

Land Value Impacts of Expressways in Dallas, Houston and San Antonio, Texas

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This paper is drawn from recent economic impact studies in the three largest cities of Texas. One study regarding Houston's Gulf Freeway was updated in 1957. The other two studies (Dallas and San Antonio) were conducted in 1957 and 1958.

The three studies used comparable approaches as well as two common methods of analyzing real estate sales data. The approach for each study involved the before-and-after concept, with control areas employed to isolate or infer net expressway effects. One common treatment of sales was to remove the value of improvements on property sold. Each study also presented measurements based on unadjusted sales data.

A variety of situations was analyzed in the three studies. The Dallas and Houston studies were concerned with impacts of expressways having continuous frontage roads. The San Antonio expressway, on the other hand, furnished frontage roads to only 18 percent of abutting lands. The expressways in the three cities traversed areas which include a great number of land use patterns.

Whereas, the comparisons of expressway impacts in the Texas cities offer some interesting and useful confirmations and contrasts, an equally important feature of this paper is its discussion of the methods used. The strengths, weaknesses and uncertainties of the before-and-after approach and its associated techniques are appraised. Suggestions for using and improving the scheme also are presented.

● THIS paper is based on recent economic impact studies in Texas' three largest cities. Two of the studies, those in Dallas and San Antonio, were completed by the Texas Transportation Institute in 1957 and 1958. The third study, which had Houston's Gulf Freeway as its subject, was conducted in part in 1951 by Norris and Elder, Consulting Engineers for the Texas Highway Department, and the U.S. Bureau of Public Roads. The same firm updated the Houston study in 1957.

The primary purpose of this paper is to review the findings of the three Texas studies regarding the influence of expressways on land values. In support of this purpose, some references are made to impacts on land use and business. Another general objective is to spell out some of the limitations of the approaches used in the studies, with special emphasis on the hazards of using real estate sales to measure land value changes and expressway effects. The three studies used highly comparable approaches as well as two common methods of analyzing the effects of the expressways on land values.

The approach of each study involved the "before-and-after" concept with comparative control areas employed to isolate or infer net expressway influences. More precisely, the selected area along each expressway was regarded as the experimental group and the comparable area that was presumed to be unaffected by the expressway was considered the control group. The aim was to establish the fact of causation, with an expressway introduced as a factor of the experimental group only. Differentials of change in the two groups presumably would be due to the expressway's effect, if it appeared

reasonably certain that no other factor had caused such differentials. The problem of assuring the absence or sameness of factors other than an expressway is crucial and difficult. It will be given consideration later in this report.

The Houston, Dallas and San Antonio studies sought to measure land value impacts through analyses of real estate sales¹. One of the common methods or treatments of sales prices was to remove the value of property improvements from price considerations. This was done by subtracting from the sales price the appraised tax value of improvements multiplied by a construction cost factor. The remaining consideration should reflect more closely the portion of the purchase price paid for land only. The construction cost factor was applied in an attempt to adjust tax appraisals, which are of a certain past date, so that they would reflect the market value (or depreciated replacement cost) of improvements at the date of the property sale. The other method common to each study was the use of sales prices as they occurred. Both of the common methods are laden with shortcomings, some of which are later discussed.

It is not practicable in this paper to describe fully the environments of the three subject expressways. Perhaps a few observations regarding the three cities and the specific areas traversed by the expressways will furnish a sufficient framework, however, for a discussion of their economic impacts.

The populations of Houston, Dallas and San Antonio were each well above 500,000 at the time of the expressway studies, as shown in the following listing:

<u>CITY</u>	<u>POPULATION^a</u>	
	1950	1957
<u>Houston:</u>		
City	596,163	872,000
Metropolitan Area	806,701	1,136,000
<u>Dallas:</u>		
City	434,462	621,500
Metropolitan Area	614,799	827,500
<u>San Antonio:</u>		
City	408,442	545,000
Metropolitan Area	500,460	710,451

^aSource: Texas Almanac, 1958-59, The Dallas Morning News, Dallas, Texas.

Each city experienced sizeable population growth from 1950 to 1957. Houston, the largest of the three, now has more than 1,000,000 residents in its metropolitan area while the Dallas and San Antonio metropolitan areas have populations of more than 800,000 and 700,000 respectively.

Houston may be characterized as an industrial city. However, its wholesale sales at three billion dollars annually are about double its retail sales. Complementing its position as a great trading center, Houston has the second ranking port in the United States from the standpoint of tonnage.

Dallas may be regarded primarily as a trade center, although its manufacturing activities also are very important. The city exceeds Houston in wholesaling and also is a leader in banking, general finance and insurance.

San Antonio is a very old city. Its highly diversified income is derived largely from agriculture, military establishments, medical services and tourist trade. Manufacturing, although important, accounts for only 12 percent of the city's employment.

¹ In addition, the Houston Gulf Freeway study reported some tax information and the Dallas North Central Expressway study included detailed analyses of the expressway's effects on tax valuations of land and improvements.

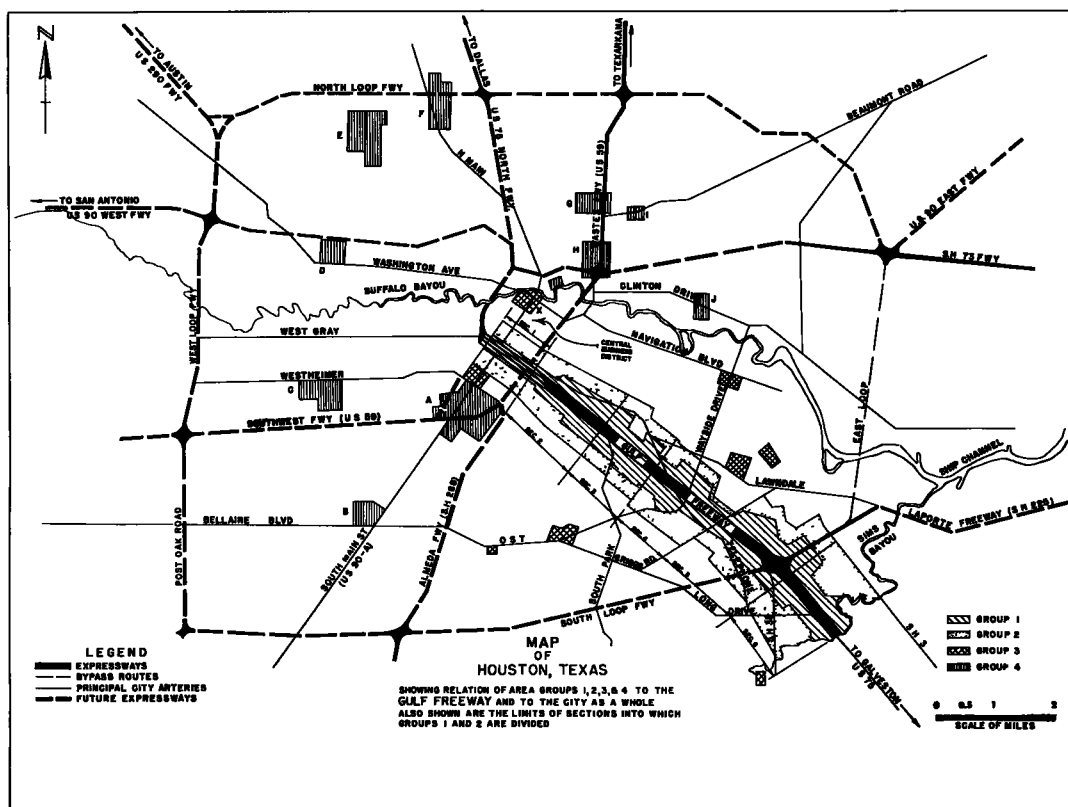


Figure 1. Study of land values and land use along the Gulf Freeway.

The three cities have demonstrated dynamic growth characteristics. Their boundaries are reaching out and their projected populations reflect still greater expansion. Each of the expressways studied was the first limited-access facility in its particular city. The expressways have the further similarity of having been located in older urban areas.

All of the expressways cut across areas of low-cost and middle-class dwellings, retail and commercial establishments, and manufacturing. The areas adjacent to the Houston and Dallas expressways had fairly high proportions of vacant land. In Dallas, about half of the area of abutting properties was unimproved. In San Antonio, a relatively small amount of the land in the selected influence area was unimproved, probably less than 20 percent.

TABLE 1

CHANGES IN LAND VALUES ALONG THE GULF FREEWAY, HOUSTON, TEXAS AND IN OTHER AREAS OF THE CITY 1939-41 TO 1954-56 (1)

	Method 1	Method 4
	Unadjusted Sales Prices	Value of Land Only ¹
Percentage Change		
Group 1 - Study Area	585	567
Group 2 - Study Area	242	142
Group 4 - Control Areas	251	103
Inferred Gulf Freeway Influence		
Group 1	334	464
Group 2	-9	39

¹"Sales Prices with improvements deducted on the basis of assessed value divided by the appropriate assessment factor and the factors based upon the increase in construction cost." Norris and Elder, op. cit., p. 62.

THE HOUSTON GULF FREEWAY STUDY (1)

Definite plans for the Gulf Freeway were developed in 1943. Construction was started in early 1946 and a three-mile section was placed in operation in 1948. The study areas for the economic impact study were along the six and one-half miles in operation in October, 1951. The freeway, which begins

TABLE 2

CHANGES IN LAND VALUES IN STUDY AND CONTROL AREAS, GULF FREEWAY STUDY 1939-41 TO 1945-46

	Method 1	Method 4
	Unadjusted Sales Prices	Value of Land Only
	Percentage Change	
Group 1 - Study Area	94	126
Group 2 - Study Area	54	22
Group 4 - Control Areas	90	130
	Inferred Gulf Freeway Influence	
Group 1	4	- 4
Group 2	- 46	- 108

TABLE 3

CHANGES IN LAND VALUES IN STUDY AND CONTROL AREAS GULF FREEWAY STUDY (1) 1945-46 TO 1954-56 (1939-41 = 100 PERCENT)

	Method 1	Method 4
	Unadjusted Sales Prices	Value of Land Only
	Percentage Change	
Group 1 - Study Area	491	441
Group 2 - Study Area	188	120
Group 4 - Control Areas	161	-27
	Inferred Gulf Freeway Influence	
Group 1	330	468
Group 2	27	147

near the central business district, was opened all the way to Galveston in August, 1952.

The before period used in the study was 1939-41 and prices were also studied in the 1945-46, 1949-51 and 1954-56 periods. Although the facility was definitely planned in 1943, its influence probably began in 1945 when its route was definitely established. Except for an eighteen block section consisting of four one-way streets near downtown Houston, the facility has six free lanes plus frontage roads (Fig. 1). These frontage roads are continuous except at railroad crossings.

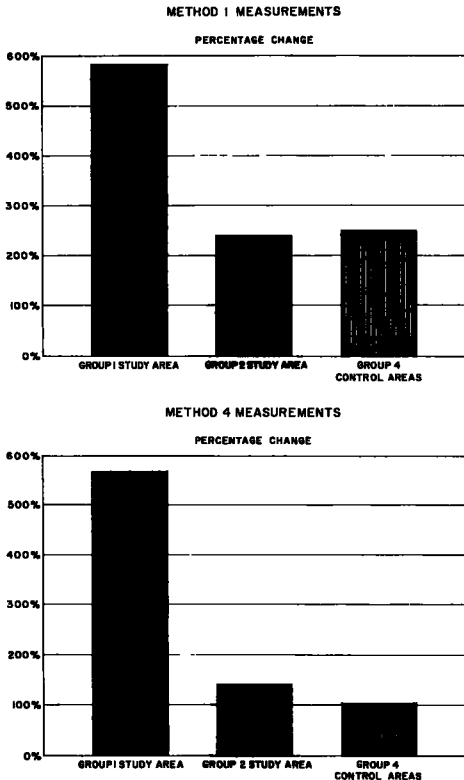


Figure 2. Houston changes in land values along the Gulf Freeway and in control areas 1939-41 to 1954-56.

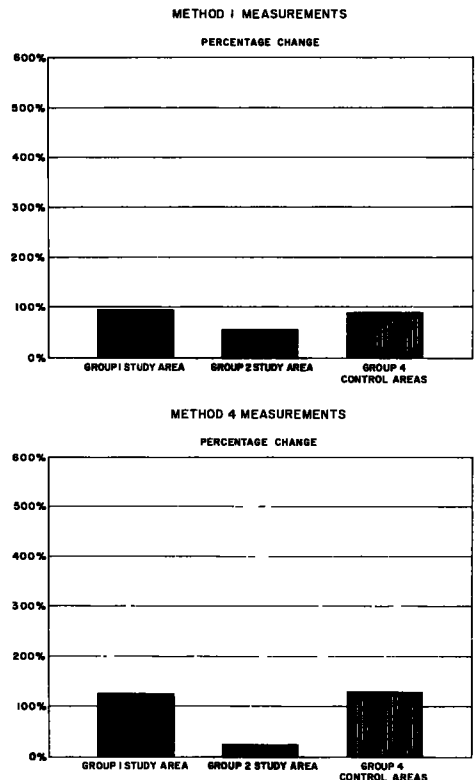


Figure 3. Houston changes in land values along the Gulf Freeway and in control areas 1939-41 to 1945-46.

The areas studied in Houston may be identified as follows:

Group 1—Immediately adjacent to the freeway, was comprised of bands two to four blocks in width on each side of the facility. Thus, the group included properties other than those abutting the freeway.

Group 2—Was the secondary area paralleling the freeway on either side and adjacent to Group 1. These Group 2 bands also varied from about two to four blocks in width.

Group 3—Areas were in the same (southeast) quadrant of Houston as the facility but not in bands like Groups 1 and 2. Findings regarding Group 3 are not included in this paper.

Group 4—Included ten areas selected for their similarity to parts of Groups 1 and 2 but located outside any possible zone of influence of the freeway. Group 4, therefore, is the control group for experimental Groups 1 and 2.

Tables 1, 2 and 3 summarize the findings of Norris and Elder regarding land value changes in the study and control areas. Only Method 1 and Method 4 results are shown because these same methods were used in the Dallas and San Antonio studies. As is shown in Table 1, the area immediately adjacent to the expressway experienced a much larger increase in land prices from 1939-41 to 1954-56 than did Groups 2 and 4. This was indicated by both methods. Method 1 measured a 585 percent increase in property prices in Group 1 and a 251 percent increase in control areas. Thus, the inferred freeway influence on Group 1 property prices was therefore 334 percent. (It should be noted that this net influence was calculated for the purposes of this paper and not by Norris and Elder in their report.)

According to Method 1 computations, Group 2 did not fare as well as the control areas; the inferred freeway influence being a negative nine percent. Method 4 measurements inferred a freeway influence of 464 percent on Group 1 land values and 39 percent on land values in the Group 2 study area.

The type of question that arises immediately is this: Is the 39 percent differential indicated by Method 4 for Group 2 significant, or is it due to the lack of similarity of study areas and control areas? Is it due to poor representativeness of sales in either control and/or study areas in either or both periods of sales? Was it caused by bias inherent to Method 4? Note that the size of 39 percent (relative to the very large impact implied for Group 1 properties) is the factor that suggests these questions. The same questions are suggested regarding the negative nine percent shown by Method 1. They do not appear to be of great importance when the rather large measurements of the impact on Group 1 are being considered.

Perhaps some additional light may be shed on these questions by inspecting measurements of the Gulf Freeway's influence over shorter periods of time. Table 2 shows changes in value in study and control areas from 1939-41 to 1945-46. (Recall that the freeway probably became a factor of influence in 1945.) The first conclusions are that the freeway had very little imme-

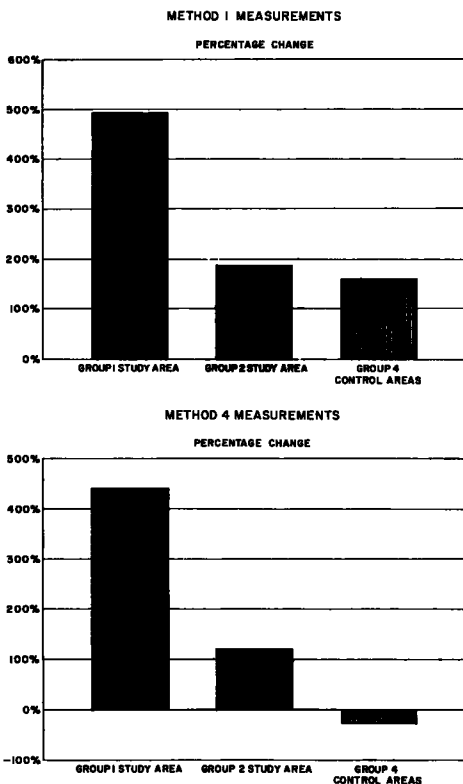


Figure 4. Houston changes in land values along the Gulf Freeway and in control areas 1945-46 to 1954-56 (1939-41=100%).

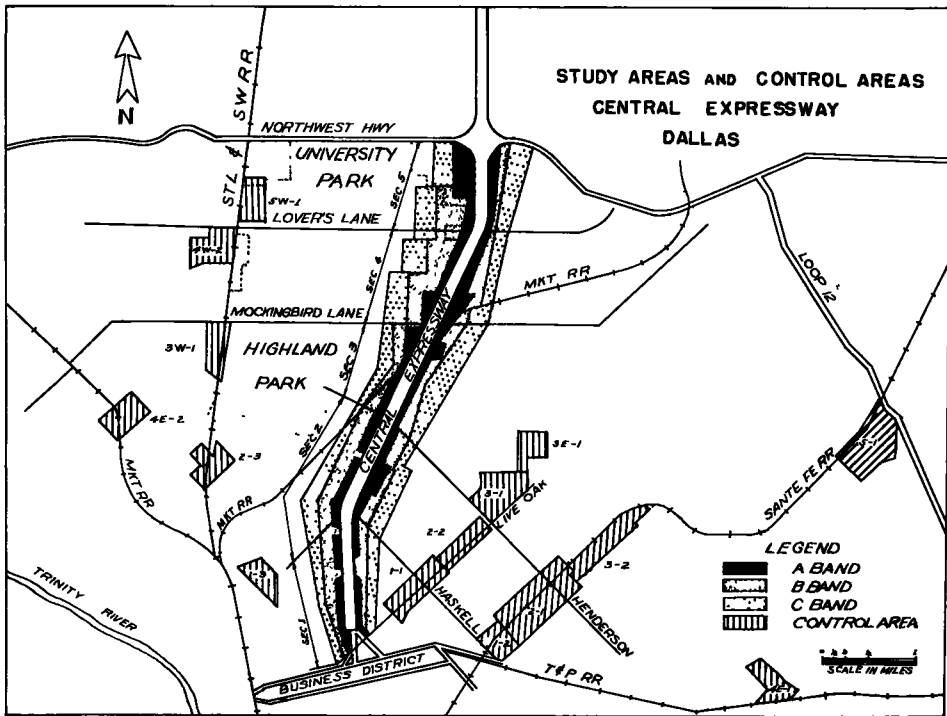


Figure 5. Study areas and control areas central expressway Dallas.

mediate effects on Group 1 property values but seemed to have damaged the more-removed properties in Group 2. Both methods of measurement seem to indicate this conclusion. Are these inferences consistent with a logical pattern? Perhaps the more distant Group 2 areas felt apprehension on the part of buyers and sellers that the value of land would be drained away to Group 1. However, Group 1 buyers and sellers apparently did not anticipate that values would accrue (from anywhere) to Group 1.

It seems more logical to assume that the areas immediately adjacent to the proposed facility might fall in value whereas the areas further removed would experience very few immediate expressway effects. Questions regarding the precision of sales prices in measuring land values come to mind again.

TABLE 4

CHANGES IN LAND VALUES ALONG THE NORTH CENTRAL EXPRESSWAY, DALLAS, TEXAS, AND IN OTHER AREAS OF THE CITY 1941-45 TO 1951-55 (2)

	Method I			Method II		
	Unadjusted Sales Prices			Value of Land Only ¹		
	Percentage Change					
A Band Study Area		405			623	
B Band Study Area		110			123	
C Band Study Area		231			185	
Control Areas, Respectively	134	132	121	140	123	127
Net Influence of the Expressway						
A Band		271			483	
B Band		-22			0	
C Band		110			58	

¹ Method II removed from sales prices the value of improvements, calculated as their tax appraisal value multiplied by a construction cost factor.

Table 3 shows that the enhancements which might be accorded to the freeway apparently occurred after 1945-46. During this period, the inferred Gulf Freeway influence was beneficial in both Groups 1 and 2 study areas. Method 4 measurements show increments of 468 percent for Group 1 and 147 percent for Group 2 on the basis of 1939-41 land prices. The size of these indicators of influence quiet some of the doubts raised in earlier questions but do not, of course, answer them.

It should be emphasized that only a part of the findings of the Gulf Freeway study has been dealt with here. Such extractions from a study face the hazard of being misused and misinterpreted. The investigator

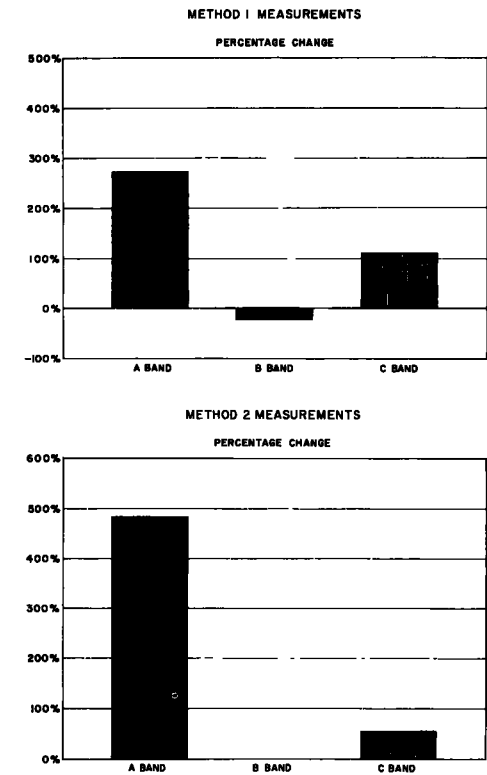


Figure 6. Dallas net influence of central expressway on land values of adjacent areas 1941-45 to 1951-55.

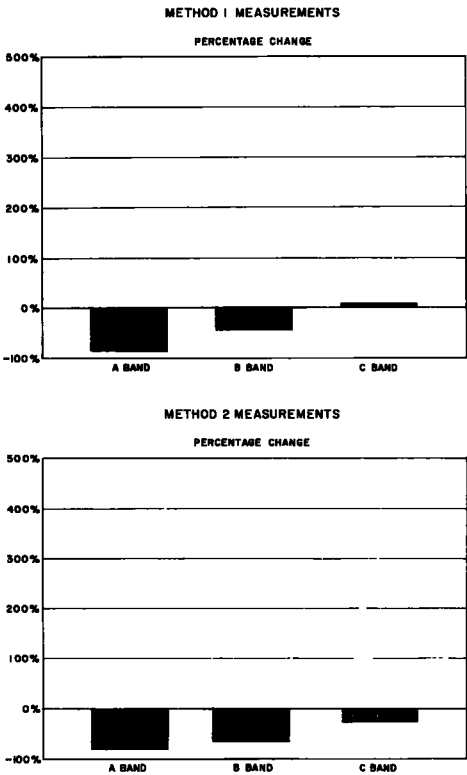


Figure 7. Dallas net influence of central expressway on land values of adjacent areas 1941-45 to 1946-50.

is in the best position to develop conclusions in view of his experience and his complete analysis of findings. The questions raised here are concerned with the tools and materials available for use in land values research. The Dallas and San Antonio Studies are subject to the same, and other questions.

THE DALLAS CENTRAL EXPRESSWAY STUDY (2)

Like the Gulf Freeway, Dallas' Central Expressway, or other type of major thoroughfare on the same route, had been contemplated for several years before it became a reality. Definite planning for the Dallas facility was not begun until late 1945, however. Initial construction was started in 1947 and the first section of the expressway was completed in 1949. The portion of the expressway chosen for study was opened to traffic in its entirety in early 1953. This portion is 5.4 miles in length from near downtown Dallas to the Northwest Highway, a circumferential route. Findings presented in this paper, however, relate only to a stretch of about 4.4 miles which may be called the older urban part of the study area.

The subject expressway has six free lanes for 3.6 miles and the remainder has four

TABLE 5

CHANGES IN LAND VALUES IN STUDY AND CONTROL AREAS, NORTH CENTRAL EXPRESSWAY STUDY 1941-45 TO 1946-50

	Method I	Method II
	Unadjusted Sales Prices	Value of Land Only
	Percentage Change	
A Band Study Area	8	56
B Band Study Area	48	58
C Band Study Area	95	97
Control Areas, respectively	95 92 88	136 122 123
	Net Influence of the Expressway	
A Band	- 87	- 80
B Band	- 44	- 64
C Band	7	- 26

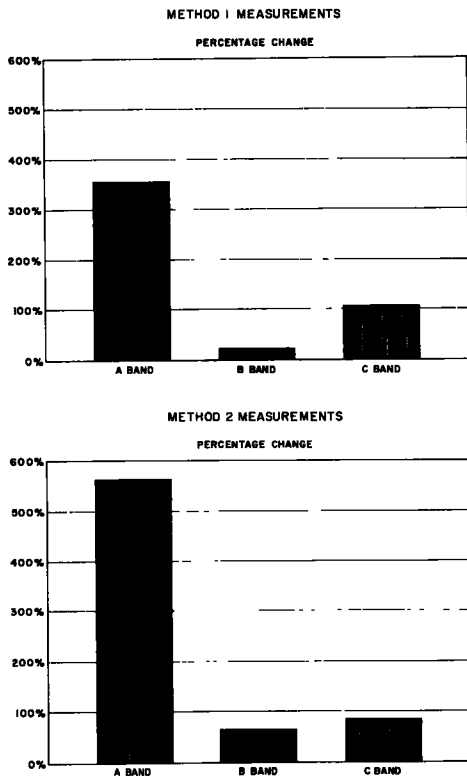


Figure 8. Dallas net influence of central expressway on land values of adjacent areas 1946-50 to 1951-55 (1941-45=100%).

Table 4 shows calculations of Central Expressway's impact on land values in A, B and C Bands up to 1951-55. The size of the measurements obtained by Method I, 271 percent, and Method II, 483 percent, leaves little doubt that A Band properties were enhanced by the expressway, and substantially. Note, however, that the next properties, B Band, apparently were not benefited. Method I indicates that there was a negative effect of 22 percent and Method II measured no differential between land value changes in B Band and its control areas.

The third band of properties was enhanced according to both methods. Is it logical that the expressway's impact leapfrogged from abutting properties to C Band? The most reasonable judgment is that it did not. The explanation of these results must lie in the questions raised earlier regarding the findings in the Gulf Freeway study. In short: Were the data used representative of land values? Were the tools of sales data analysis too dull to measure impact accurately? Were control areas truly comparable to study areas in the before period? Results presented in Table 5 increase the probability of analyzing the questions adequately. Note the similarity of these results with those in Table 2 regarding the Gulf Freeway's early impact.

free lanes. Continuous frontage roads are provided except at one railroad overpass. The area excluded from consideration in this paper is located near the Northwest Highway. The expressway's influence on this area was analyzed separately from its influence in the older urban area.

The study area along Central Expressway was divided into three bands, described as follows:

A Band—Which consisted of properties abutting the expressway right-of-way on each side.

B Band—Which was adjacent to the abutting properties and averaged about two blocks in width.

C Band—Which was adjacent to B Band and also averaged about two blocks in width.

Sixteen non-affected or control areas were chosen because of their similarity to various sections in the three study area bands.

Sales data were collected for the years 1941 through 1955. The before period was 1941-45 and the after period was 1951-55. A middle period of sales, 1946-50, was used to check immediate expressway effects. Four different methods of treating real estate sales were presented in the report of the Dallas study. Only Method I and Method II are dealt with in this paper, these being the same as Methods 1 and 4, respectively, of the Gulf Freeway study.

TABLE 6

CHANGES IN LAND VALUES IN STUDY AND CONTROL AREAS, NORTH CENTRAL EXPRESSWAY STUDY 1946-50 TO 1951-55 (1941-45 = 100 PERCENT)

	Method I		Method II		
	Unadjusted Sales Prices		Value of Land Only		
	Percentage Change				
A Band Study Area	397			567	
B Band Study Area	62			65	
C Band Study Area	136			88	
Control Areas, respectively	39	40 33		4	1 4
	Net Influence of the Expressway				
A Band	358			563	
B Band	22			64	
C Band	103			84	

Band study and control areas did not accurately represent the properties in the areas. Further, the lack of representation introduced a bias adverse to the measurement of beneficial effects of the expressway in all time periods in which the impact was calculated.

Table 6 deals with land value changes in the 1946-50 to 1951-55 time period in the Dallas study. The indexes of influence show that A Band was spectacularly benefited. Land values in B Band also were enhanced but not greatly, and somewhat less than those of C Band. The favorable influences of the expressway seem to have been restricted to the 1946-50 to 1951-55 period and more than offset any earlier damages.

TABLE 7

CHANGES IN VALUES OF UNIMPROVED LAND IN STUDY AND CONTROL AREAS, NORTH CENTRAL EXPRESSWAY STUDY 1941-45 TO 1951-55

	Percentage Increases		Influence of the Expressway
	Study Area	Control Area	
A Band	518	150	368
B Band	383	162	221
C Band	291	186	105

Separate calculations of the Central Expressway's impact on values of unimproved land were made. The results for the 1941-45 to 1951-55 period are presented in Table 7. The measurements show that vacant land was benefited 368 percent in A Band, 221 percent in B Band, and 105 percent in C Band. Although not shown in Table 7, the enhancements apparently occurred after 1946-50 since negative influences were calculated for vacant land in all three bands from 1941-45 to 1946-50.

Again, the question arises as to whether the expressway damage calculated for the early period was due to a mismatch of study and control areas or to actual disbenefits. The fact that damages were measured for all study area bands in the early period suggests that control areas may have been superior. It cannot be contended from the evidence, however, that the expressway did not have any negative effects in the study areas during the early period.

THE SAN ANTONIO EXPRESSWAY STUDY (3)

The study of expressway effects in San Antonio had as its subject two expressway sections totaling 3.7 miles in length and located near downtown San Antonio. One of the sections is the route of US 81 and the other of US 87. Since the two sections merge,

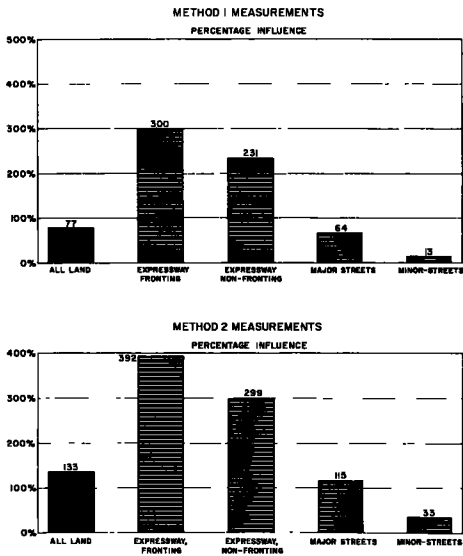


Figure 10. San Antonio expressway influence on values of adjacent lands by type-of-street locations.

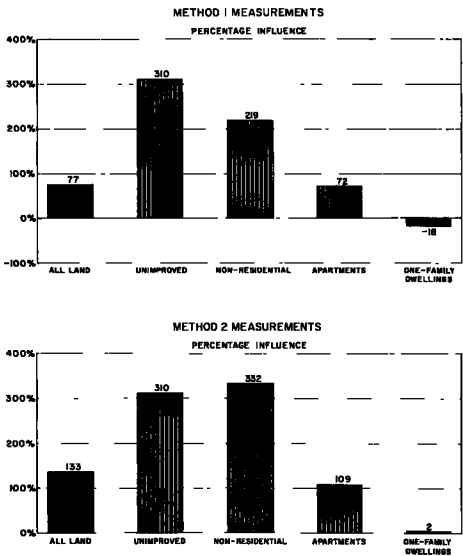


Figure 11. San Antonio expressway influence on values of adjacent lands by land uses.

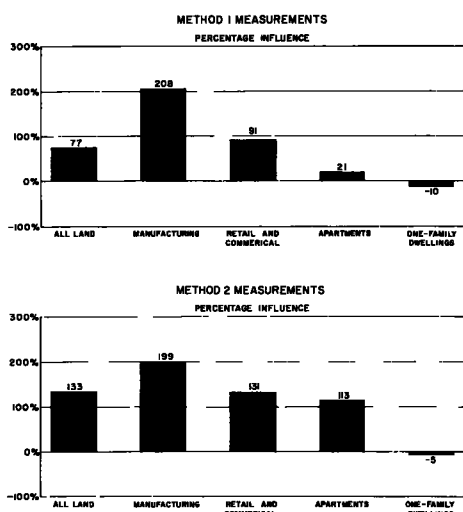


Figure 12. San Antonio expressway influence on values of adjacent lands in various zoning districts.

were classified as to use, zoning and type-of-street location. Analyses then were made of the expressway's impact on various-type properties. This scheme yielded measures of influence on abutting properties, which were called A Band in the Dallas study. Otherwise, no direct comparisons regarding bands of properties are possible for the three studies. Actually, the San Antonio study area has a width about equal to Dallas' A and B Bands combined, being about two to three blocks on either side of the expressway. Along major thoroughfares crossing the facility, an additional two blocks were included in the study area.

Estimates of the expressway's impact on land values in the over-all study area are presented in Table 8. Both Method I and Method II measurements indicate that land values rose more in study areas than in control areas from 1941-45 to 1952-56. The net influence of the expressway was 77 percent under Method I and 133 percent under Method II.

Table 9 shows calculations of the expressway's influence on land values at different street locations. The greatest enhancement apparently accrued to properties on frontage roads, the benefits being 300 percent by Method I measurement and 392 percent according to Method II. Other abutting properties were benefited seemingly to a substantial degree. The remainder of study area properties received positive but smaller influences especially if they were located on minor streets.

It was found that the use of property conditioned the impact of the expressway. Table 10 shows that unimproved land and non-residential properties were enhanced substantially. Apartments received benefits according to each index. Method I measured damages for one-family dwellings although Method II calculations resulted in small benefits for this class of property.

Another series of measurements concerned the expressway's influence in various zoning districts. Again, a somewhat logical pattern was found (Table 11). Land zoned

they were treated as one expressway in most of the study analysis. Along most of their length, the expressway sections have four freeway lanes separated in pairs by a median. One short stretch has six free lanes. Frontage roads are not continuous being limited to about 32 percent of the abutting land.

The before period in the San Antonio study was 1941-45, in view of the fact that definite planning for a part of the expressway had been started in 1946. The after period was 1952-56, although the sections studied were not fully completed until 1954. Five control areas were selected as representative of the area of the city crossed by the expressway sections.

The methods of analyzing sales prices were the same in the San Antonio study as in the Dallas and Houston studies. However, the San Antonio study area was not divided into bands as were the Dallas and Houston study areas. Instead, all properties that sold in study and control areas

TABLE 8
CHANGES IN LAND VALUES ALONG US 81 AND US 87
EXPRESSWAYS, SAN ANTONIO, TEXAS AND IN OTHER
PARTS OF THE CITY (3)
1941-45 TO 1952-56

	Method I	Method II
	Unadjusted Sales Prices	Value of Land Only ¹
	Percentage Change	
Study Areas	164	200
Control Areas	87	67
	Net Influence of the Expressways	
Study Areas	77	133

¹ Method II = Sales prices minus tax appraisal of improvements multiplied by a construction cost factor. The method is the same as Method II of the North Central Expressway study and Method 4 of the Gulf Freeway study.

for manufacturing was calculated to have received the greatest benefits. Retail and commercial and apartment zoning districts also were enhanced. Areas restricted to one-family dwellings were indicated to have suffered in value from the expressway's presence. The negative influence was small, however, being minus ten percent under Method I and minus five percent under Method II. Again, the question arises as to whether this negative influence was real or a chance product of the study scheme.

Additional analyses of expressway effects on property classified by two or more of the above factors were attempted. The number of sales of more closely defined property types restricted such efforts. It was confirmed, however, that land used and zoned for one-family dwellings and located on minor streets apparently was influenced very little. Properties located on frontage roads were benefited regardless of zoning and use. Land in non-residential uses and zoning districts was calculated to have benefited at all locations.

TABLE 9

INFLUENCE OF THE SAN ANTONIO EXPRESSWAYS
ON VALUES OF LAND BY TYPE-OF-STREET LOCATION
1941-45 TO 1952-56

Location of Land	Method I	Method II
	Unadjusted Sales Prices (%)	Value of Land Only (%)
Expressway Frontage Roads	300	392
Abutting Expressway not on Frontage Roads	231	299
Abutting Expressway, all Main Thoroughfare, not at Expressway	254	321
Minor Streets, not at Expressway	64	115
	13	33

QUESTIONS RELATING TO METHODOLOGY

Several questions have been raised in this paper regarding the approach and the

TABLE 10

INFLUENCE OF THE SAN ANTONIO EXPRESSWAYS
ON VALUES OF LAND IN VARIOUS USES
1941-45 TO 1952-56

Land Use	Method I	Method II
	Unadjusted Sales Prices, %	Value of Land Only, %
Unimproved	310	310
Non-residential ¹	219	332
Apartments ²	72	109
One-family dwellings	- 18	2

¹Includes local retail, commercial and manufacturing.

²Includes duplexes.

methods of sales data analysis used in the Houston, Dallas and San Antonio economic impact studies. These questions were introduced for the purpose of encouraging and soliciting aid in the improvement of economic impact research. Obviously, the examination of findings was not made to discredit them. In the first place, each of the study reports makes objective interpretations of the findings and notes their limitations. Some of the conclusions quite properly were based upon inspections of the study and control areas including observations of land use changes.

Every research effort must be performed within restrictions of time, expense, available skills and, to some extent, proved methodology. It should be remembered also that approaches, methods and techniques adequate for one area do not necessarily lend themselves to ready application elsewhere. Sources of data and their reliability vary from place to place. The cost of research and the size of budget differ from project to project. Furthermore, with any given set of objectives, economic impact studies are extremely complicated. There is a newness about this area of inquiry; even when standard tools and concepts are used there is a newness in terms of their application.

As is true of most research projects, a study of an expressway's effects could become a full career and perhaps a worthwhile one. Even then, such a study could not be complete in all of its parts. Early studies are likely to have grievous faults which should be considered as opportunities for improvement rather than for destructive

TABLE 11

INFLUENCE OF THE SAN ANTONIO EXPRESSWAYS
ON VALUES OF LAND IN VARIOUS ZONING DISTRICTS
1941-45 TO 1952-56

Zoning	Method I	Method II
	Unadjusted Sales Prices, %	Value of Land Only, %
Manufacturing	208	199
Retail and Commercial	91	131
Apartments	21	113
One-Family Dwellings	- 10	- 5

criticism. Some valuable economic impact data have been assembled. The aim now is to assure a continued increase in their quality.

The remainder of this paper is concerned with but a few of the problems encountered in measuring the effects of expressways on land values. Attention is given primarily to the schemes employed in the Texas studies and to the use of real estate sales data to obtain estimates of land value. The topics to be discussed are as follows:

1. What recommends the "before-and-after" approach?
2. How good are control areas?
3. What do sale prices measure?
4. What do the "Texas" methods measure?
5. What measurements are needed?

These topics are only examples of the many considerations that should receive deliberation. Admittedly, they receive only a superficial examination in this paper. Time limitations make a more searching treatment impractical.

The "Before-and-After" Approach

The advantageous features which recommend the "before-and-after" approach are that it is easy to understand and apparently simple to apply. Certainly, most readers may be expected to understand the procedure of a before-and-after study. Whether or not they accept the findings at face value is another matter.

The apparent simplicity of using the approach is quite deceptive, however. Since most observations must be made over a period of time, many factors other than a road improvement are likely to influence the study area. Very few such factors are identifiable and also measurable so that their influence may be known and thus controlled. Another difficulty arises in most economic impact studies because the research is conducted in the after period. This aggravates the problem of determining the nature of study areas in the pre-road period.

Would a multiple correlation approach escape the pitfalls inherent in the before-and-after approach? Would more factors be measurable and more accurately controlled? Would statistical control be understood and does such a design assure more precise and reliable findings? The conclusion is that both approaches face many of the same problems and that a correlation technique would add as many difficulties as it would avoid.

It seems apparent, however, that the before-and-after approach is woefully incomplete unless comparative control areas are used with it. A new problem is hereby added, that of selecting control areas and proving their comparability to study areas in all respects except the presence of an expressway.

Control Areas

In theory, the control group should have been identical in composition and potential to the experimental group in the before or pre-road period. Furthermore, factors at play in one group during the influence period should have been the same as those affecting the other group, except that an expressway was introduced into the experimental or study areas. Such a laboratory situation would control a multitude of factors including many not even identifiable. The difference in land values or other phenomena observed in the two groups over the study period would be strictly attributable to the road improvement.

The paradox that comes to mind is that the goodness of control areas can be proved absolutely only by evaluating the multitude of factors that the scheme is supposed to control so painlessly. Perhaps there is no sufficient answer to this argument, at least in this paper. It is, therefore, circumvented.

An ideal matching of control and study areas will never be obtained. Realistically then, requirements are reduced to the assurance that control and study areas are reasonably comparable and unlikely to have been affected differentially by any factor other than the road improvement. Similarly, the amount of effort to be spent in selecting control areas must be in balance with the over-all research effort and in harmony with specific purposes and objectives.

Real Estate Sales Data

There are very few indicators that may be used to measure land values. Among these, real estate sales prices appear to offer the greatest promise but are not without definite drawbacks. An alternative sometimes used is tax valuations of land. These, however, often lag behind market values by several years and are subject to a variety of mismeasurements.

An appraisal approach might be tried but, in turn, this alternative would be carried out through the use of market data including real estate prices. The derivation of land value effects from an expressway's impact on vehicular costs and travel time holds much promise, at least theoretically, but such an approach would face a wide variety of difficulties of a fundamental nature, including the determination of incidence of benefits. Opinion polls sometimes are useful but they lack the quality of objectivity that is so highly desirable.

Perhaps there are still other alternatives that should be investigated. At the present time, analyses of real estate sales data seem to be the universal choice. Findings based on sales are considered a direct reflection of the public's reaction of land market factors and thus to an expressway. Unfortunately, their universality of acceptance has not yet overcome the myriad of problems that sales data introduce.

A body of technical problems is bypassed if it is assumed that bona fide sales, those reflecting actual market value, have been identified. The next concern is whether properties that sold were representative of the properties that existed in study and control areas and in their various strata.

Ideally, a bona fide sale of each property in each time period is what is needed. This, of course, will not happen and a lesser ideal is substituted for it. A pattern of sales to represent a good sample of land values in each time period becomes the requirement. Since such a pattern may not occur, even this modified requirement is not necessarily fulfilled. Adjustments of sales data must be made and sometimes must take rather abstract forms.

Seemingly, if control and study areas were truly comparable, representativeness of sales would be assured. This does not necessarily follow, especially in the after period. The expressway itself may cause certain types of study area properties to sell, properties unlike those selling in control areas and not typical of properties adjacent to the facility.

If a road improvement has a substantial impact on land values, it is almost a certainty that some properties will be ripened for new uses. Such properties are likely to sell first as it would be coincidental if their pre-expressway owners had the highest interest in succeeding uses. This seems especially true for older built-up urban areas. It also seems logical that properties that are vacant or have relatively inexpensive improvements would be among the first to become subject to succession of uses. From these assertions it may be concluded that properties of less than average value in study areas might be the most likely to sell in the after period. This occurred in Dallas' A and B Bands. There is also reason to believe it may have happened in 1945-46, at least, along Houston's Gulf Freeway.

If, during the same period, average properties are sold in control areas, or at least properties that are superior to those which sell in study areas, the consequent comparison will yield either an underestimate of enhancements, or an overestimate of damages. In fact, entirely fallacious damages might be shown for study areas. This may explain some of the negative measurements found in the Gulf Freeway study in the 1939-41 to 1945-46 period.

The fact that expressways are likely to encourage a succession of uses raises questions as to the nature of the estimates of land value influences yielded by the methods employed in the three Texas studies.

Methods of Analyzing Sales Data

The two methods of treating sales data used in each of the three Texas studies are subject to a variety of criticisms. One of the most important of these is that the methods do not properly measure the value of land that is ripened for supersession of use. This

contention holds even if a representativeness of sales occurs, a condition questioned in the previous section. This is a primary concern of the following discussion.

If a road improvement has an impact on adjacent lands, its effect must either enhance or damage properties in their existing uses or ripen them for a change in use. There was strong evidence that the latter influence was felt by land adjacent to expressways in Houston, Dallas and San Antonio. In fact, new uses for some properties became economically feasible immediately. This is to say that the value of properties in a vacant state became greater than the value of land and pre-expressway buildings together plus the net costs of clearing the land. While other properties would have been ripened toward supersession, it is the case of full readiness that is discussed here.

A purchase price for a property ripe for reuse might well represent little more than the market value of the property in its existing use. The actual value of the land, however, would be the purchase price plus the costs of clearing and waiting minus the salvage value of the building. If the salvage value of the building exceeded the expense of its removal and waiting costs, the unadjusted purchase price of the property would overindicate the value of the land by the amount of the excess. If, on the other hand, costs of clearing the land were greater than the salvage value of improvements, the purchase price would underestimate land value by the amount of the difference.

In control areas, total purchase prices overestimate land values by an amount equal to the full value of improvements. (This assumes, of course, that control areas are not experiencing use succession.) Thus, while prices of properties ripe for supersession in study areas may overestimate land values, the excessive amount will be less than the overestimate made by control area prices. The consequence is that a comparison of changes in untreated purchase prices in study and control areas will lead to an undermeasurement of the expressway impact. This may have been the nature of the Method I measurements, which used untreated sales prices, in the three Texas studies. The bias against expressway enhancements is even greater under this method if sales prices in study areas reflected less than the value of vacant land, that is if the salvage value of improvements failed to pay costs of clearing and waiting.

It is suitable at this point to refer again to Tables 2 and 5. Perhaps the failure of Method I to measure values of land ripe for succession in use accounted in part for the negative influences in the early periods in Dallas and Houston. (Poor matching of control and study areas and lack of representativeness of sales also may have been factors in this regard.) Does Method II (Method 4 in the Houston study) which removes the value of improvements from sales prices, do a better job?

Method II removes the value of buildings from purchase prices to give an estimate of the value of vacant land. In the Texas studies, tax valuations of buildings were employed in this method together with construction cost factors to estimate building value at the date of sale. Proving the adequacy of the components used in Method II is a critical step, but for brevity's sake it is assumed that this task has been satisfactorily completed. The question remains: Will Method II, accurately applied, measure an expressway's impact on land ripened for use succession?

Method II would underestimate an expressway's influence on properties brought nearer to reuse. The subtraction of building values from sales prices in control areas will leave the portion of the price that was paid for bare or vacant land. The removal of building value from sales prices of study area properties ripened for reuse will result in a remainder reflecting less than the value of vacant land. This is true because the total purchase price reflected the value of land in a vacant state. Thus the Method II will aggravate the bias explained regarding Method I or untreated sales prices, especially for cases where total purchase price already reflected less than the value of vacant land.

It should be stated that the larger the expressway's benefits to land the more accurately percentage-wise will Method I and II measure them. This follows because the proportion of the total price made up of old building value will diminish with increases in land value. Thus errors arising from the presence of improvements will become a smaller part of the total purchase price.

Suppose that the expressway damages adjacent properties. Will the methods reflect the degree of disbenefit accurately? Method I will again overestimate land value by the

value of buildings in control areas. Land values in study areas also will be overestimated, but the amount is uncertain. If it may be assumed that property damages accrue to land, then the uncertainty is removed; Method I will also overestimate the value of land by the full value of improvements in both study and control areas. Seemingly, then, damages to land would be properly measured; but this is not the case. The method will undermeasure the damage to land values in study areas. This occurs because the absolute damage is measured percentagewise on the basis of the full purchase price during the before period. The accurate percentage damage would result only if the vacant land value in the before period is used in the calculation.

Therefore, Method I cannot be considered a measure of land values but rather a measure of property values. Method II, although designed to reflect land values, accurately measures them only if the purchase price was actually paid for land and buildings, the part of the price paid for buildings being equal to their depreciated replacement cost. In this way, Method II will lead to accurate measurements of damages to land if such occurred.

Perhaps a simple solution is that any method that is used should measure the same phenomenon in both study and control areas. Such a method is yet to be developed. There is little doubt that other methods are needed and that every property that sells must be carefully classified and the purchase price treated with a suitable method in each case.

What Measurements Are Needed?

The types of measurements that should be sought by economic impact research, and the precision of these measurements, depend upon the purposes that should be fulfilled. It is fruitless to search for proof that "something" happened. In many instances, this conclusion can be reached by a casual drive along a new facility. Rather, the aim should be to determine what happened, the magnitude of the effects and an explanation of the processes whereby the changes occurred. The implications of the impact also should receive careful attention.

To assure properly conceived research and adequate measurements, the persons who profess the need for answers should express their purposes precisely. Through this device, they can better exploit economic impact research. On the other hand, researchers must seek to base their objectives on the problems of the ultimate consumers of the information. If appropriate tools and methods are not available, it is the obligation of researchers to develop them. Perhaps it is this latter task that makes economic impact research the challenging area of inquiry that it is.

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