The Land Use Map Versus the Land Value Map—A Dichotomy?

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● CHANGES in land use and in land value are major variables in all studies of the economic impact of highway development. They are in most cases determinant, and they lend themselves to objective measurement. For these reasons there is a recent notable increase in the volume of economic research reports that deal with these twin variables.

Studies with this focus are not new; land use and land value investigations have been the staple product of research in the fields of land economics and geography for many decades. In spite of this history, there is a disturbing lack of precision in current efforts to measure the impact of highway programs by tracing changes in land use and value. This paper reports one effort to refine concepts of use and value change, and to sharpen the methodological tools by which their measurement is attempted.

One of the major consequences of a change in the quantitative or qualitative level of highway services is to be found in the changes in land use that can be attributed to highway improvement. These use changes, in turn, create a base for and are foreshadowed by changes in land value. The major focus of this paper is on the sequence in which these associative land use and value changes occur in time, and on the patterns which they form in space.

Land use and value changes are constantly occurring and will continue to occur, whether or not an overt change is made in the existing level of highway services. The research worker is never able to conclude that the changes associated with the improvement of a highway facility are therefore to be attributed to that improvement. He is always faced with the prospect that they might have occurred anyway. In this setting the burden of proof rests upon any assertion that observed changes in levels of land value or intensities of land use are to be attributed to known changes in the availability of highway transportation. One of the major hypotheses underlying this paper is that land use and value changes associated with highway change are not necessarily to be attributed to it, and that the preponderance of argument must be great before causal relationships can be validly inferred.

A second assumption is that the time sequence in which these changes occur is highly important. In a market economy, changes in land use are foreshadowed by changes in its value even though the nature of the use of land ultimately creates the base for its value. That value is typically imputed to the land ahead of (and often far ahead of) the time at which the exercise of these new uses becomes economic reality. To use existing land value levels as a measure of the economic impact of a highway improvement is therefore an untenable procedure until something is known about the lag that exists between anticipatory value increases and ultimate use changes. Where this lag is great, the effect of highway improvement can be to force land into idleness, devoted to no economic activity other than that involved in the waiting process.

Another reason for attributing high significance to the time sequence relates to the element of abruptness of the decisions and the responsiveness of the market as choice is exercised among the alternative uses of land. An upsurge of residential demand can push meandering tentacles of urban development far out into rural areas. In these circumstances, values often tend to be overstated in total, and their relative distribution with respect to the altered use pattern can be seriously misleading. Mistaking the effects of abnormal market conditions for the effects of highway improvements must be avoided. To sharpen the distinction between these effects requires something more than the net changes or results detected in a "before and after" study. The time sequence, rate and duration of the elements of change must be interpreted "in process", to gain the needed perspective.

Almost all studies of the impact of highway development begin with an unstated assumption that the ultimate effect of better roads is higher land values and more intensive land use. There is massive historical evidence to support this assumption,

and in global terms there is little reason to question its general validity. The development of new types of limited access highways requires re-examination of this hypothesis regarding the value-appreciating consequences of highway development.

Accessibility is the key to land value and land use. Where accessibility is impaired to any degree it may not be valid to assume a linear relation between land value, land use, and highway development. The system of interstate highways to be constructed under the Expanded Federal Aid Highway Act of 1956 will bring about a basic change in old patterns and forms of accessibility. Land uses directly abutting the Interstate System will often have access by means of service roads, whereas in the past access to the older highways would have been direct from any abutting property. This does not necessarily imply that access has been impaired, but in many cases the nature of the access to the highway will have been substantially altered. By separating local from through traffic, the nature of access to certain forms of land use may actually be improved, although direct access from abutting properties may be limited or precluded. Considerations of this nature call for a careful study of the relations between land value and land use as they are affected by proximity to the highway, access to the highway, situation with regard to major interchanges or crossovers, and relation with the pattern of service and access roads. The tasks of measurement in this setting will demand a relatively high degree of refinement and precision in any techniques developed to measure use and value changes.

There is another unstated assumption that an increase in the level of highway services will enhance the value of land in any given use. If a farm once located in a dirt road is now served with a gravel road, it has been customary to regard this as a value-enhancing factor. When the level of road service is improved further, and access to market is provided over an all-weather road, an additional value increment is appropriately inferred. These value-enhancing effects, and the observations supporting them, have been appropriate to a developing economy in which the level of highway services had failed to keep pace with the demand.

With the continuing improvement of highway networks in rural and urban areas a possibility arises that in some areas the highway network may be approaching a level that can be considered adequate for certain existing patterns of land use. If this condition prevails, further development in the highway network may be of limited value to the adjacent lands, in their present uses. If the existing roads and streets in a residential subdivision are satisfactory for residential traffic needs, additional highway developments may not lead to more intensive uses or higher values associated with residential use but may require major changes in land use to permit their realization. Similarly, if all farms in an area are on hard surfaced, all weather, snow plowed roads, the addition of more traffic lanes or of superior engineering features may exercise little influence on the value of adjacent lands if they remain in agricultural use. The value enhancing forces associated with highway development at this level may require a change in existing use patterns to permit their realization.

This argument suggests that land value and land use changes associated with highway development may be divided for purposes of analysis into two classes:

1. Economic impacts that are observed within major use classes. These might be termed "intra-use class changes."
2. Economic impacts that are observed to occur only when there are major changes in land use. These may be termed "inter-use class changes."

In examining economic impact in terms of either of these classes, highways may affect both the level of total values and the relative distribution among locations or uses.

It is apparent that the major impact of highway development is to be observed in connection with shifts of land among major classes of use, that is, the inter-use class changes. Put in other terms, increases in land value or in the intensity of land use associated with a given highway improvement are of less significance if the land use remains the same than if the class of use changes. Among agricultural uses, some value increases can be observed to relate to improvements in the highway network. After a certain level is reached, if additional increases occur they are likely to reflect a new level of values associated with a shift to residential, commercial or urban use.

These observations have led to the heaviest concentration, in this study, on the economic impact of highway development as it is manifest at the "hinges" linking major classes of land use. It is at these margins of transfer among major use classes that the critical impact of highway development is most clearly discernible.

The argument to this point can be summarized as follows: Because of the limited access feature of the new interstate freeways, it will be necessary to pin-point the study and measurement of any consequent changes in land values. This will require greater precision in land value determination than has been necessary in the past.

Similarly, because the new highway program is being superimposed upon an existing and well-developed network of roads and highways, it can be anticipated that the major consequences of the new system will be reflected in shifts in land use, rather than in the intensification of existing uses. For this reason it will be necessary to develop concepts and definitions of land use, and use changes, that can be determined objectively and that relate to relatively small areas of land. Without this precision, the treatment of land use will be confined to description alone, and it will have little value as an analytical tool.

In this connection, one can identify two kinds of variation in land use:

1. Those that can be detected by aerial photographs or by field study; the "visible changes."
2. Those changes that involve a shift in intensity of use without resulting in a change in major use classification or in the proportion of the total area covered with structures. These are the "invisible changes" that may be relfected in data on the dollar volume of business transacted, or in other measures of the "flow" of economic activity.

Paralleling these use changes, there are also two types of change in land values:

1. The realized changes, that occur when properties are sold and that can be more or less accurately determined by reference to a market process.
2. The latent or unrealized changes that may have taken place but as yet are unreported in any market transaction and thus must be inferred from market sales of similar properties, if any, or imputed to the property through some subjective process of appraisal or assessment.

The collection of data on land use has been greatly simplified in recent years through the process of aerial photography. With the development of procedures for spot field checking of the aerial photographs, a technique is available that makes it economically feasible to conduct repeated land use surveys by aerial means as frequent time intervals. Systematic data of this nature, at intervals of one or two years, are now available for a number of urban areas and major highway routes.

One of the innovations attempted in this study has been the development of a uniform grid for the classification and mapping of land uses. In open country this grid has usually been the square mile or the quarter section (160 acres). In suburban areas, land use grids of 40 acres and of eight city blocks have been used with success. By relating land use to a grid system the analysis of land use changes over time is greatly facilitated. An additional advantage, of importance in the study of large areas, lies in the fact that land uses related to a grid structure lend themselves to analysis through machine tabulation and mass-data techniques.

The collection of land value data has experienced no similar technological revolution. It is still a laborious, expensive, and time-consuming process. It is further complicated by the small number of properties changing hands in any one year. Referring to the types of use and value changes enumerated above, the bulk of the important use changes are "visible" changes and can be studied by means of aerial photographs. The major part of land value changes (in an areal sense) are the latent or unrealized changes that have not been reflected in the market place or through a commercial sale.

In this setting, it is pertinent to explore the possibilities of developing a measure of changes in the levels or configuration of land values by inferring them from observed land use changes. If dependable relationships can be found that link land values to land use, in either an ordinal or cardinal sense, a long step forward will have been taken in the attempt to identify and measure the economic impact of highway development.

With this formulation of the problem two difficulties emerge. One involves the refinement of land use classifications to render them operational for analytical purposes. Traditional land use classes are broad, functional designations involving concepts of major use types designated as agricultural, residential, commercial, industrial, etc. Those classes are too broad for use with any acceptable degree of precision. The first step in refining these broad use classes has involved the determination of the extent to which given units of area are "covered" by structures. The extent of the "coverage" and the uses to which the structures are put can be determined from aerial photographs, with verification by field reconnaissance.

The designations as to use and the size of the use areas are transferred to plat maps showing ownership or parcel boundaries. From these data the use maps are drawn showing the percentage of land in each use in the "covered" areas and in the "uncovered" areas. Uses in the covered area include residential (urban, rural, etc.), commercial (neighborhood grocery, shopping center, filling station, etc.), industrial, and institutional (school, church, road, street, etc.). Uses in the uncovered areas include farm (or idle rural), idle development (awaiting residential, commercial, industrial or institutional development), auxiliary commercial (storage, parking, outside display space, etc.) and auxiliary industrial (factory parking lots, loading areas, etc.).

At this level of refinement the land use classes are still too crude to permit any close relationship with land values. The next step in refinement has involved a rearrangement of use-class boundaries on the basis of the characteristics of the individual properties: floor space, type of structure, function to which it is put, etc. Land use classes thus refined, when incorporated into the grid system of analysis, have shown promise of yielding systematic relationships with land value.

A critical area in the application of this procedure of land use mapping involves the suburban fringe where the surface is only partially covered with residences. If the residential area is fully built up, with lots of conventional size, there is no serious problem. If lot sizes range from one-half to ten acres or more, three possibilities exist:

1. The area may be an exclusive residential district, of expensive homes on large lots, and in that case can be regarded as fully covered for that class of use.
2. The area may experience further residential subdivision and thus reflect a highly undeveloped or uncovered status, at the time of survey.
3. The area may experience further subdivision with major changes in use, to commercial, industrial, etc.

Where the pattern of current use comprises islands of land with a high percent of covered area, interspersed among large areas of open land, the process of land use classification needs to be repeated at frequent time intervals to yield useful results. In a dynamic market economy typified by unplanned urban expansion, this problem is inherent in the situation. It is unfortunately true that some of the greatest difficulties in relating land use to land values can be expected in the areas receiving the full force of anticipatory or developmental urban-growth pressures.

The mapping of landuses is an established procedure and the results are readily understood. Land value mapping is a relatively uncommon analytical device. Where it has been attempted in the past it has usually been confined to large units of area, often of the size of a county and rarely ever smaller than a civil township. Units of this size are much too large for analytical purposes.

In order to reduce land value data to a form that will permit the study of their association with land use it is necessary to express them in terms of an appropriate grid. As described above, the grids used have been the section or quarter-section, in open country, and tracts of 40 acres or eight city blocks, in urban areas.

Two problems emerge in an attempt to develop a usable grid pattern of land values:

1. In any small area, for example a tract of 40 acres, or one of 8 city blocks, there are too few market transfers of real property to permit a dependable reference to market price in determining value. The pattern of values must often be inferred from sales in an earlier time period or from those of similar properties outside the unit area.

2. The market rarely establishes values for land that are separate from the value of buildings or improvements on the land. The subjective element in any attempt to map land values alone is so great that the results are of little use. This fact forces attention upon the composite value of the land with its appurtenant improvements.

Although it would be possible to rely on the process of appraisal to determine the value of properties in small areal units, the cost would be prohibitive. The only readily available data on property values by small areal units or ownership tracts are those placed on the tracts by the property tax assessors. From many studies of the relation between property tax assessments and market prices one knows that the reliability of assessors' data is seriously impaired. Properties of low value are frequently over-assessed relative to higher-priced properties; large and complex properties are typically undervalued compared to smaller ones. Assessment data commonly lag behind market values, and are sometimes unchanged for years on end. These characteristics preclude the direct use of assessors' valuations.

In spite of these defects, the possibility remains that assessment values may be useful if some systematic relation can be discovered between assessing practices and market prices. One procedure that has met with some success involves the calculation of the ratios of the assessed value of the land to the assessed value of structures on the land, for each property involved in a market sale. This "building/land" ratio is commonly less than one for rural lands (assessed value of improvements are well below the assessed value of the land), and greater than one for urban properties. In urban, suburban, and rural residential areas an array of these ratios for properties that have been sold in recent years has disclosed a substantially linear and positive relation between the size of the ratio and the market price of the property.

In other words, although assessed values are not systematically related to market price, it has been found that in certain urban and suburban uses the ratios of building assessments to land assessments provide a reasonably satisfactory base for estimating market values.

With the use of the building/land ratio, it has been possible to estimate market values from assessors' data, for all ownership (or assessment) tracts, in spite of the fact that very few properties have actually been sold in any given time period.

From the network of estimated values thus determined it is a simple matter to reduce the tract values to estimates of value per unit area. In rural areas the grid selected has usually been one square mile, or one-quarter square mile (160 acres), depending upon the size of the ownership parcels. In urban areas a grid of eight city blocks or 40 acres has been found suitable for most purposes.

With property values (land plus structures) available on a grid of area units it is then possible to construct "area-value" maps of the "relief" or topography of values and to evaluate the degree of coincidence, or spatial association, between patterns of use and value. This is important; for the two patterns must be closely associated geographically if it is to be possible to explain or predict value impact rationally on the basis of use changes. From examination of the small number of maps thus far prepared, the spatial association of use and value is quite clear in general but rather poor in detail. The imperfect association is believed to be the result of inadequacies in estimating area value, and even more, in the classification of types of land use. Land use classification requires more categories and, probably, some different concepts, than those which are now commonly used for planning studies. Furthermore, it remains to be demonstrated to what extent even the general spatial association which exists between patterns of use and value will hold through time. These are questions which can be answered only through continued study.

It should be noted, however, that the maps prepared to date have shown a high correspondence between grid-squares of high land use intensity and grid-squares of high land values. In maps prepared for three townships in Washington county, adjacent to the city of St. Paul, Minn., ten of the twelve "highs" are centered in identical grid squares on the land use intensity and land value maps; the other two are within half a mile of identical positions. Although further improvement in use classification and value determination procedures is needed, the data support a tentative conclusion that

land use and land value can be treated analytically as two branches from the same stem of economic relationships.

On the basis of work accomplished to date it is possible to indicate some of the uses to which these techniques of measurement may be put. With the explosive development of cities, and the radical amendment to highway network through the Interstate System, one will witness the development of an entirely new topography of land and property values. It is as if some gigantic economic upheaval were thrusting up new mountain peaks and creating new valleys and escarpments of land values in what once had been a comparatively flat and featureless plain. To continue the analogy, one can also detect the appearance of economic fault-lines in the value structure and can note the appearance of areas where values are eroding away.

These changes can be more readily identified if one can develop a systematic procedure for "area-value" mapping, in a time sequence. Time is the important element in this problem. What changes first occur, following a highway development? In what order can subsequent changes be expected to take place? It is admittedly impossible to develop perfect knowledge regarding the impact of forthcoming highway improvements. The hope remains that land owners, city planners, tax authorities and the general public can be given better indicators of the scope and nature of the impending changes that the new highway program will bring.

The generalized effect of these changes can already be anticipated. The effect of better transportation is to increase the availability of land for any given use or user. Lands once disadvantaged are rendered more valuable. The lands distant from an urban core are appreciated in value relative to lands at the center.

In this framework, there can be detected a flattening-out in the gradient of land values as one follows radial lines away from central business districts. The network of urban property values is spread over a much wider area. The net effect is to depreciate site values and the monopoly element in location. In commercial and business uses, the front-foot value of land seems likely to depreciate relative to square-foot values. In a more massive fashion, the importance of land serving retailing, residential and recreational needs increases relative to the importance of the land required to provide food.

Better highways intensify these trends. It is all the more necessary that there be developed techniques of study and measurement that will permit one to include the total structure of land uses and values within his frame of reference. Paul F. Wendt, in a recent article remarked that: "...One of the first steps necessary to further analysis of the changing structure of urban land values appears to be the development of accurate land use information portraying the increments to the supply of urban land over time and the assessed values adjusted to market value of the major classifications of urban land." (1)

The techniques of land use and land value mapping described in this paper are offered as one possible answer to the felt need that Wendt has aptly stated.

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REFERENCE

1. "Economic Growth and Urban Land Values." The Appraisal Journal, p. 443, (July 1958).