighton and Colorado (ratio scale).

Figure 5. Filling and service stations: comparison of Brighton and Colorado (ratio scale).

to do so would allow comparisons to be made between individual businesses. This is particularly true in view of the fact that the number of businesses over the period 1946-1957 is shown at the bottom of each figure. The chart, showing number of businesses, gives the maximum number of stores doing business in any quarter of a given year.

Adjustment of Data for Price Changes

No adjustments have been made in sales tax collections to take account of price changes that have occurred over the years 1946-1957. Such adjustment would, indeed, be necessary for meaningful comparisons if it could be shown that price changes that occurred in Brighton were materially different from those which occurred statewide. It is unlikely that changes in the price level of purchased items in Brighton are very different from those which occurred statewide, because any statewide index of price changes would be dominated by price changes which occur in the metropolitan area of Denver. For all practical purposes, Brighton is a part of this area. At any rate, no satisfactory measures are available. It will be assumed throughout that even if sales tax collections had been adjusted for price changes, the same relationships between Brighton and the state, as shown in Figures 2-10, would prevail.

FINDINGS IN THE CASE OF BRIGHTON

Of the communities studied in this report, Brighton is probably the one which has been least affected by unusual business and industrial expansion, or other exceptional developments, over the period of the study. This is evident from Figures 2-10

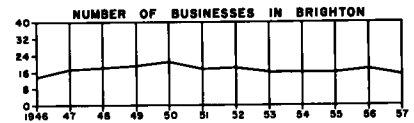
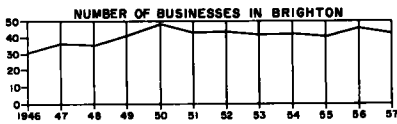
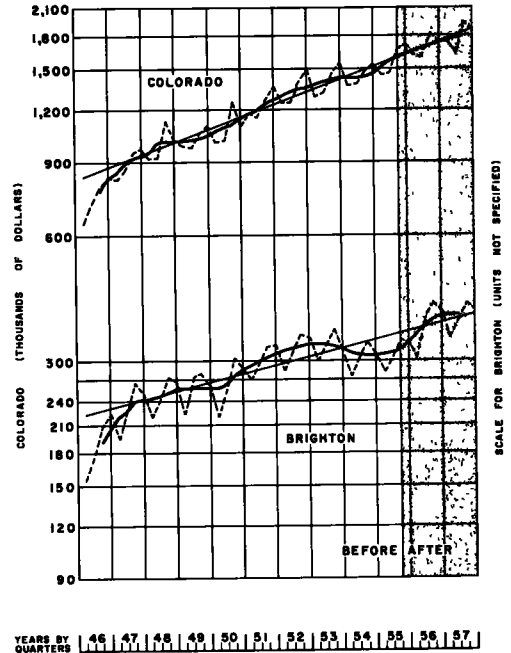
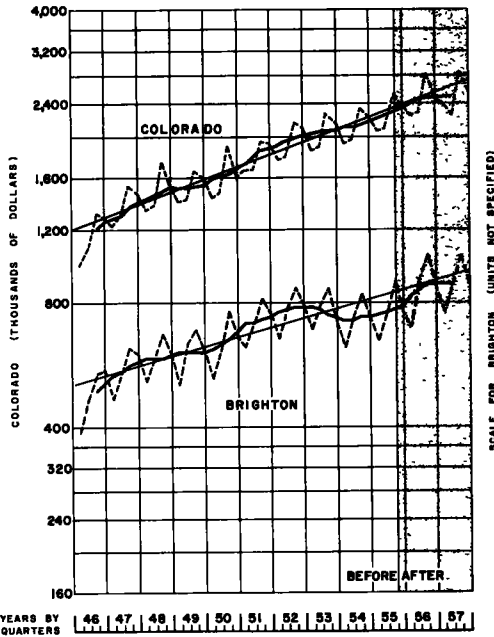


Figure 6. Food group: comparison of Brighton and Colorado (ratio scale).

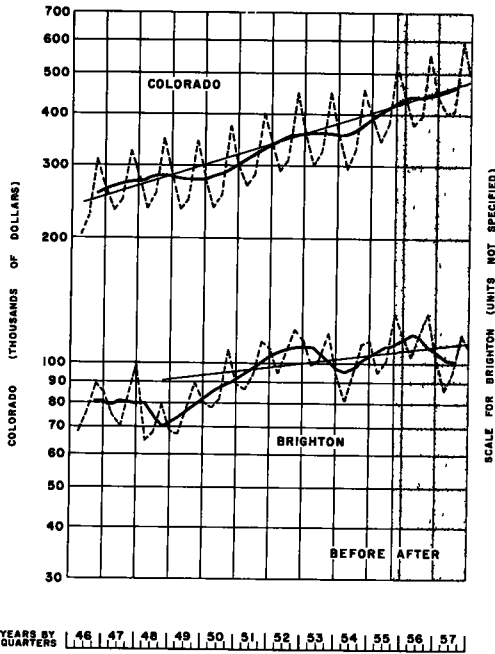
Figure 7. Grocery stores, motor stores, and meat markets: comparison of Brighton and Colorado (ratio scale).

showing sales tax collections from the various businesses in Brighton. Total business activity in Brighton (Fig. 2) follows very closely the pattern of business activity statewide, though the over-all rate of change in Brighton is somewhat less than that for the state. Fluctuations in the "moving average" for Colorado are almost exactly duplicated by those for Brighton. As is to be expected, however, fluctuations in the moving average for Brighton are more pronounced than those in the curve for the state. This basic characteristic is exhibited, also, in the case of the automotive group prior to the bypass date, July 1955 (Fig. 3). It is also true, though in varying degrees, for businesses selling automobiles and bicycles (Fig. 4); the food group (Fig. 6); the grocery and meat market trade (Fig. 7); and the furniture and general merchandise groups (Figs. 9 and 10).

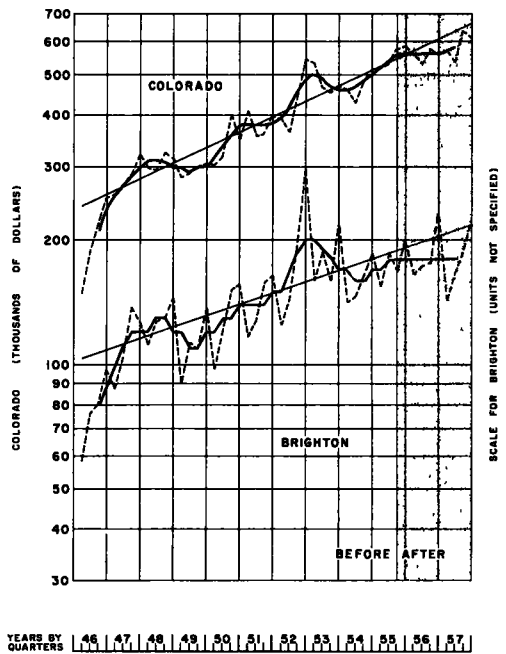
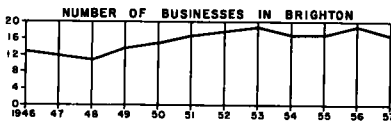
The growth in population in Brighton, as indicated in the table on page 46, declined percentagewise in the period 1940-1950, as compared to that of the previous decade, whereas the percentage increase in population for the state was larger in the decade 1940-1950 than in the period 1930-1940. This would account, in part, for the smaller rate of growth in business activity in Brighton, as compared to the state (Fig. 2).

In a striking way, the moving average of quarterly sales tax collections for Brighton has paralleled that of the state for the period preceding the opening of the bypass highway. A reasonable assumption is that this related movement should continue following the opening of the bypass if business activity is indifferent to it. Employing this line of reasoning, it would appear from Figures 2 through 10 that:

1. The bypass has not affected the general level of business activity in Brighton.
2. The immediate effect of the bypass on the automotive group (Fig. 3) has been to



YEARS BY QUARTERS | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57



YEARS BY QUARTERS | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57

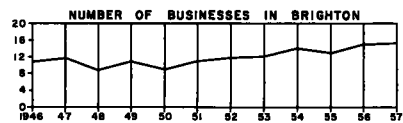


Figure 8. Restaurants, taverns and cafeterias: comparison of Brighton and Colorado (ratio scale).

Figure 9. Furniture group: comparison of Brighton and Colorado (ratio scale).

decrease gross sales by about 13 percent per quarter for a period of about 1 year. Indications are that a substantial improvement in this activity is taking place and that perhaps a level which existed before the bypass might be achieved. This effect on business activity for the automotive group arrears to be due largely to a deterioration in service and filling station sales (Fig. 5). No concomitant effect is noticeable in the sales of automobiles and bicycles (Fig. 4) although the number of businesses has declined from 1954 to 1957. In the case of filling and service stations, the rate of increase in sales from 1948 to 1954 was at a level close to that established by the state as a whole. The effect of the bypass on total sales of this group is clearly shown in Figure 5 though no accompanying change occurs in the number of businesses.

3. The level of business activity of the food group as a whole (Fig. 6) is indifferent to the opening of the bypass. Variations in business activity appear to be completely consistent with the pattern established between Brighton and the state as a whole in the years preceding the bypass. This situation prevails with regard to grocery stores and meat markets (Fig. 7), as well as to restaurants and taverns (Fig. 8).

4. Sales tax collections from businesses in the furniture class (Fig. 9) vary in a manner that would be expected had there been no bypass highway. The usefulness of patterns of variations established between the community and the state for analysis of the economic impact of the bypass is borne out in Figure 9. The sales picture for Brighton alone from the middle of 1955 to 1957 infers that the bypass had some detrimental effect on this group in businesses. However, when comparisons are made with the state such variations seem quite consistent with what might be expected had attention not been given to the bypass date at all.



5. Sales of the general merchandise group of businesses (Fig. 10) also appear to be unaffected by the opening of the bypass highway.

#### Discussion of the Findings

The economic profile of a community is composed of many components, each of which is important in the total picture. The manner in which these components depend on one another is largely unknown, and to measure their relative importance is difficult. The components are put together in a way which achieves, at any given time, a general state of balance which is likely to be unique to that community. It is reasonable to suppose that the dislocation of one of these components will produce change in the economic profile, in proportion to the severity of the dislocation. Moreover, such dislocation ought to be revealing of the role played by the component in the profile. Thus, in the case of the present study, if a highway passing through a community has the effect of contributing to the economic well-being of that community, the movement of traffic around instead of through it will alter the economic profile according to the net effect produced by the change in location of the highway.

This conceptual framework is a simple one. The major difficulty facing the investigator who attempts to work within this framework is one of finding tools of analysis capable of measuring realistically the changes in the economic profile brought about by dislocation of one of its components. The temptation is always present to assume away much of that which is probably present and to claim for the tools the capacity of measuring exactly changes whose identity can be known only roughly.

However, if the pattern of change can be understood and is predictable, tools of analysis can be built which stand a reasonable chance of performing the required task.

It is common for economic changes which take place at the community level to be in concert with similar changes at the state level. Moreover, this relationship is likely to persist over long periods of time imbuing the relationship with a predictive quality which is valuable in assessing the nature and extent of dislocation when it occurs. There is evidence of this relationship in the graphs depicting business activity for Brighton and the state. The possibility exists that the predictive relationship which has been established between the community and the state by this analysis will fail at the precise moment when the effect of the dislocation (the highway bypass) on the economic profile of the community is being judged, thereby rendering practically worthless any results that rest upon an interpretation of this relationship. Perhaps the only safeguard here is the precaution of the investigator. The associated risks are no different from the risks inherent in other decisions that the community and highway planner must make completely apart from the problem of the highway bypass. Justification for studies in this area of highway economic research lies in reducing the uncertainties concerning the impact of a proposed bypass on the well-being of the community.

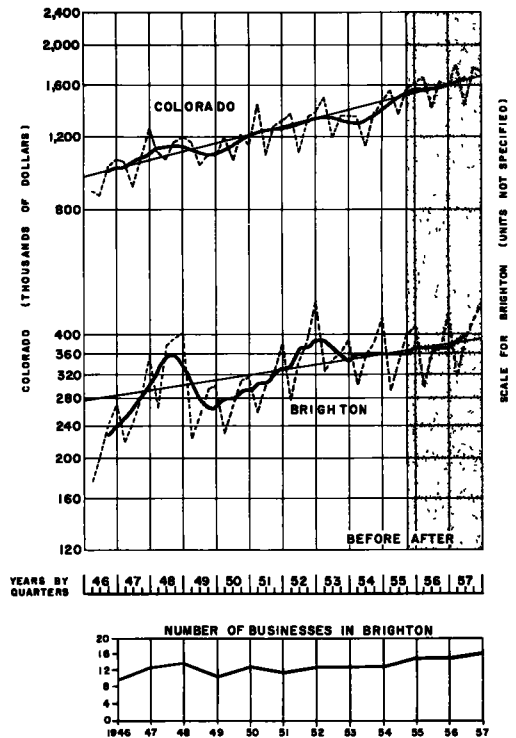


Figure 10. General merchandise group: comparison of Brighton and Colorado (ratio scale).

**POPULATION OF BRIGHTON AND COLORADO—1930, 1940 AND 1950**

	1930	1940	1950	Percent Changes	
				1930-40	1940-50
Brighton	3,394	4,029	4,336	+18.7	+ 7.6
Colorado	1,035,791	1,123,296	1,325,089	+ 8.4	+18.0

Source: U. S. Bureau of the Census, Census of Population, 1950.

**IMPACT ON LAND VALUE AND USE**

The subsequent portion of this paper deals with the impact, if any, that new and improved US 85 and US 87 have had on land value and land use in certain areas of Colorado where these highways are located. This study was based on the assumption that these highways, by virtue of their character and location, have affected the values and uses of land along their routes, and further that if such effects could be isolated and measured, a rational basis for estimating effects of similar, future highway improvements in Colorado might be provided.

Scope of the Study

The Colorado study is concerned with an examination of parcels of land located along US 85 and US 87 which are the principal north-south travel routes of Colorado and connecting links between the state's three largest cities, Denver, Colorado Springs, and Pueblo. Of the two, US 85 is the older—having been built several decades ago. With the building of US 87 since the end of World War II and with extensive improvements to portions of old US 85, an integrated network of divided-lane, limited-access highways has been provided. (Certain portions of old US 85 serve also as the route of new US 87 and therefore, carry the designation of US 85-87. The connecting links through Denver, Colorado Springs and Pueblo were still under construction at the time of the study.) Stages in the development of these highways over the period 1946 through 1958, are depicted in Figures 11-14. In this highway network, there are essentially three classes of road:

1. New highways—those constructed over new routes (US 87).
2. Old highways—those in existence before the study period (US 105 and 27, which were formerly US 85).
3. Improved old highways—where an additional lane has been built parallel to an old lane (US 85-87).

As will be noted later, this three-fold designation of highways serves an important role in the analysis.

Because some segments of the highway are not yet complete, and others not sufficiently complete to make meaningful before-and-after comparisons, it is clearly impossible to subject the entire network to examination. Moreover, certain areas are so bound up with influences other than the location of the highway that meaningful measurements of impact on land value and land use cannot be made. This applies particularly to a large portion of El Paso County north of Colorado Springs, which is greatly influenced by the Air Force Academy installation.

There is the methodological problem of choosing those parcels of land which provide the greatest opportunity for detection of impact of the highway. The decision was made to study those parcels which would certainly reflect the effect, if any existed, of the highway on the value and use of said parcels. Parcels abutting or virtually abutting the highway provide opportunity for fairly clearcut measurement of impact of the highway, though it is certain that some parcels not abutting the highway and, hence, not included, might also be affected by it. (For comments regarding the meaning of virtual abutment, see Appendix.)

Pertinent also to the concept of the present study is the variety of types of land over which the highways extend (Fig. 15). (In the rural area north of Denver in Adams

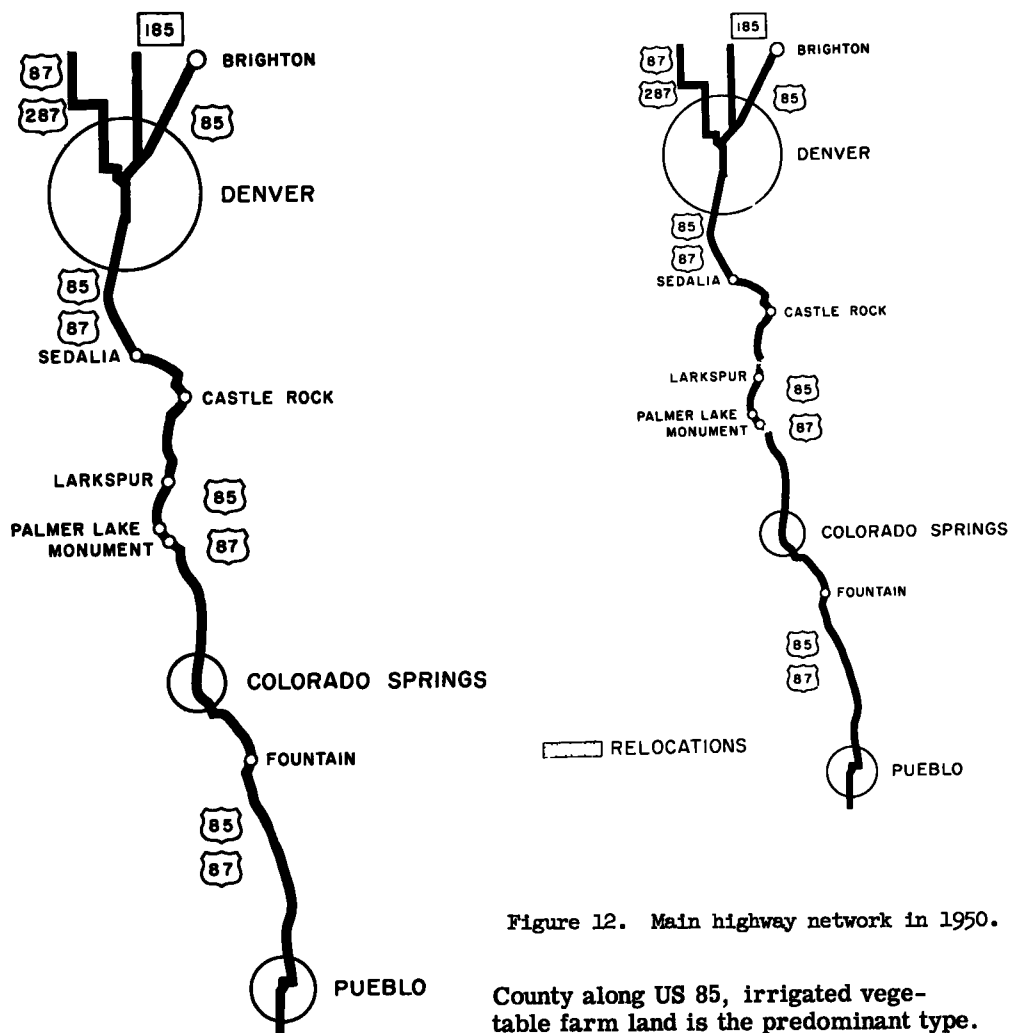


Figure 12. Main highway network in 1950.

Figure 11. Main highway network in 1946.

Paso and Pueblo Counties, grazing land predominates, though occasional parcels are under limited cultivation. The terrain throughout the length of the subject highway network is level to rolling, but not mountainous.) Type of land as well as type of highway plays a major role in the analysis. Effort is made to find out if given types of highway improvements exert different degrees and kinds of impact on four classes of land; namely, grazing, dry farm, irrigated and rural-urban land.

#### Concepts Important to the Study

**Land Value.** — It is important in a study which seeks to measure impact of a highway on land value, that a defensible and easy to apply definition of land value be established. There are a variety of meanings given to the word "value" in relation to land, depending on one's point of view. The most appropriate definition of value for purposes of this study is the amount of money (per some common unit) that given types of parcels of land command in the market place; for example, sales price per acre.

**Land Use.** — The concepts of land value and land use are intrinsically related. Land has value in terms of the use to which it is put, or in terms of its intended use. The

County along US 85, irrigated vegetable farm land is the predominant type. Dry farm land, excellent for the growing of wheat, rye and other grains, is the prime type of land in Adams County along US 87, and in Arapahoe County south of Denver. Farther south in Douglas, El

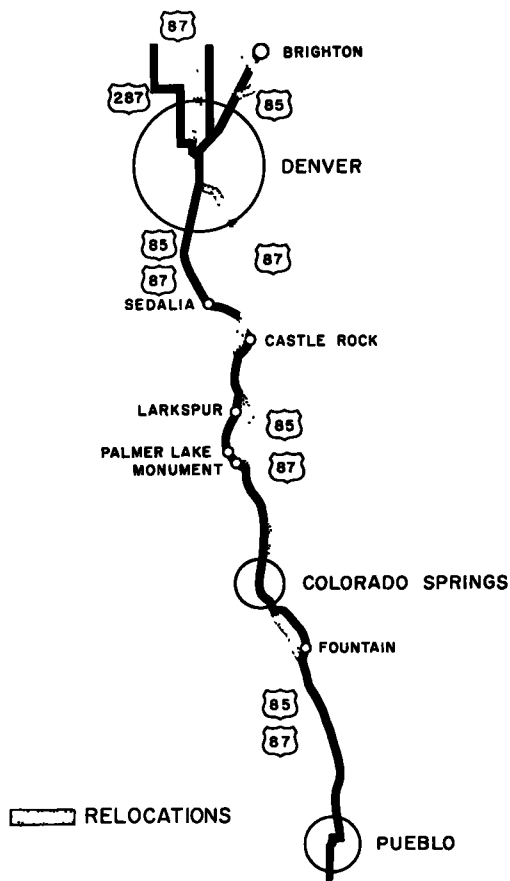
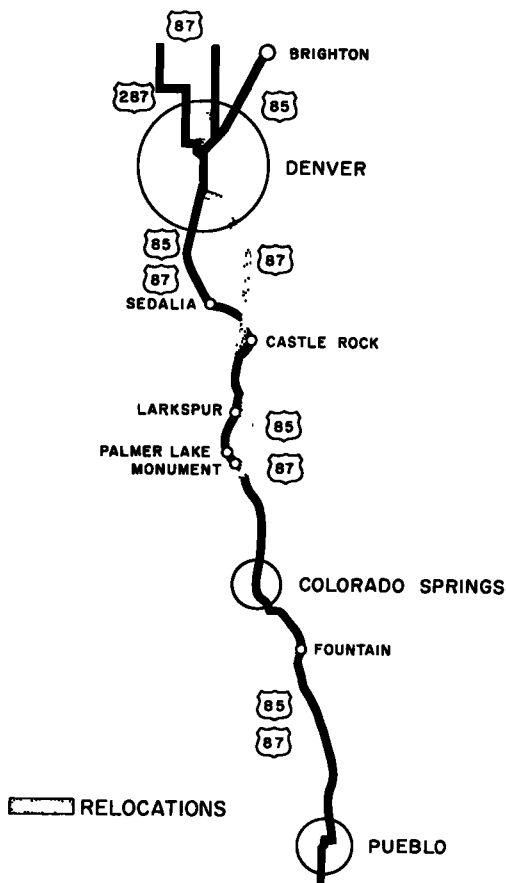


Figure 13. Main highway network in 1954.

Figure 14. Main highway network in 1958.

assumption is made in this study that land is in its "highest and best" use position at the time of sale, but that conditions may occur (for example, an impending highway) which may cause it to fall below its "highest and best" use position. As the findings will indicate, such influences are present in the case of some parcels as a result of the location of the highways.

Assignment of Parcels to "Before" and "After" Periods.—Equally difficult to define as land value is the date on which the landowner or potential purchaser of land located in the path of a proposed highway becomes "aware" of the impending development. This date is important. To a very great extent, this study is concerned with measuring what effect this "awareness" has on the price the buyer and seller of land will agree upon for a given parcel, and the use of which it is likely to be put. There will be varying degrees of awareness among different buyers and sellers; therefore, any date that might be used has its limitations. The date which has most to recommend it, however, is the approval date of the highway project; that is, that date on which agreement is reached by state and Federal highway planners regarding financial and construction arrangements for the proposed projects. It is this date which is assumed to mark the beginning of public awareness of the proposed highway. Sales of land occurring before the approval date for given segments of highway are designated "before"; and those occurring after this date are denoted "after".

## Data Collection Methods

To carry out the program of analysis previously indicated, requires the identification of parcels of land which abut the highway and have been sold during the period 1946-1957. The cash consideration in the sales price of a parcel was established from the value of revenue stamps affixed to the warranty deed. To arrive at an estimate of the full sales price, the amount of mortgages outstanding were noted in deeds of trust at the time of sale. Records kept by the county assessor in the various counties provided data on assessed valuations of land and improvements. Other data kept by the assessor as well as abstract companies, were necessary in identifying and determining the sizes of parcels. Such records were also useful in tracing successive sales of a given parcel, portions of an original parcel, or combinations of several parcels.

Illustrations of how the information was collected and recorded are shown in Figures 16 and 17. The sale of a parcel of rural land which changed hands only once during the period 1946-1957, is shown in Figure 16. Figure 17 illustrates a situation with regard to a fairly active parcel of land denoted as "rurban" because, in spite of its proximity to an urban community, it also evidences some of the characteristics of rural land. Further discussion of procedures employed in developing data on land transactions is contained in the Appendix.

An important consideration in the selection of areas for study was the tremendous task of developing information over many miles of road. Although some scheme of sampling might appear to be a feasible way of reducing the quantity of work involved, such was clearly impracticable because of the great variations in the essential characteristics of one transaction as compared with another. In addition, the magnitude of the task could not be completely known from the outset and could be fully realized only when the job of abstracting data was well under way. The data used are the result of efforts to achieve complete coverage of all property transfers within the period 1946-1957, over the segments of highway indicated.

The real property sales schedules were edited for completeness and evidence of reliability of data. With respect to the latter, there were numerous transactions which were omitted because of the strong possibility that they were not "bona fide" negotiated sales between earnest buyers and sellers; for example, a sale from John Smith to John Smith, Inc.; a sale in settlement of an estate, etc.

Limitations of these data are presented in the Appendix.

## Analysis Methods

A meaningful basis for classifying parcels had to be found before any analysis of the data could be undertaken. Experimentation with various bases led to the selection of the following:

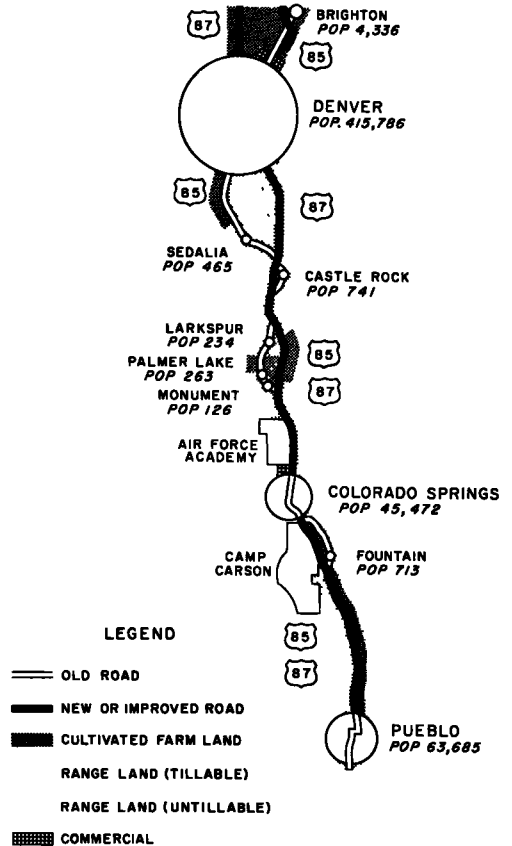


Figure 15. Main highway network in subject area and abutting culture (1958). (Size of circle is proportional to the population of community, 1950.)

REAL PROPERTY SALES SCHEDULE

Description:

COUNTY Douglas PHASE: RURAL DATES OF R.O.W. ACQUISITION 4/1/50  
 RANGE: 95 TWP: 47 TAX DISTRICT: 5 BEFORE AFTER  
 SECTION(S): 26, 27 PLAT NO: 32 T. NO. 1  
 DATE OF TRANSFER: 7/6/53 BOOK: 1101 PAGE 243  
 BUYER: Jones, A. B. SELLER: Smith, C. D.  
 DESCRIPTION: Sec. 26: S 1/2 NW 1/4, NE 1/4 NW 1/4 NW 1/4 NE 1/4, TRACT (55A) IN NE 1/4, Sec. 27: TRACT (37.37A) IN NE 1/4 SE 1/4  
 WARRANTY DEED REV. STPS.: 9<sup>90</sup> DEED OF TRUST STATED ON W. D. No  
 TERMS OF DEED OF TRUST: - BOOK: - PAGE: -

Computations:

SALES PRICE: 9000<sup>00</sup> IMPROVEMENT: YES   
 ACRES: 252.37 (TIME OF SALE) BASE REP. COST: - (1941)  
 PRICE PER ACRE W/IMP.: 36<sup>00</sup> IMPROVEMENT ASSESSMENT -  
 PRICE PER ACRE LAND ONLY: 36<sup>00</sup> CONST. COST INDEX: - (DATE OF SALE)  
 LAND ASSESSMENT: 1310 REPROD. COST AT TIME OF SALE: -  
 ASSESSMENT PER ACRE: 5.19 DISTANCE INDEX: 4.00 mi.  
 CLASSIF. OF LAND: HIGHWAY FRONTAGE: 2.12 mi.

TYPE	ACRES	ASSESSMENT	CENTER OF GRAVITY:
G-6	111.37	4 <sup>50</sup> 500 <sup>00</sup>	3.88 X 4.29 Y
G-7	100	3 <sup>20</sup> 320 <sup>00</sup>	REFERENCE POINT: 12 E 20 N
DF-4	41	12 <sup>00</sup> 490 <sup>00</sup>	
TOTAL	<u>252.37</u>	<u>1310<sup>00</sup></u>	

$$(710)(x) = (3.5)(10) + (4.5)(80) + (6)(320) + (3)(320) + (1.5)(80) + (0.5)(70)$$

$$x = \frac{3535}{710} = 3.00$$

$$710(y) = (0.5)(120) + (2)(160) + (3.5)(160) + (6)(320) + (6.5)(80) + (7.5)(70)$$

$$y = \frac{3905}{710} = 4.29$$

Figure 16.

(a) whether the parcel was sold "before" or "after" the program date of the highway; (b) whether the parcel was improved or unimproved; (c) whether the land was grazing, dry farm, irrigated or rural-suburban, each as determined by assessed valuation per acre; and (d) whether subject land abutted a "new" highway, an "improved-old" highway or an "old" highway.

This plan of classification provides opportunity for generalizing about the impact of various kinds of highway improvements on the several kinds of land which were identified.

REAL PROPERTY SALES SCHEDULE

Description:

COUNTY EI Paso PHASE: RURBAN DATES OF R.O.W. ACQUISITION \_\_\_\_\_

RANGE: 9B TWP: Z5 TAX DISTRICT: 41 BEFORE AFTER

SECTION(S): 36 PLAT NO: 4G T. NO. 4 - (1a-2+16) - 1

DATE OF TRANSFER: 2/11/53 BOOK: 1234 PAGE 567

BUYER: SARAN, V. SELLER: HENNING, R.

DESCRIPTION: SALE OF TRACTS # 4A + 4G

WARRANTY DEED REV. STPS.: 13<sup>20</sup> DEED OF TRUST STATED ON W. D. Yes

TERMS OF DEED OF TRUST: SARAN ASSUMES DOT BOOK: 109B PAGE: 991

of 7/2/51 FOR USE OF TREANOVIC, \$50,000 NOTE @ 6% P. A.; PAYMENTS OF 8.52/mo (inc. int) begin. 8/2/51

Computations:

SALES PRICE: 48,450 } 60,450 IMPROVEMENT: (YES) NO

ACRES: 1.69 (TIME OF SALE) BASE REP. COST: 30,500 (1941)

PRICE PER ACRE W/IMP.: 35,769 IMPROVEMENT ASSESSMENT 14,500

PRICE PER ACRE LAND ONLY: 12,593 CONST. COST INDEX: 131.6 (DATE OF SALE)

LAND ASSESSMENT: 450 REPROD. COST AT TIME OF SALE: 23,176

ASSESSMENT PER ACRE: 266 DISTANCE INDEX: 303'

CLASSIF. OF LAND:

TYPE	ACRES	ASSESSMENT
------	-------	------------

HIGHWAY FRONTAGE: 100'

CENTER OF GRAVITY: 215' X 120' X

SW COR. 46

REFERENCE POINT: E N

$$(1)(109) + (0.69)(366) = 1.697$$

$$109 + 253.9 = 1.697$$

$$7 = \frac{362.9}{1.69} = 214.7'$$

TOTAL \_\_\_\_\_

$$(1)(100) + (0.69)(150) = 1.697$$

$$100 + 103.5 = 1.697$$

$$7 = \frac{203.5}{1.69} = 120.4'$$

Figure 17.

A list of factors was devised which would relate sales price per acre of a given parcel to the possible impact of the highway on its value and use. Only a few of the factors explored proved productive under the criteria that reasonableness and consistency of relationships of impact should be obtainable. The factors which "held up" best under these criteria were:

1. Sales price per acre (adjusted for change in value of the dollar) for improved as well as unimproved parcels.

2. Distance of parcel in miles from an urban community.
3. Size of parcel in acres.
4. Assessed valuation as a basis for classifying land of given types and extent of improvement. For rural land, the following classifications were employed:
  - (a) Grazing land—assessed valuation per acre under \$10.
  - (b) Dry-farm land—assessed valuation per acre, \$10 and under \$40.
  - (c) Irrigated land—assessed valuation per acre, \$40 and under \$135.

"Rurban"-suburban properties were assumed to be characterized by land valuations which exceed \$135 per acre.

Some of the factors which did not prove productive were: highway frontage, distance between the highway and the center of gravity of the parcel, average elapsed time between sales of a given parcel related to the approval date, extent of land improvements and reproduction costs of improvements adjusted by cost indexes.

The relationship which was found to be most revealing of impact was that between adjusted sales price per acre, and the size (in acres) multiplied by distance of the parcel from an urban community.

These relationships, as they refer to various types of land and various types of highway improvements, are presented in a series of scatter diagrams as a part of the findings. These diagrams, plotted on a log-log paper because of the range of values existing in the acre-distance measurement, are intended to serve as a schematic representation of relationships revealing of the impact of the highway on land value and land use. Moreover, they are suggestive of approaches to the important task of predicting the character of impact which occur as a result of highway improvements.

### Findings of the Study

Some of the findings of the study relate to the effect of the highway on land value and land use; and others refer to the possibility that there are predictive qualities in certain relationships established in the study.

1. Of significance, first, is the fact that the value of nearly all types of rural land (whether improved or unimproved), as measured by sales price per acre, was greater in the "after" period than in the "before" period. This observation applies to the two forms of highway improvement in which before and after comparisons could be made namely, new highways and improved old highways (Columns 5-10, Table 1). (An old highway would naturally have no "before" and "after" time period within the present study. Data presented in Table 1, on real property transactions along the route of "old" highways allow comparisons between improved and unimproved properties only.) Undoubtedly, some part of such increase in value is attributable to factors other than the existence or impending existence of the highway. The fairly consistent increase in value, however, over most all types of land strongly suggests that the highway has given location value to properties adjacent to it.

2. There are wide differences in the extent of impact on various classes of land according to type of highway improvement adjacent to the highway. A few classifications of land display little or no increase in value, and in one instance, there is a decline in value in the after period, as compared with the before period. These observations suggest that land value is at least partly a function of the type of highway as well as the type of land within the zone of influence of the highway. This contention is further supported by evidence that unimproved parcels, in the case of all classes of land, show a greater relative increase in value than improved properties; and also by evidence that irrigated land parcels, upon which there were improvements at the time of sale, show substantially less appreciation in sales price per acre in the after period than do improved grazing or dry farm land parcels (Table 1). It appears that there is greater appreciation in sales price per acre of parcels located along new highways than alongside improved old highways. This is particularly true in the case of grazing land and "rurban" land whose parcels along improved old highways show virtually no appreciation at all, while substantial increases are noted to have occurred alongside new highways.

3. Indications of impact of the highway on land use are reflected in the differences in number of transactions, size of parcels sold, and distance of parcels from a metro-



politan community for the before period as contrasted to the after period. It seems noteworthy that the number of transactions, particularly of unimproved properties, is substantially greater alongside of new highways than alongside of improved-old highways. The average size of parcels of land sold in the after period was generally less than in the before period. The average distance from a metropolitan community was greater for parcels sold in the after period than in the before period. This fact is consistent with what is already obvious—that expansion of a community occurs in areas made accessible by improved highways and that as land becomes scarce, the parcels available for purchase become farther removed from the community.

4. If it is true that land available for purchase becomes increasingly scarce as one approaches a metropolitan community (for example, Denver, Colorado Springs, or Pueblo) it follows that such scarcity causes land to be more valuable, and hence capable of commanding a higher market price. Also because of the scarcity of available land, it is reasonable that the size of parcels available for purchase are smaller, on the average, the closer said parcels are to a metropolitan community, and that value as reflected by sales price per acre is greater (Columns 19-22, Table 1). In short, then, if what has been said is true, the interrelationship of these two factors—distance from a community and size of parcel—should bear a joint relationship to the value of said parcel.

The tenability of this hypothesis was tested through use of "scatter diagrams" in which a dot "before" the highway and an (x) "after" the highway was plotted for each parcel sold according to the product of the size of the parcel and its distance from Denver, Colorado Springs, or Pueblo (Figs. 18-23). (See the Appendix for a discussion of the rationale behind the determination of which city, Denver, Colorado Springs, or Pueblo, should be used in making the distance measurement.)

The results shown in Figure 8 and 19, for "new" highways, are interesting. In the case of grazing land, transactions in the "before" period take no discernible pattern; that is, sales price per acre and size-distance (measured by acre-miles) appear to be randomly distributed (Fig. 18). This is the pattern which one might expect because the highway is not in existence, and hence, can not give location value to parcels which are sold. In the "after" period, however, the data tend to show an inverse relationship between sales price per acre and acre-miles of parcels sold; that is, the smaller the acre-miles factor, the larger the sales price per acre, and conversely. This result makes tenable the hypothesis proposed earlier; namely, that a highway reflects location value on abutting land by making it more accessible, and hence, more desirable for purchase. The more desirable land is for purchase, the more scarce it becomes and the higher its price. The results for "rurban"-suburban land (Fig. 19), are similar to those for grazing land, though they are not quite so sharp. Nonetheless, "before" period transactions appear to be randomly distributed, while "after" period transactions display the expected inverse relationship between sales price per acre and acre-miles.

Further evidence of the reasonableness of this notion is found in the relationships in the case of parcels which abut "improved-old" highways (Fig. 20) and parcels which abut "old" highways (Figs. 21, 22, and 23). While the relationship between sales price per acre and acre-miles is more evident in some instances than in others, it is apparent that, in general, it is upheld. An "improved-old" highway, for which there is a "before" and "after" period to which transactions can be assigned, should reflect such relationship in both periods simply because of impact of the accessibility provided by the "old" highway before it was improved (that is, before another lane was added). The same line of reasoning applies to the several parcels adjacent to "old" highways.

In the case of dry farm land and irrigated land parcels the hoped for relationships were obscured by the fact that a particular segment of "new" highway which was involved was very close to an "old" highway. The implication is that subject parcels would reflect a relationship between sales price per acre and acre-miles in both the "before" and "after" periods simply because they were influenced by the long existing accessibility of the "old" highway nearby (Figs. 11-15).

TAB  
CHARACTERISTICS OF REAL PRO  
BY TYPE OF PAR

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
	Number of Transactions				Adjusted Sales Price Per Acre				Change in Adj Sales Price Per	
	Improved Parcels		Unimproved Parcels		Improved Parcels		Unimproved Parcels		Improved Parcels	Unimproved Parcels
	Before	After	Before	After	Before	After	Before	After		
<b>New Highways</b>										
Grazing Land	10	16	7	16	15.14	48.35	12.56	151.15	+219.4	
Dry Farm Land	22	12	22	34	99.83	318.29	56.34	288.94	+218.8	
Irrigated Land	22	15	6	18	314.89	614.54	148.95	1465.07	+ 95.2	
Total or Average	54	43	35	68	50.49	72.69	34.99	235.53	+ 44.0	
<b>Improved-Old Highways</b>										
Grazing Land	45	13	12	14	39.65	36.64	8.89	9.82	- 7.6	
Dry Farm Land	16	22	13	9	81.75	308.29	89.85	381.46	+277.1	
Irrigated Land	4	--	2	--	907.50	--	309.00	--	--	
Total or Average	65	35	27	23	441.41	81.38	9.92	12.73	--	
<b>Old Highways</b>										
Grazing Land		9		4		24.96		159.82	--	
Dry Farm Land		29		6		194.13		61.57	--	
Irrigated Land		16		3		355.82		465.78	--	
Total or Average		50		13		129.23		112.22	--	
<b>Grazing Land</b>										
New Highways	10	16	7	16	15.14	48.35	12.56	151.15	+219.4	
Improved-Old Highways	45	13	12	14	39.65	36.64	8.89	9.82	- 7.6	
Total or Average	55	29	19	30	34.33	45.36	9.48	19.88	+ 32.1	
<b>Dry Farm Land</b>										
New Highways	22	12	22	34	99.83	318.29	56.34	288.94	+218.8	
Improved-Old Highways	16	22	13	9	81.75	308.29	89.85	381.46	+277.1	
Total or Average	38	34	35	43	88.49	311.72	60.24	299.60	+252.3	
<b>Irrigated Land</b>										
New Highways	22	15	6	18	314.89	614.54	148.95	1465.07	+ 95.2	
Improved-Old Highways	4	--	2	--	907.50	--	309.00	--	--	
Total or Average	26	15	8	18	318.71	614.54	149.92	1465.07	+ 92.8	
<b>Rurban-Suburban Land</b>										
New Highways	8	40	7	32	13746.00	12057.00	1989.00	8292.00	- 12.3	
Improved-Old Highways	5	5	4	3	20042.00	9344.00	6455.00	774.00	- 53.4	
Total or Average	13	45	11	35	16168.00	11756.00	3974.00	7645.00	- 27.3	

1. Transaction classified "before" if sale took place on or before approval date of construction of highway in question. "After" refers to sale after approval date.
2. Average Distance of Parcel to City: See "Location and Identification of Abutting Parcels" (Appendix).
3. Adjusted Sales Price Per Acre is sales price per acre adjusted for price changes by applying price indexes corresponding to type of land sold, i.e., Grazing, Dry Farm, or Irrigated.

**EXHIBIT 1**  
**PROPERTY TRANSACTIONS CLASSIFIED BY TYPE OF LAND AND HIGHWAY**

(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Number of Improved Acres	Average Size of Parcels Sold				Average Distance of Parcel to City				Average Acre-Miles			
	Improved Parcels		Unimproved Parcels		Improved Parcels		Unimproved Parcels		Improved Parcels		Unimproved Parcels	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
	(In Acres)				(In Miles)				(Acres X Miles)			
103.4	691.00	487.00	455.00	164.00	27.30	29.30	10.30	19.40	12842.00	17379.00	4357.00	1680.00
412.8	75.00	23.00	72.00	61.00	8.00	5.50	6.30	18.40	832.00	201.00	698.00	200.00
889.0	28.00	15.00	55.00	5.00	4.00	4.00	4.90	3.80	158.00	36.00	104.00	26.00
573.1	170.00	188.00	146.00	70.00	9.90	11.20	6.90	14.80	2781.00	6535.00	1328.00	502.00
10.5	553.00	206.00	1386.00	2446.00	15.10	10.90	9.00	12.20	968.00	270.00	549.00	2628.00
326.5	180.00	24.00	16.00	30.00	8.90	6.80	6.60	4.10	3122.00	322.00	218.00	361.00
--	1.00	--	1.00	--	8.00	--	7.90	--	8.00	--	8.00	--
--	427.00	92.00	624.00	1501.00	13.10	8.30	7.80	9.00	1439.00	303.00	350.00	1741.00
	371.00		79.00		24.50		16.70		11944.00		1557.00	
	52.00		82.00		11.30		9.60		610.00		807.00	
	69.00		9.00		8.60		6.90		521.00		65.00	
	119.00		64.00		13.70		11.20		2670.00		867.00	
103.4	691.00	487.00	455.00	164.00	27.30	29.30	10.30	19.40	12842.00	17379.00	4357.00	1680.00
10.5	553.00	206.00	1386.00	2446.00	15.10	10.90	9.00	12.20	968.00	270.00	549.00	2628.00
109.7	578.00	361.00	1043.00	1229.00	17.30	21.10	9.50	16.00	3127.00	9709.00	1952.00	2122.00
412.8	75.00	23.00	72.00	61.00	8.00	5.50	6.30	18.40	832.00	201.00	698.00	200.00
326.5	180.00	24.00	16.00	30.00	8.90	6.80	6.80	4.10	3122.00	322.00	218.00	361.00
397.3	119.00	24.00	51.00	55.00	8.40	6.30	6.50	15.40	1796.00	279.00	520.00	234.00
889.0	28.00	15.00	55.00	5.00	4.00	4.00	4.90	3.80	158.00	36.00	104.00	26.00
--	1.00	--	1.00	--	8.00	--	7.90	--	8.00	--	8.00	--
877.2	24.00	15.00	42.00	5.00	4.60	4.00	5.60	3.80	135.00	36.00	80.00	26.00
316.9	0.58	0.90	2.80	0.80	0.46	7.33	1.30	1.10	0.28	8.20	14.40	1.40
88.0	2.63	1.78	1.67	6.67	1.12	0.60	1.18	3.03	3.20	1.30	1.95	22.87
92.4	1.37	1.00	2.39	1.30	0.71	6.58	1.26	1.27	1.40	7.43	9.87	3.24

4. Grass Land classified as land assessed at less than \$10 per acre at time of sale.
5. Dry Farm Land classified as land assessed at \$10 and under \$40 per acre at time of sale.
6. Irrigated Land classified as land assessed at \$40 and under \$135 per acre at time of sale.
7. Urban-Suburban Land classified as land assessed at \$135 or over per acre at time of sale.

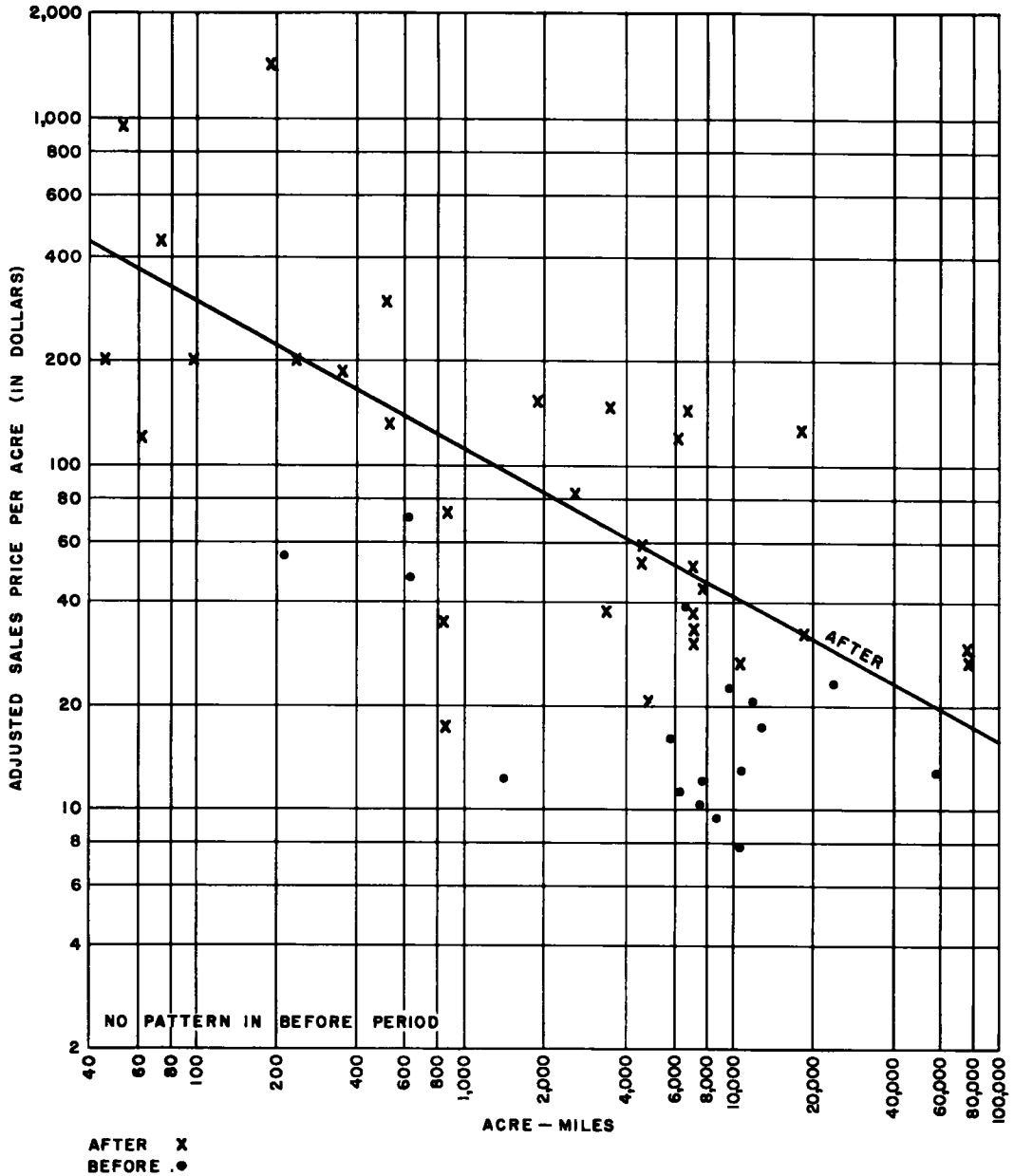


Figure 18. Relationship of sales price per acre and acre-miles:grazing land parcels before and after new highways.

### Implications of the Findings

The supposition that a highway gives location value to abutting land seems to be fairly clear from the evidence derived in the study. Such location value is simply a manifestation of the fact that land made accessible by an improved road will become more valuable land. When an existing road is improved, some enhancement in value in abutting land should be expected but, as shown in the present study, the relative increase in value is not as great as in the case of a new highway improvement. This may

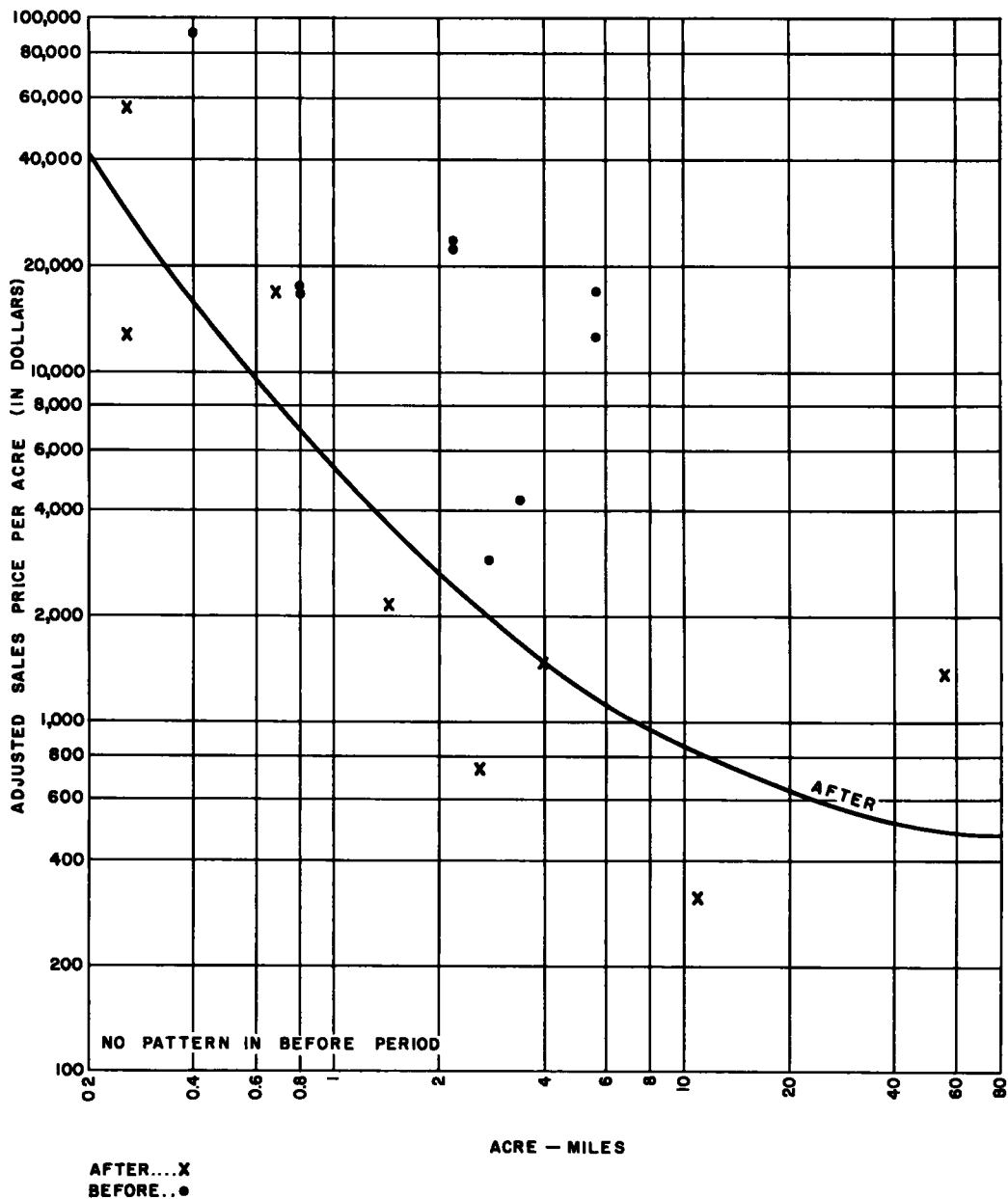


Figure 19. Relationship of sales price per acre and acre-miles: suburban-rurban land parcels before and after new highways.

be explainable by the fact that land adjacent to an "improved-old" highway has simply been made more accessible by virtue of the improvement made to it. The tentacles of urban expansion into suburban and rurban areas are inclined to follow the lines of least resistance, in proximity to major access routes. Such forces of expansion have been present in Denver, Colorado Springs and Pueblo for at least 10 years. Because of the scarcity of land it is reasonable to assume that land values and the land use

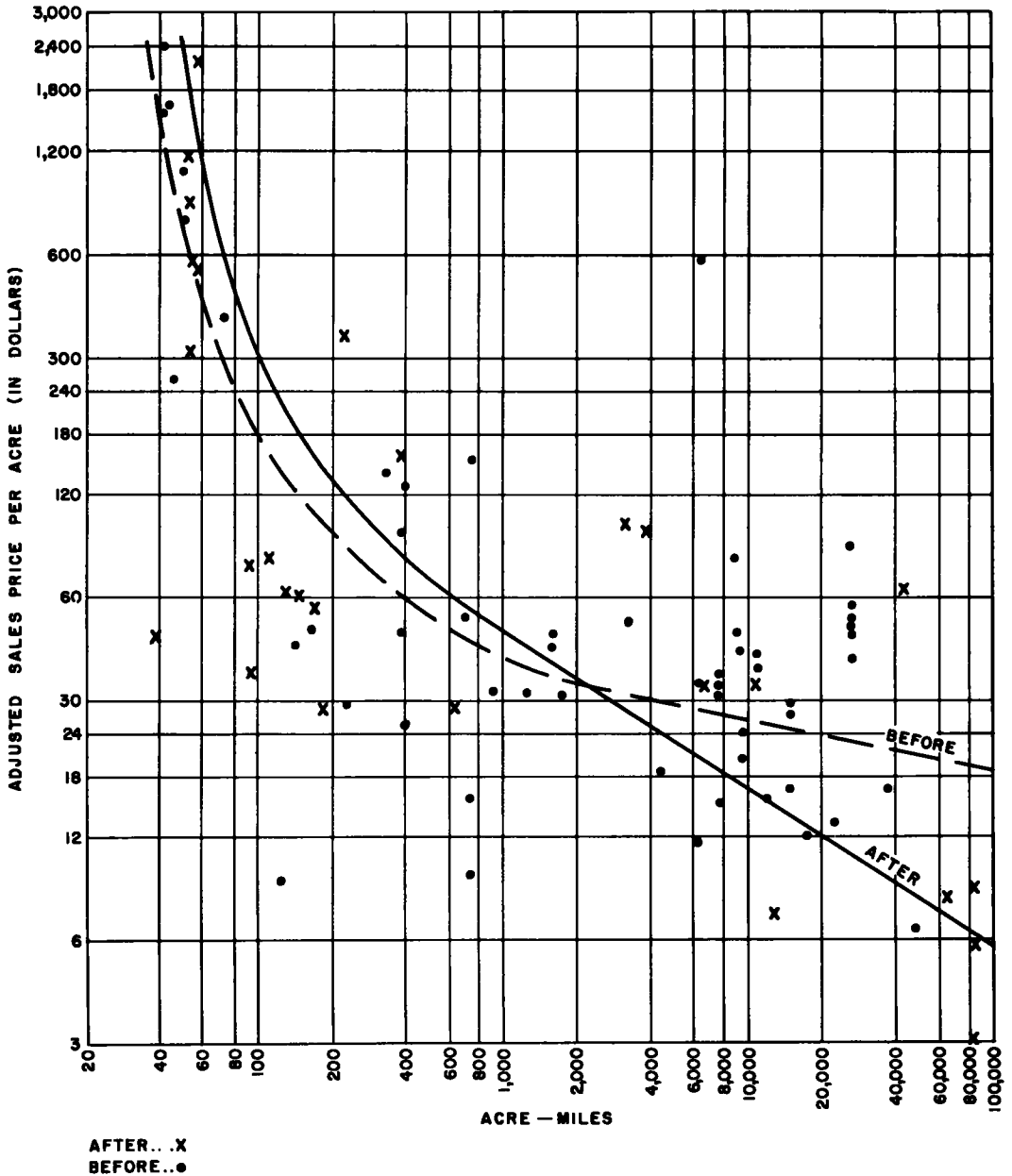


Figure 20. Relationship of sales price per acre and acre-miles:grazing land parcels before and after improved-old highways.

structure along an established, though improved, highway would not be affected as much by the improvement as land "opened up" by a "new" highway.

Inasmuch as land has value in terms of the use to which it is put, it would seem reasonable, also, that an improved parcel, particularly one which is intensively improved and comparatively small in size, would be less susceptible to forces which might tend to alter its present use. This reasoning is supported by the fact that, generally speaking, improved properties reflect less impact from highway location than do unimproved properties.

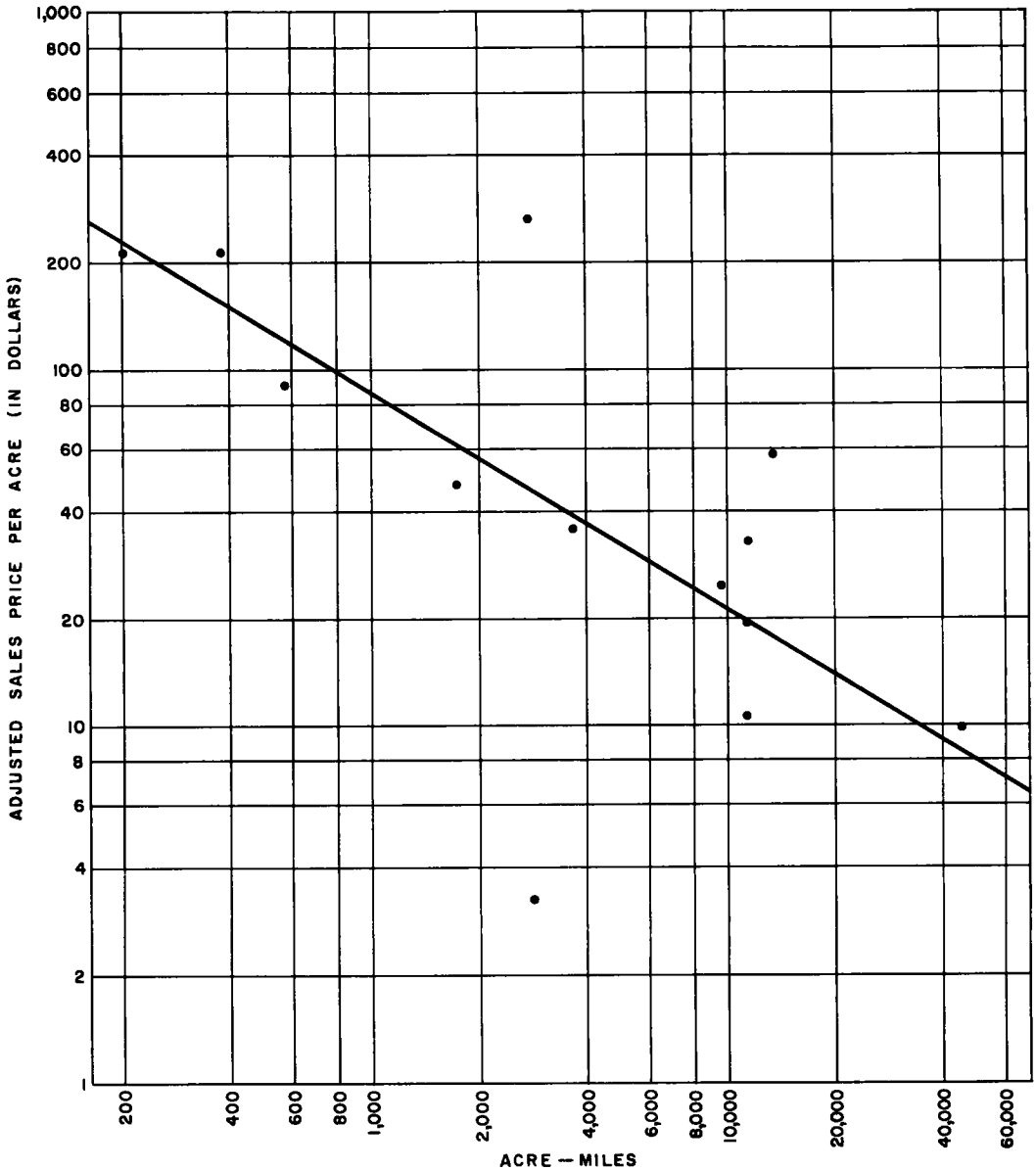


Figure 21. Relationship of sales price per acre and acre-miles: grazing land parcels, old highway, 1946-57.

This same line of reasoning applies to differences in impact noted between types of land sold in the "before" period as compared with the "after" period. Improved grazing land which has the lowest use value per acre (in terms of assessed valuation), reflects the greatest relative amount of impact from the highway, while rural-suburban land, which has the highest use value per acre, reflects the least relative amount of impact from the highway. These observations indicate that the more valuable the land is in its present use, the less will be the influence of a highway improvement adjacent to it.

The notion that the size of the parcel and its distance from a metropolitan community

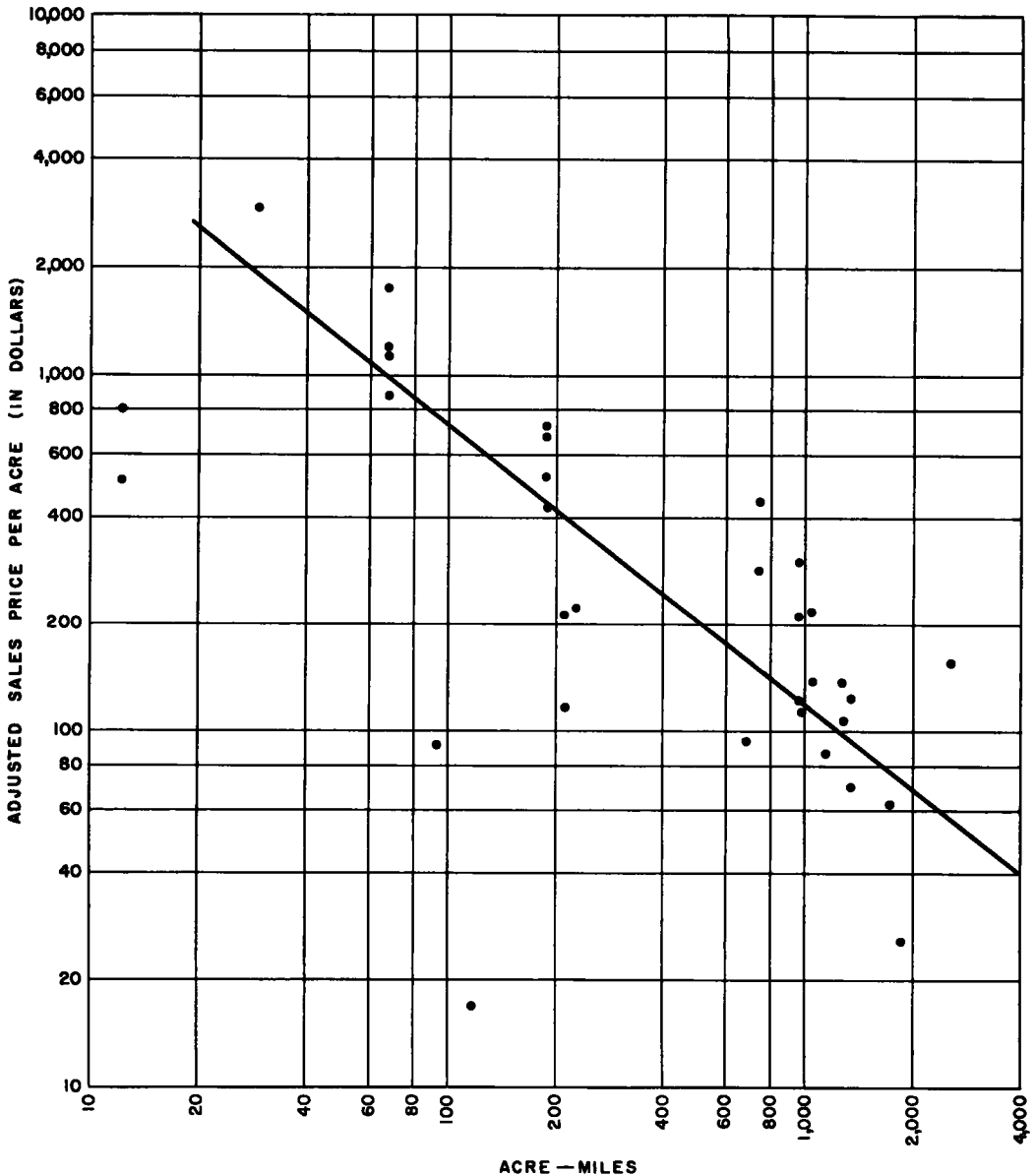


Figure 22. Relationship of sales price per acre and acre-miles: dry farm land parcels, old highway, 1946-57.

are jointly related to the value of said parcel has been examined in this paper. It was believed that some predictive qualities of land value relative to highway location might be provided if a relationship could be established for parcels included in the study. Because highways make land accessible to a community and because accessibility is a prime contributor to the value of land, then it follows that the relationship of size-distance to sales price per acre shows to what extent a given parcel of land is made accessible by a given highway. For example, one might expect to find no discernible relationship between size-distance and sales price per acre in the case of parcels sold "before" the program date of a "new" highway; but "after" said program date, such relationship should appear.



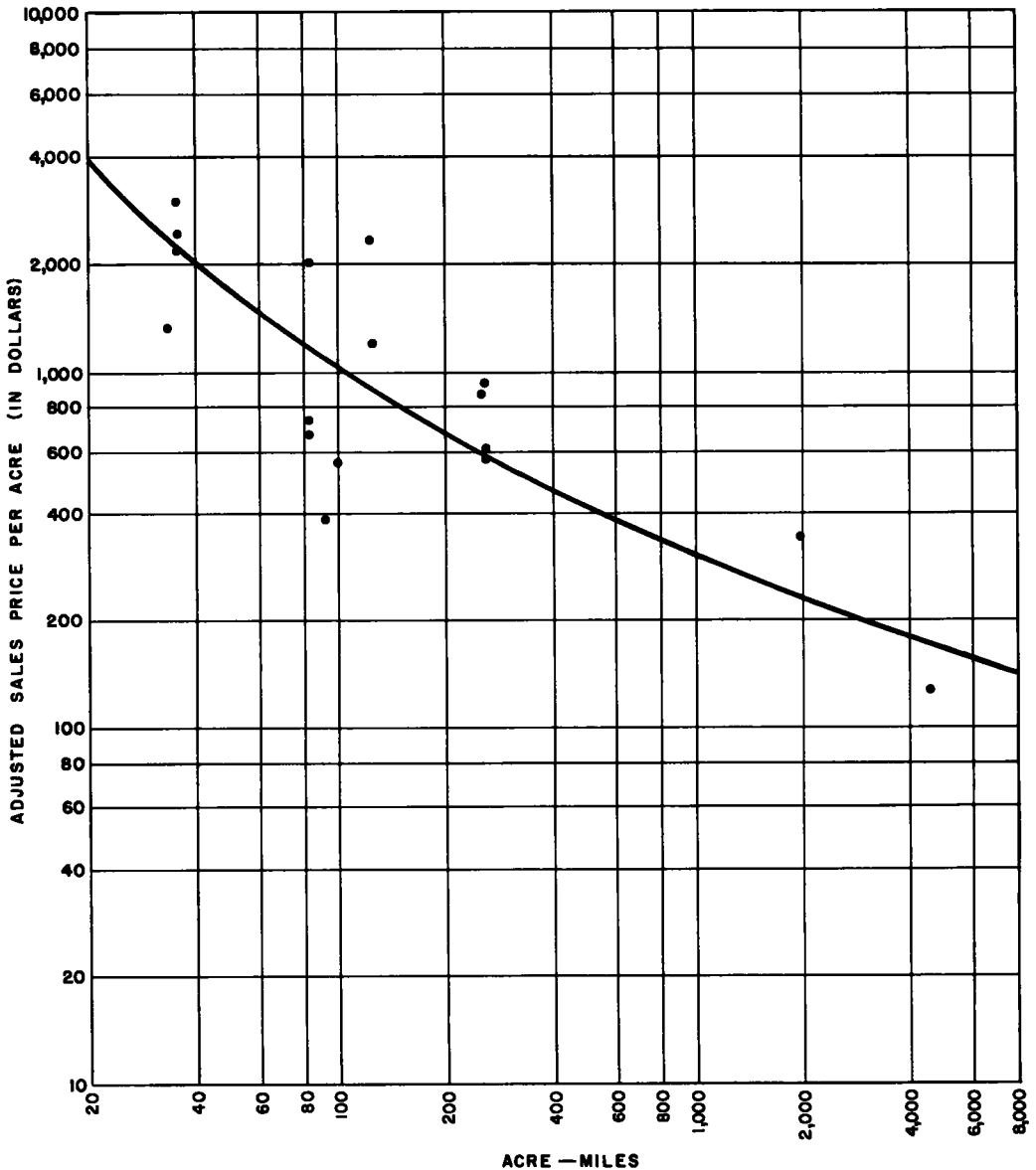


Figure 23. Relationship of sales price per acre and acre-miles: irrigated land parcels, old highway, 1946-57.

If these relationships do have predictive qualities, it would seem that they are in terms of providing the highway planner with some yardsticks as to what impact might be expected for given types of parcels in relation to the given kind of highway improvement whose location make such land more or less accessible.

The findings of this phase of the study, as well as the methodology employed, are regarded as somewhat tentative in nature. Not only is it probably too early to tell what the ultimate impact of the highway network will have on land value and land use; but in important respects there has been set forth in Colorado some rather fundamental

generalizations and a new slant on methods of analysis of impact which, of course, must stand the tests of further studies.

#### ACKNOWLEDGMENT

Acknowledgment is made to the Planning and Research Division, Colorado Department of Highways, for use of the data and the careful preparation of the Figures, and tables in this paper.

### *Appendix*

#### COLLECTION OF SALES TAX DATA

The analysis of business activity in this study requires quarterly sales tax collections by various business groups over the period 1946-1957. Information covering these business classes had to build up from reports of sales tax collections from individual businesses. A complete search of the records month by month was necessary to develop a 12-yr business history of the individual store. Identity of the business had to be established; in addition, change in ownership, temporary closing of the store and conversion in type of business had to be recognized and dealt with. For the years 1956 to 1957, such information was more handily acquired than for the years 1946 to 1955, because the records for these later years were kept on electrically operated rotary filing drums. Data for the earlier years, 1946 to 1956, were compiled from microfilms.

The form used in the compilation of sales tax data is shown in Figure 24, on which have been recorded examples of the entries made. The top part of the form was cut off after the entries were made in order to conceal the identity of the business.

#### COMPUTATIONS FOR THE CENTERED 4-QUARTER MOVING AVERAGES

Data of the sort shown in Figure 24, were summarized by quarters for the years 1946 to 1957 for each business group having four or more stores doing business in each of the years 1946 to 1957. Data were rounded to the nearest dollar.

Figure 25 shows a summary of total sales tax collections for Brighton, Colorado. The circled figures are the number of firms from which sales taxes were collected.

Centered 4-quarter moving averages were obtained by averaging together successive quarterly totals and "centering" the averages so that each average could be referred to a given quarter. This procedure is illustrated step by step, taking the first few years of sales tax collections for Brighton from Figure 25.

1. Total collections for the four quarters, 1946, is \$78,746. Dividing by four gives \$19,686, the average quarterly collection for these four quarters.

2. "Moving" now to the total collections for the 2nd, 3rd, and 4th quarters of 1946, and 1st quarter, 1947, gives \$84,336. Dividing by four gives \$21,084, the average quarterly collections for the second successive group of four quarters. In the next step, the 3rd and 4th quarters of 1946, and the 1st and 2nd quarters of 1947, are added together and the result divided by four, which gives an average per quarter of \$22,837.

3. Each of these averages is logically not related to any given quarter. For example, the average \$19,686, obtained from the four quarters of 1946, would pertain to a time halfway between the end of the 2nd quarter and end of the 3rd quarter. This difficulty is remedied by "centering" the moving averages. For instance, the average of \$19,686 and \$21,084, or \$20,385, can be referred to the 3rd quarter of 1946. This figure is the "4-quarter centered moving average" for the 3rd quarter, 1946.

This process is represented schematically in table on page 63.

Figure 26 shows the 4-quarter centered moving averages of total sales tax collections in Brighton over the period 1946-1957. Note that there are no centered moving averages for the first two quarters of 1946, nor the last two quarters of 1957. Information for these four quarters has been sacrificed in order to obtain a description of the general movement of the data over the years.

Year	Quarter	Collections	Moving Total	Moving Average	4-Quarter Centered Moving Average
1946	1	15,459	78,746	19,686	20,385
	2	17,766			
	3	22,272			
	4	23,249			
1947	1	21,049	93,803	23,451	22,248
	2	24,777			
	3	31,739			

**QUARTERLY ESTIMATES OF TOTAL COLORADO SALES TAX COLLECTIONS  
FOR VARIOUS BUSINESS GROUPS  
2ND QUARTER, 1954 TO 4TH QUARTER, 1957**

Statistics of sales tax collections for various business groups have been available from the Colorado Department of Revenue for many years. Because of pressing demands of other work made on the Department and because of temporary disruption in the production of statistical data during the installation of data processing equipment, these data have not been available since the 3rd quarter of 1954. The analysis conceived for this study calls for the construction of a time series of sales tax data for individual business groups statewide so that comparisons can be made to companion sales tax data for selected communities. Such a program requires estimates of statewide sales tax collections classified by business group for the period from the 3rd quarter, 1954 to the 4th quarter, 1957.

Present Owner	<u>A Shopin</u>	Name of Business	<u>Shopin's Bicycle Shop</u>	Owner No	<u>3-61</u>
Previous Owner	<u>G Beardwell</u>	Previous Name	<u>G &amp; V Market</u>	" "	<u>3-42</u>
Next Prev "	<u>D Mearry</u>	Next Prev Name	<u>Mearry's Inn</u>	" "	<u>3-22</u>
Third Prev "	<u>S. Tealovic</u>	Third Prev Name	<u>310 RESTAURANT</u>	" "	<u>3-20</u>
Fourth Prev "	<u>H. Paedovich</u>	Fourth Prev Name	<u>310 RESTAURANT</u>	" "	<u>3-17</u>

CUT HERE AND DESTROY TOP PART

47-499C	Tax Ser #	Lo - tion	Pur Class	Tax	Owner ship	Beg Date	Close Date	Owner No
		<u>CANYON ROCK</u>						
		<u>210 So. Bram</u>	<u>2-2</u>	<u>Q</u>		<u>7/11/50</u>	<u>/ /</u>	
<u>47-410 B</u>		"	<u>3-4</u>	<u>M</u>		<u>4/30/55</u>	<u>10/15/55</u>	" "
<u>47-375 D</u>		"	<u>3-6</u>	<u>Q</u>		<u>8/2/53</u>	<u>3/22/55</u>	" "
<u>47-710 A</u>		"	<u>3-6</u>	<u>Q</u>		<u>11/1/51</u>	<u>6/29/53</u>	" "
<u>47-620 A</u>		"	<u>3-6</u>	<u>M</u>		<u>3/4/46</u>	<u>6/13/45</u>	" "

SALES TAXES PAID (Includes refunds and assessments)

YEAR	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC.	TOTAL
1957			<u>19 21</u>			<u>35 61</u>			<u>72 12</u>			<u>40 21</u>	
1956									<u>3 11</u>			<u>7 15</u>	
1955			<u>12 01</u>	<u>72 91</u>	<u>83 00</u>	<u>59 96</u>	<u>63 41</u>	<u>42 59</u>	<u>30 02</u>	<u>110 97</u>			
1954			<u>30 62</u>			<u>37 11</u>			<u>44 22</u>			<u>10 40</u>	
1953			<u>1 11</u>			<u>14</u>			<u>7 77</u>			<u>29 31</u>	
1952			<u>3 72</u>			<u>5 21</u>			<u>0 61</u>			<u>4 19</u>	
1951												<u>03</u>	
1950													
1949													
1948	<u>5 11</u>	<u>5 43</u>	<u>6 13</u>	<u>2 55</u>	<u>1 13</u>	<u>12</u>							
1947	<u>5 17</u>	<u>6 32</u>	<u>5 10</u>	<u>8 04</u>	<u>9 10</u>	<u>10 41</u>	<u>15 26</u>	<u>11 23</u>	<u>10 36</u>	<u>14 55</u>	<u>9 47</u>	<u>10 01</u>	
1946			<u>10</u>	<u>1 20</u>	<u>2 40</u>	<u>3 16</u>	<u>4 10</u>	<u>6 20</u>	<u>5 30</u>	<u>14 76</u>	<u>0 29</u>	<u>9 39</u>	
TOTAL													

Figure 24.

The procedures used in making these estimates follow closely one of the more classical, empirical methods for dealing with time series data. This method would suppose in the present case that a time series of sales tax collections is composed of four components: (1) trend (T) which characterizes the long-term, inherent growth forces in the series; (2) cyclical fluctuation (C) which denotes the long-term, somewhat cyclical, variations which occur in varying degrees in all series; (3) seasonal variation (S) which denotes the periodic fluctuation which occurs from quarter to quarter within the span of a year; and (4) residual variation (R) which denotes that which is left over when T, C, and S are filtered out.

It is supposed, also, that each of these components enters into the original series (O) in such a way that one may symbolically represent the original series as the product of the four components; that is,  $O = T \times S \times C \times R$ . Because each of these components tends to behave in a manner which is predictable, estimates for the missing quarters are made by dismembering the original series into its components according to the formulation  $O = T \times S \times C \times R$ .

Procedures used to isolate each of the individual factors often involve several steps, the result of each step yielding a combination of components. A practical procedure for developing estimates of the values of  $T \times C$  is by the method of "4-quarter centered moving averages" explained earlier. Values of T are then derived by "fitting" or approximating the movement of these 4-quarter centered moving averages by selecting from a number of possible mathematical curves one which appears to describe the series fairly well. On the other hand, the fitting might be done freehand.

Cyclical variation is not so conveniently projected mathematically as are the values of T, and freehand projections are often used. For short periods of time, freehand projections appear to give results that are usually quite as good as those obtained using mathematical formulations.

Present Owner _____	Name of Business _____	Owner No _____
Previous Owner _____	Previous Name _____	" " _____
Next Prev. " _____	Next Prev. Name _____	" " _____
Third Prev. " _____	Third Prev. Name _____	" " _____
Fourth Prev. " _____	Fourth Prev. Name _____	" " _____

CUT HERE AND DESTROY TOP PART

Tax Ser #	Locs- tion	Business Class	TOTAL Tax	Owner ship	Beg. Date	Close Date	Owner No.
	<i>Brighton</i>	<i>411 Groups</i>			/ /	/ /	" "
					/ /	/ /	" "
					/ /	/ /	" "
					/ /	/ /	" "

YEAR	SALES TAXES PAID (Includes refunds and assessments)												TOTAL
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	
1957		(225) 14,527			(227) 5,370			(237) 6,138			(237) 5,704		
1956		(234) 13,256			(249) 5,359			(248) 5,350			(259) 4,790		
1955		(224) 7,224			(219) 5,728			(230) 5,762			(231) 4,920		
1954		(212) 38,718			(217) 46,628			(230) 48,072			(228) 52,432		
1953		(217) 46,710			(219) 49,426			(223) 47,716			(217) 45,262		
1952		(219) 28,746			(215) 45,202			(229) 47,416			(226) 50,852		
1951		(215) 29,520			(218) 45,244			(216) 46,332			(218) 44,756		
1950		(224) 32,616			(224) 27,124			(231) 49,361			(221) 31,799		
1949		(207) 29,000			(210) 45,532			(211) 42,793			(212) 45,864		
1948		(161) 29,444			(162) 32,244			(157) 36,255			(160) 33,412		
1947		(135) 41,082			(171) 24,772			(181) 41,729			(188) 43,766		
1946		(179) 15,452			(177) 17,766			(187) 22,274			(186) 23,299		
TOTAL													

Figure 25.

Values of S resulting in an index of seasonal variation are obtained by dividing the values of T x C for each quarter into the corresponding quarterly values of the original series. Symbolically the result of this division is S x R, since T x C is divided into T x C x S x R. The effect of R is then removed from S x R by simply taking a median of all the first quarter values of S x R, all second quarter values of S x R, etc. The hoped-for result is an index which typifies the variation in sales tax collections from one quarter to the next for any year.

The step-by-step procedure actually employed to obtain quarterly estimates of Colorado sales tax collections for various business groups is outlined:

1. Tax figures for each of the quarters in the years 1946-1953, and the first two quarters of 1954, were obtained from the Colorado Department of Revenue covering each of the business groups listed in step 4.
2. Tax collections for a given business group were expressed as proportions of total statewide tax collections quarter by quarter. Proportions were used in preparing estimates, rather than the actual collections. Because proportions tend to be less variable than actual collections, estimates based on their use are more reliable.
3. The method of "4-quarter centered moving averages" was applied to the figures derived from step 2, and the results were placed on graphs to facilitate the selection of the appropriate curve for deriving trend.
4. Values of T were developed for each business group according to the following
  - a. Apparel group—mathematical fit given by the equation,  $y = 0.0556 + 0.013!(0.8976)^x$  where y is the value of T corresponding to x quarters from 3rd quarter, 1946, when x = 0. For the 4th quarter, 1946, x = 1, etc.
  - b. Automobile group—freehand fit.
  - c. Automobiles and bicycles—freehand fit.

Present Owner \_\_\_\_\_ Name of Business \_\_\_\_\_ Owner No \_\_\_\_\_  
 Previous Owner \_\_\_\_\_ Previous Name \_\_\_\_\_ " " \_\_\_\_\_  
 Next Prev " \_\_\_\_\_ Next Prev Name \_\_\_\_\_ " " \_\_\_\_\_  
 Third Prev " \_\_\_\_\_ Third Prev Name \_\_\_\_\_ " " \_\_\_\_\_  
 Fourth Prev " \_\_\_\_\_ Fourth Prev. Name \_\_\_\_\_ " " \_\_\_\_\_

CUT HERE AND DESTROY TOP PART

Tax Ser #	Lo'n- tion	Business Class	Tax	Owner ship	Beg. Date	Close Date	Owner No
	Brighton	Total All Groups			/ /	/ /	" "
	4-QUARTER	CENTERED			/ /	/ /	" "
	MOVING	AVERAGE			/ /	/ /	" "
	(000's)				/ /	/ /	" "

YEAR	SALES TAXES PAID (Includes refunds and assessments)												TOTAL
	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT	OCT	NOV	DEC	
1957			51.			52.							
1956			52			50			50.			50.	
1955			52.			54.			52.			53	
1954			45			46			47.			49	
1953			50			47.			48.			46	
1952			44			46			47			49	
1951			43			42.			43.			43.	
1950			38			40			41			42	
1949			34			35			36			36	
1948			32			33			33			33	
1947			29			27			29			31	
1946									20			22	
TOTAL													

Figure 26.

- d. Filling and service stations—horizontal line at the mean of the series.
  - e. Food group—least squares linear fit given by the equation,  $y = 0.25180 + 0.00006x$  where  $x$  and  $y$  have the same meaning as in a.
  - f. Grocery stores, motor stores, and meat markets—least squares linear fit given by the equation,  $y = 0.1661 + 0.00021x$  where  $x$  and  $y$  have the same meaning as in a.
  - g. Restaurants, taverns, cafeterias, etc.—horizontal trend at  $y = 0.045$ .
  - h. Hotels, cottage camps, resorts, etc.—horizontal trend at  $y = 0.008$ .
  - i. Furniture group—least squares linear fit given by the equation  $y = 0.05309 + 0.00018x$  where  $x$  and  $y$  have the same meaning as in a.
  - j. Merchandise group—freehand fit.
  - k. Drug stores—horizontal trend at  $y = 0.030$ .
5. Estimates of the values of T for the missing quarters were prepared for each business group by extrapolating the series obtained in step 4. An example of this analysis is shown in Figure 27 for the apparel group of businesses.

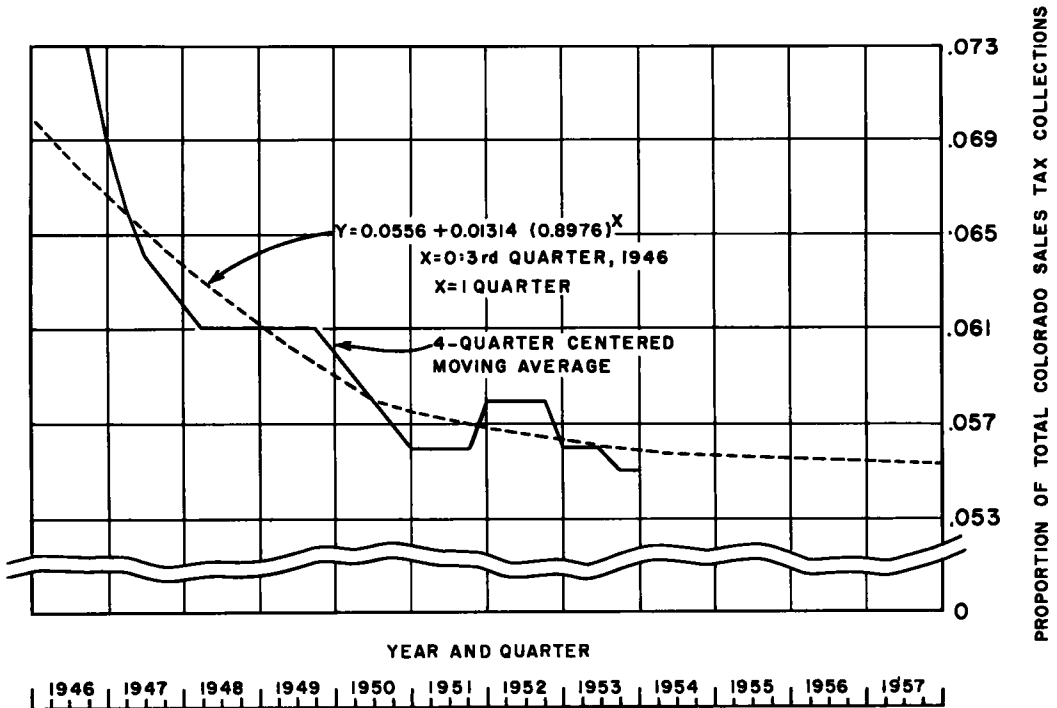


Figure 27. Four-quarter centered moving average of quarterly sales tax returns for the apparel business group as a proportion of total Colorado quarterly tax returns, June 1946- December 1953, fitted mathematically and projected to 4th quarter 1957.

6. The cyclical component, C, was estimated freehand by noting the historical relationship between the cyclical pattern of the series under study and the total sales tax collections statewide. This estimate was then superimposed upon the estimates of T obtained from step 5. Figure 28 shows the estimates of C superimposed upon values of T for grocery stores, motor stores, and meat markets.

7. Seasonal indexes were computed for each of the business groups in step 4. The seasonal indexes found were compared to the seasonal variations revealed by figures for the West Region in the Monthly Report of Retail Trade, Bureau of the Census for the same business groups in the period 1954-1957. No significant departures from the normal seasonal pattern were observed for the Western Region during this period, thereby giving some assurance that no radical departures from the general seasonal pattern for the various business groups had occurred in Colorado during this period.

8. Estimates obtained from step 6. were then adjusted for seasonal variation; that is, seasonal variation, S, was combined with  $T \times C$  to give estimates of  $T \times C \times S$ .

9. Minor adjustments were made in the estimates of quarterly values obtained from step 8. The sum of the estimates of proportions for the individual business groups for each quarter was forced to equal quarterly estimates of composite series

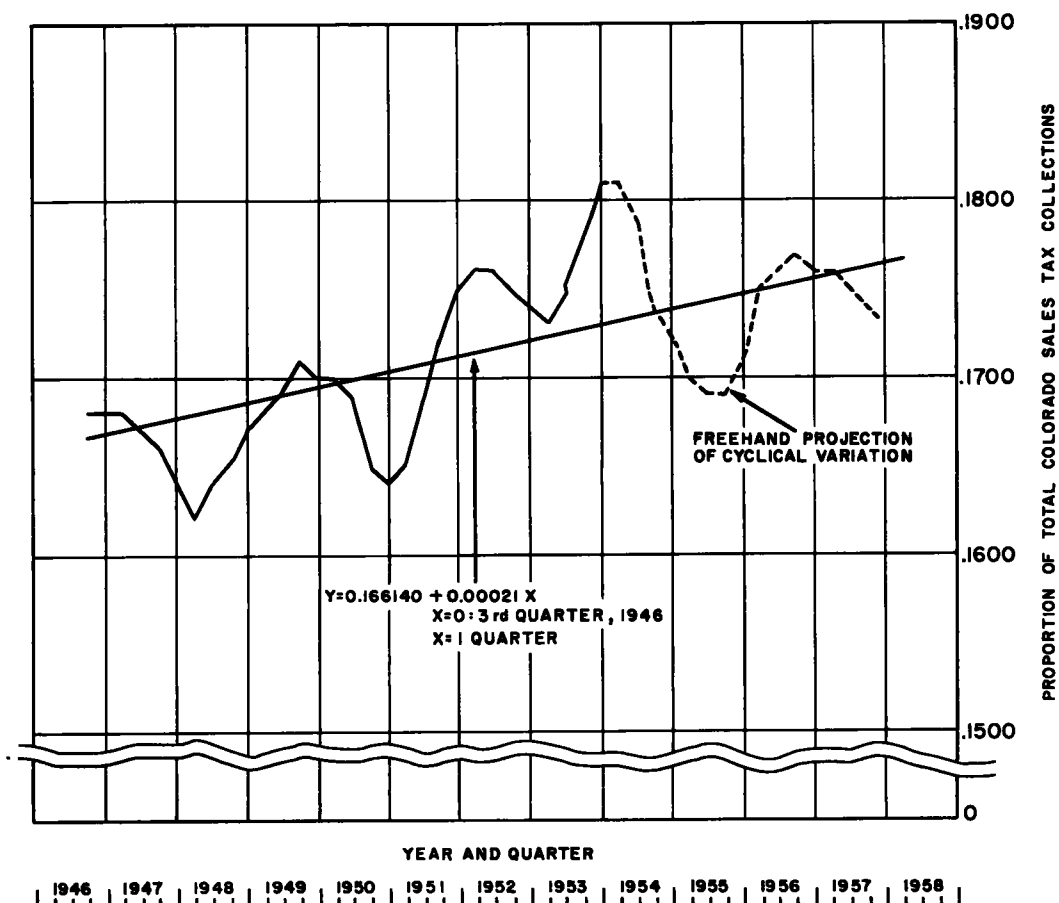


Figure 28. Centered moving average of sales tax collections from grocery stores, motor stores and meatmarkets in Colorado fitted by least squares straight line and freehand projection of cyclical variation, 1946-1957.

prepared specifically for this purpose. That is, the combined quarterly estimates of the apparel group, automobile group, food group, furniture group, and general merchandise group were compared to quarterly estimates of the sum of these groups and appropriate adjustments made.

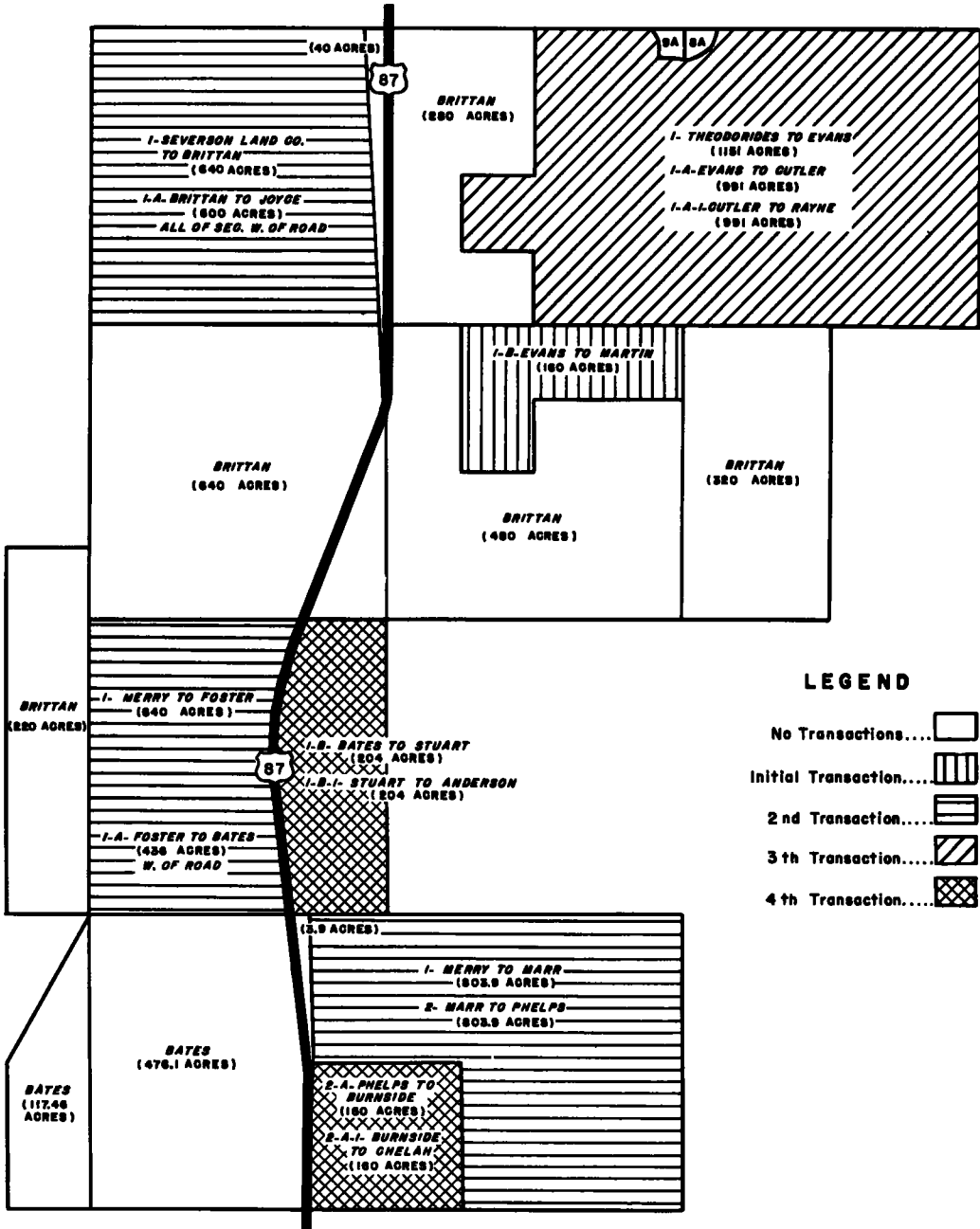


Figure 29. Example of technique to trace land transfers in rural areas (Jan. 1, 1946 to May 1, 1958).



**TABLE 2**  
**QUARTERLY SALES TAX COLLECTIONS FOR SELECTED BUSINESS GROUPS COLORADO, 1946-1957<sup>1</sup> (DOLLARS)**

Year	Quarter	Total Colorado	Apparel Group Total	Automotive Group Total	Automobiles & Bicycles	Filling Service Stations	Food Group Total	Grocery Stores & Meat Markets Motor Stores	Restaurants, Taverns & Cafeterias	Hotels, Cottage Camps, Resorts, Boarding Houses	Furniture Group Total	General Merchandise Group Total	Drug Stores
			I	II	II <sub>2</sub>	II <sub>3</sub>	III	III <sub>4</sub>	III <sub>6</sub>	III <sub>8</sub>	IV	V	V <sub>2</sub>
1946	1	3792199	314886	399489	297254	76509	992442	646839	204341	26709	148130	894878	144450
	2	4087823	313279	503304	242870	78953	1082534	704472	223642	27889	187112	879276	152305
	3	4811195	329394	613260	300046	95813	1320610	793122	307901	55637	221436	1033449	168388
	4	4978092	359035	666602	342181	101849	1293525	834246	266663	38140	251259	1066554	153177
1947	1	4920186	326736	675786	378406	97174	1228897	819879	232130	31560	266998	1047941	165449
	2	5067133	322791	789494	472737	95531	1301173	865584	246706	34721	271502	903626	154958
	3	5729801	331054	882848	514294	109830	1533297	958275	327264	67695	288996	1074050	171768
	4	6051034	389777	920468	538425	126885	1463106	970356	284226	43723	319986	1261970	165665
1948	1	5640951	374758	849696	499516	120877	1338206	919526	235510	32927	299235	1098186	176825
	2	5818974	342067	948210	589390	109190	1370973	926416	253715	35626	293370	1057477	163164
	3	6572949	354016	1064025	646512	120791	1741734	1121517	350553	74459	326331	1176475	186159
	4	6234511	399783	981342	584959	124943	1527360	1021587	289333	46330	313683	1200166	170814
1949	1	5792996	382572	862593	518100	117018	1408926	982885	234101	34812	282416	1164334	180182
	2	5802243	349777	1034787	680564	100443	1423156	973502	248942	38917	248998	1016173	172134
	3	6285163	343470	1135050	726358	111131	1673436	1052393	342842	78345	301194	1084535	190945
	4	6183208	388114	1082719	677378	118014	1605808	1107391	279130	47134	305381	1085563	176035
1950	1	5927093	383623	960038	613647	113332	1431228	1000898	236005	34402	302074	1203757	197237
	2	6142799	347061	1118511	761906	101661	1474242	1019736	254330	36475	318800	1047463	183095
	3	7482765	374717	1481865	995466	131636	1914264	1254093	373652	79252	400110	1210961	202041
	4	6594888	388920	1134180	714668	125345	1602209	1079834	296346	46193	350676	1154907	189459
1951	1	7453926	445191	1283858	828160	138340	1678399	1180880	269117	39100	410723	1430375	227189
	2	6828657	367270	1165396	753585	115368	1673872	1158749	358736	40976	358497	1075784	204375
	3	7472239	388422	1203862	770456	126274	1980583	1269723	401553	84106	360595	1276516	224653
	4	7498775	417824	1184106	730242	142281	1971876	1362107	344391	54697	398177	1336905	212846
1952	1	7217456	484380	1022576	612634	136671	1784264	1256320	290900	40222	391388	1361639	241975
	2	6959869	395491	1132717	719835	121880	1798142	1245860	309751	42727	364901	1093098	216409
	3	8115017	416447	1328053	829317	144322	2188431	1381830	449632	99540	454537	1340015	239031
	4	8177332	480160	1257334	748275	161590	2136545	1489999	355019	56382	540773	1386569	226775
1953	1	7786082	478355	1182910	737983	142975	1853973	1291930	300036	40103	536022	1493421	256041
	2	7678300	405076	1318960	868616	130569	1904599	1321567	323383	41995	467837	1190094	231280
	3	8351880	429121	1369274	862985	152688	2286222	1469373	456395	96206	450774	1354378	247165
	4	8068632	449819	1256766	763015	157084	2193771	1550654	356464	55926	469905	1357249	228981
1954	1	7618677	463858	1085997	657604	146259	1919577	1368469	295819	39204	462157	1351939	252139
	2	7620564	398002	1246532	798992	134920	1968726	1383966	325330	42454	430855	1149279	230825
	3	8594905	438300	1461100	902500	154700	2346400	1478300	455500	103100	481300	1358000	257800
	4	8681080	503500	1449700	894200	173600	2231000	1536600	390600	60800	512200	1458400	243100
1955	1	8649329	519000	1392500	873600	173000	2049900	1453100	346000	51900	519000	1556900	276800
	2	8795622	475000	1592000	1046700	158300	2093400	1468900	378200	52800	527700	1345700	263900
	3	9970011	508500	1794600	1146600	179500	2532400	1665000	528400	119600	578300	1565300	299100
	4	9743567	565100	1695400	1062000	194900	2396900	1714900	438500	68200	584600	1627200	272800
1956	1	9372169	562300	1537000	965300	187400	2239900	1621400	374900	56200	562300	1677600	299900
	2	9185690	496000	1671800	1065500	165300	2287200	1598300	395000	55100	532800	1396200	275600
	3	10436979	532300	1868200	1127200	187900	2807500	1826500	553200	125200	574000	1628200	313100
	4	9634258	558800	1657100	953800	192700	2476000	1743800	433500	67400	558800	1599300	269800
1957	1	10005248	600300	1620900	950500	200100	2391300	1740900	400200	60000	570000	1780900	320200
	2	9367262	505800	1704800	1030400	168600	2248100	1620500	402800	56200	533900	1423800	281000
	3	11271938	574900	2040200	1217400	202900	2863100	1938800	597400	135300	631200	1758400	338200
	4	10472439	607400	1822200	1078700	209400	2565700	1874600	471300	73300	617900	1738400	293200

<sup>1/</sup> Except for total Colorado collections shown in the first column, all figures after 2nd Quarter, 1954, have been estimated. Figures not estimated were obtained from various Annual Reports, Colorado State Department of Revenue.

<sup>2/</sup> Less occasional auto sales. <sup>3/</sup> Included in Automotive group total. <sup>4/</sup> Included in Food group total. <sup>5/</sup> Included in General Merchandise group total.

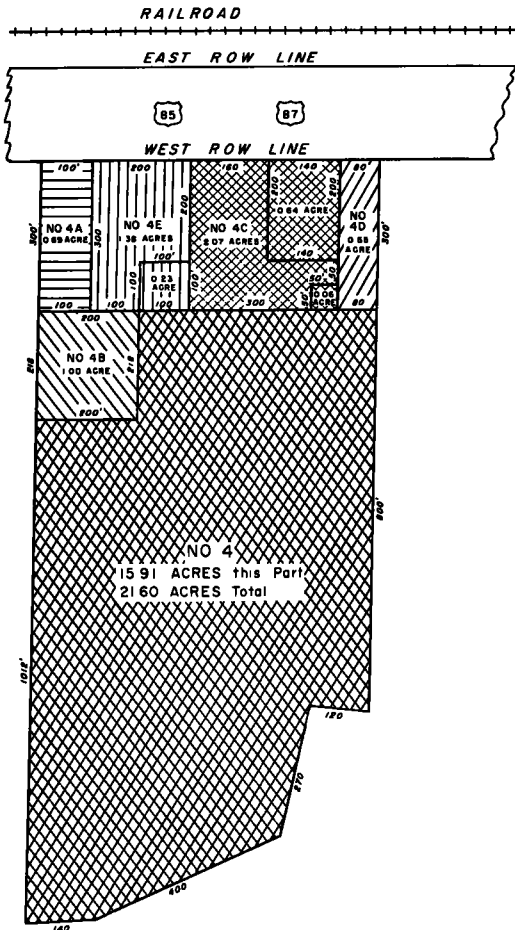
10. Finally, the proportions resulting from step 9. were multiplied by total sales tax collections statewide for corresponding quarters giving estimates of quarterly sales tax collections for the various business groups. These estimates are given in Table 2.

**LOCATION AND IDENTIFICATION OF ABUTTING PARCELS**

It was found necessary in the course of abstracting information on real property sales to keep track of the location and identity of parcels through the use of work maps. The criterion of virtual abutment referred to in the body of the report means that parcels included in the study had to abut the existing subject highway, as in the class of "old" and "improved-old" highways, or would abut the highway at a later date, as in the case of "new" highways.

Ownership of selected parcels was established for 1957 from records kept by the assessor in the various counties or by use of the facilities of abstracting companies; the stages in the development of a given parcel were then recreated year by year back to the year 1946. For example, a given parcel in 1957 might have been but a small part of a transaction in 1946, involving large tracts of land situated some distance from the highway in question. On the other hand, though less likely, the parcel selected in 1957 might have been formed by the banding together of a number of smaller parcels, each of which might have been sold and resold many times during the period, 1946-

1957. An illustration of the work involved in tracing the history of a given parcel in the rural areas is shown in Figure 29. Figures 30 and 31 show the method of identifying parcels in tracted areas.



**MEASUREMENT OF DISTANCE FROM AN URBAN COMMUNITY**

The choice of the urban community from which measurements were made to the center of gravity of a given parcel was made according to Reilly's law of retail gravitation (1):

$$d = \frac{D}{1 + \sqrt{\frac{P_1}{P_2}}}$$

in which

- d = highway mileage to the "breaking point" from the smaller of two communities.
- D = highway distance between the two communities.
- P<sub>1</sub> = the population of the larger community.
- P<sub>2</sub> = the population of the smaller community.

If the distance between the smaller community and the center of gravity of the parcel was less than or equal to d, the distance measurement used in arriving at acre-miles for the parcel was made from the smaller community. If, on the other hand, this distance were greater than d, then the measurement was made from the

Figure 30. Delineation of a typical tracted area (1957 conditions shown).

larger community. In all instances, distances were measured from the 1957 incorporated limits of the community chosen.

#### INDEX NUMBER USED FOR DEFLATING SALES PRICES PER ACRE

Studies were made by the Colorado State Tax Commission in 1950 and 1951, concerning price changes in sales prices per acre of rural land in Colorado. As a result of these studies, a general index of sales price per acre was constructed for all rural land for the period 1913 to 1952. For the period 1946-1952, this index does not differ substantially from similar indexes published by the Agricultural Research Service of the U. S. Department of Agriculture for Colorado; moreover, indexes published by the Agricultural Research Service were available for Grazing, Dry Farm, and Irrigated lands for the entire period 1946-1957. For these reason, it is believed that the use of the Agricultural Research Service indexes given in Table 3 is justified for purposes of this study.

① Merry to Bardwell	Sells Tr. #4 = 21.60 ac.
①a Bardwell to Predovich	Sells #4A = .69 ac.
1a-1 Predovich to Shapin	1 <sup>st</sup> resale of #4A
1a-2 Shapin to Teglovic	2 <sup>nd</sup> " " #4A
①b Bardwell to Teglovic	Sells #4G = 1.00 ac.
(1a-2 + 1b) Teglovic to Henning	Sells #4A + 4G = 1.69 ac.
(1a-2 + 1b) - 1 Henning to Saran	Resells #4A + 4G
①c Bardwell to Carmichael	Sells #4E = 1.38 ac.
1ca Carmichael to Britton	Sells 100' x 200' PT 4E = 0.23 ac.
1cb Carmichael to Bardwell	Sells remainder of 4E = 1.15 ac.
①d Bardwell to Shapin	Sells #4C = 2.07 ac.
1da Shapin to Predovich	Sells 140' x 200' PT 4C = 0.44 ac.
1da-1 Predovich to Merry	Resells 140' x 200' PT 4C
1da-2 Merry to Severson	Sec. Resale 140' x 200' PT 4C
1db Shapin to Rieber	Sells #4C ex. 140' x 200' PT 4C
1dba Rieber to Sutton	Sells 50' x 50' PT 4C = 0.06 ac.
①e Bardwell to Spurgeon	Sells #4D = 0.55 ac.
1ca Spurgeon to Livingston	Sells 1/2 50' of #4D = 0.31 ac.

Figure 31. Identification of transactions in tract #4 (same identification procedure used for untraced land) (Jan. 1, 1946-Dec. 31, 1957).

**TABLE 3**  
**INDEX NUMBERS OF AVERAGE VALUE PER ACRE BY TYPE OF LAND**  
**IN COLORADO (1946 = 100)**

Year	Type of Land and Assessed Valuation Per Acre		
	Irrigated (\$40 & over)	Dry Farm (\$10 & under \$40)	Grazing (Under \$10)
1946	100	100	100
1947	112	122	126
1948	123	138	140
1949	127	151	144
1950	123	144	144
1951	146	174	156
1952	158	186	182
1953	151	185	178
1954	149	182	175
1955	155	171	174
1956	152	168	167
1957	151	162	160
1958	159	177	175

Source: Adopted from Current Developments in the Farm Real Estate Market, Agricultural Research Service, United States Department of Agriculture, A R S series, various issues.

No specific price index is available for use in deflating sales prices of urban, suburban and rural land. Construction cost indexes or building cost indexes might be suitable for this purpose. It is felt, however, that price changes in the sale of land parcels in urban, suburban and rural areas are more likely to follow general price levels than levels established for specific activities such as construction. Lacking a reasonable alternative, the consumer price index for Denver, constructed by the National Industrial Conference Board, has been employed (Table 4).

**TABLE 4**  
**CONSUMER PRICE INDEX FOR DENVER**  
**(ADJUSTED BASE, 1946 = 100)**

1946	100.0
1947	112.5
1948	120.0
1949	118.7
1950	119.7
1951	129.2
1952	130.8
1953	131.6
1954	132.2
1955	132.8
1956	134.1
1957	137.5

Source: National Industrial Conference Board publications.

#### LIMITATIONS OF THE STUDY

Those limitations which appear to be most important are summarized as follows:

1. Sales price of land parcels, as determined from the value of revenue stamps

on warranty deeds, together with balances of deeds of trust may be unreliable in some instances. The value of revenue stamps affixed to the warranty deeds may misstate for many reasons the amount of cash involved in the transaction. Although it is generally agreed that most lawyers and real estate agents affix the proper value of stamps to the warranty deed, the unknown extent of accuracy of sales price information is a limitation.

2. Even if sales prices are known exactly, the value of the various items transacted are inadequately known. To properly compare one transaction with another, some value should be placed on assignment of water rights that may be included in the sales price, as well as other tangible assets such as mineral rights, machinery, wells, livestock, fruit trees, growing crops and the like. Because every transaction involves varying amounts of these assets, some accounting of them should be made. This was not done in this study, simply because no effective method could be found to do it.

3. Despite efforts to encourage the adoption of uniform assessing procedures and practices in the state, variations still persist in assessments of similar properties located in the counties from which information was gathered. Classification of land on the basis of assessed valuations, as was done in this study, has limitations.

#### REFERENCE

1. Converse, P.D., "Retail Trade Areas in Illinois." Business Studies, No. 4, Univ. of Ill. Bull., 43:68, 30-31 (July 16, 1946).