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LAND TENURE AND VALUE RESPONSE TO WATERWAY IMPROVEMENT: THEORY AND PRELIMINARY RESEARCH DESIGN

Submitted to

The Oklahoma Water Resources Research Institute
Oklahoma State University
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by

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Preface

This project was first conceived about two and one-half years before the opening of the McClellan-Kerr Arkansas River Navigation System to its northwestern terminus at the Tulsa Port of Catoosa. The empirical study of changes in land tenure and value associated with the development of this system remains of interest as a potential contribution to the body of knowledge about the responses of economic units to changed environmental conditions. As the system opens up, studies such as this also take on more policy significance as state and local governments begin to wrestle with problems of land use management. The following news item from a Tulsa paper provides a first-hand indication of why better understanding of the processes of land tenure and value change is so important for planning purposes.

> "You would think they were playing poker and using warranty deeds for chips."
>
> Don Frank, president of Midcontinent Map Co., thus described his feelings at the number of changes in real estate ownership in the Port of Tulsa area over the past two years.
>
> On the wall map, . . . 793 changes in real estate ownership are clustered heavily in the port and turning basin area and form almost a continuous line of change marks between east Tulsa and the port and between Claremore and the port.
>
> The wall map was last issued in 1969, and the number of changes is phenomenal, says Frank."

(*Tulsa World*, Jan. 24, 1971)

The problem remains that any extensive field research into the characteristics of the market for land is bound to be highly labor intensive.

Larkin Warner
February, 1971

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The purpose of this water resources research project relates to the identification of the impact of the development of the Arkansas Waterway upon land tenure and land value. Hypotheses are derived from a simple economic response model. The model is neither elaborate nor particularly original. It is essentially an extension of the micro-economic behavior of economic agents in space. Although some of the model's assumptions are unrealistic, an attempt is made to abstract from the key features of the real world patterns associated with the particular waterway development under study. Thus it is possible to assess alternative strategies for empirical tests of the model's hypotheses.

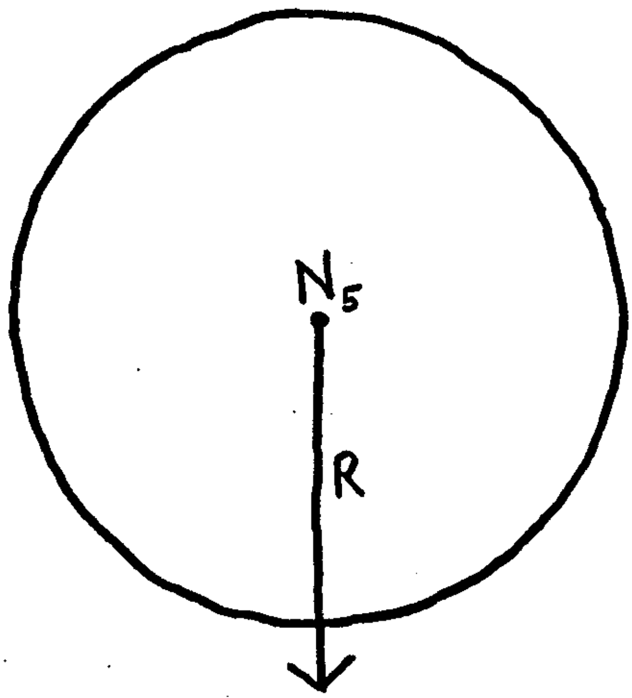
Basic Framework

Let the "economic landscape" be that of the uniform circular plane common in works on abstract location theory (Figure 1) [3, 20]. The plane is a region within a national economy. A single, perfectly straight, potentially navigable river (R) runs into the center of the plane. Throughout the plane, and along the river, there is a heirarchy of cities.[1] The largest single city, N_5, the city of the highest hierarchical order, lies at the center of the plane and at the end of the river. The plane is linked to the national economy by land and

[1] Beckmann [3, pp. 72-88] has developed a simple model which hypothesizes the size pattern of cities in a region such that there are a given number of satellite cities of a given order per city one rank higher in the region's ordering of cities.

FIGURE 1

THE HYPOTHETICAL ECONOMIC LANDSCAPE



air transport. The river extends beyond the plane and is a potential economic link with the national economy.

A decision is made to undertake a public works project to make the river navigable. All of the direct economic changes resulting from the creation of the navigable waterway are assumed to relate to (1) transport cost reduction, (2) increased availability and certainty of water supply for municipal and industrial uses, and (3) recreation and other amenities.

In order to focus more closely on the land tenure and land value impact of these three changes in the economic environment, several further assumptions are made. (1) Regulations require the maintenance of minimum standards of water quality along the entire length of the waterway such that economic responses to the waterway's development will not be warped by the potential gains available to upstream polluters. (2) Before the decision is made to improve the waterway, all non-urban land is utilized by small-scale family farms. (3) Because the plain's rainfall is adequate for farming, irrigation is not practiced. (4) No flooding problem exists either before or after the waterway improvement. The river banks are stable through time, and hence there is zero flood control benefit from the improvement. (5) All non-urban land along the waterway is privately owned, uniformly assessed and taxed, and subject to no zoning restrictions. (6) Prior to the improvement decision, all urban uses of riparian land are unaffected by the river except in the purest physical-barrier sense.

After the decision is made to improve the waterway and make it navigable, economic agents anticipate direct benefits. The whole plain, and particularly the space adjoining the waterway will enjoy greater "input-output access" due to lower transportation charges [35, pp. 87-96]. In addition, activities utilizing water inputs will face new data with respect to increased water availability, greater certainty about supply, and lower water costs. These transport and water supply features will lead to new land uses, and to the expansion of certain types of existing economic activities. Transport and water input costs will be lowered relative to those of the national economy and will be changed with respect to the internal economy of the region. Finally, the development of long navigation pools will greatly expand the recreation and amenity value of the waterway.

As pointed out above, the direct benefits of the waterway improvement are anticipated <u>immediately</u> after the decision is made to undertake the project. This is true even though considerable time may elapse between the announcement and the project's final completion. Unless overall national or regional growth stagnates for other causes, the direct benefits are likely to ultimately become realities. In the meantime, anticipatory responses by economic agents will tend to foreshadow the future. These responses will occur more quickly and more decisively to the extent that there is a high degree of certainty with respect to (1) the final project completion date, and (2) the technological transport and water supply characteristics expected.

The direct (anticipated or realized) benefits accrue partially to land, or more specifically to the owners of land. There will be an increase in land value reflecting the capitalization of these benefits, and a change in land tenure reflecting the acquisition of land by economic units better able than previous owners to capture benefits.

The general pattern of the value and tenure responses may be explored within the framework of this simple model. Although the responses cannot be separated entirely, it will be convenient to look at the interrelationship between the two, and then to examine each separately. If zoning in the plain were initially such as to prohibit non-farming uses of non-urban land, then the most intensive changes in land value will be limited to urban places and urban fringes likely to be annexed. If it is assumed that the highest order city in the center of the plain at the end of the waterway is the only nodal point large enough to achieve economies of scale in transshipment sufficient to warrant facilities to transfer processed or unprocessed agricultural produce from land transport to barges, then changes in non-urban land value will occur only to the extent that a reduction in transportation costs for agricultural products from the nodal shipping point effectively increases the demand for the region's farm products. Since this impact will radiate uniformly from the highest-order city, the increase in farm land values will tend to be uniform throughout the plain. If, however, there are no zoning constraints with respect to the use of non-urban land (as is assumed above), and if all original non-urban land uses are for farming, some change in non-urban land value will also be caused by potential shifts in land use away from farming. That is, above and beyond the general shift in farm land prices due to the better transport available from the central city, changes in the value of land in the open country associated with the waterway will also be associated with new types of land use. The discussion proceeds first to an examination of the hypothetical value response pattern in space, and then to the associated hypothetical changes in land use and ownership.

Land Value Responses

Because of the potential advantage of locating water-using industry, water transport-using activities, and water-related recreation and amenity oriented facilities on or near the river, the rate of change in land value will vary inversely with distance from riverine nodal points.[2] Nodal points along the river consist of cities and rural points at which land transport routes cross the waterway. In addition, the waterway itself becomes a "nodal line" within the region. Thus it is expected that the rate of change in land value will vary inversely with distance from these nodes, and that the nodes will not all exert an influence of the same intensity. The central city of the plain (the highest order city) will exert the strongest influence, other cities will exert influences declining with their rank in the heirarchy of the region's cities, rural nodal points of land transport intersection will exert less influence, and the river's own nodal line will exert the least intense influence.

These land value responses can be visualized as a surface of value changes over time within the plane. If V is taken as the absolute change in value per unit of rural land per unit of time, adjusted for the effect of trend and non-waterway related influences, the basic cross sections or "slices" of this response surface may be generally expected to take the following simple form for exponential decline:

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2 It is assumed that there are no negative value responses. This appears reasonable because the assumed increase in demand for farm products causes a basic increase in the value of farm land. In many cases involving public works such an assumption is not warranted. For example, although a highway improvement may increase the value of land adjacent to the facility, in certain settings there may be offsetting declines in land value also created by the facility. [26, p. 236].

$$V_i = V_n e^{-bx} \qquad \text{or} \qquad \log_e V_i = \log_e V_n - bx$$

where V_i is the change in land value at location i;

V_n is the change in land value at some nodal point n;

e is the natural logarithm;

x is the distance between i and n; and

b is a value change gradient.[3]

This means that a cross-section running at right angles, or in other transverse relations to the waterway, R, will take the form described in Figure 2.

This general right-angle cross-section pattern will, of course, be disturbed by nonriverine nodes. Of interest also is the behavior of V along the waterway's length. This is referred to as the longitudinal impact. In Figure 3, let N_5 be the highest order node--the region's central city lying at the end of the waterway. Lower order cities are signified by N_4 and N_3; non-urban land transport junctions by N_2, and the nodal line effect of the waterway itself by N_1. River-miles are measured along the horizontal axis, and V is again measured vertically. The impact of N_1 is ignored for the moment because its effect on V is pervasive throughout the length of the waterway. It is probable that the exponent b will take on lower absolute values for nodes of higher order, and higher absolute values for nodes of lower order. Even with a fairly simple pattern of nodes along the waterway, several possible river-length response surfaces can be illustrated readily.

Case (1) in Figure 3 illustrates one of the least complex of the value response possibilities. Here the absolute magnitudes of b are

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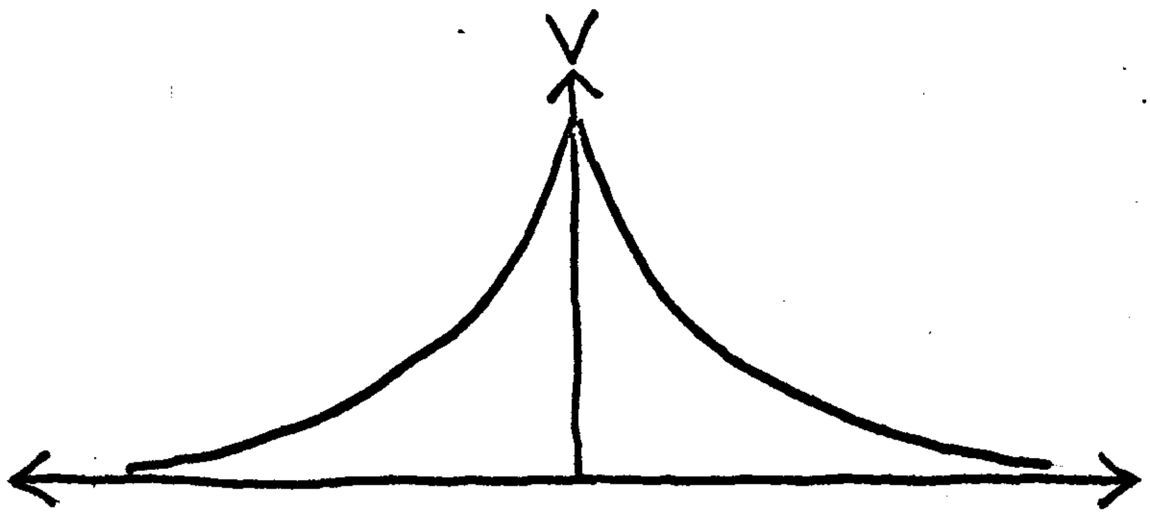
3 This concept is borrowed from its familiar application with respect to the way in which urban population density varies with distance from the central city. [7]

FIGURE 2

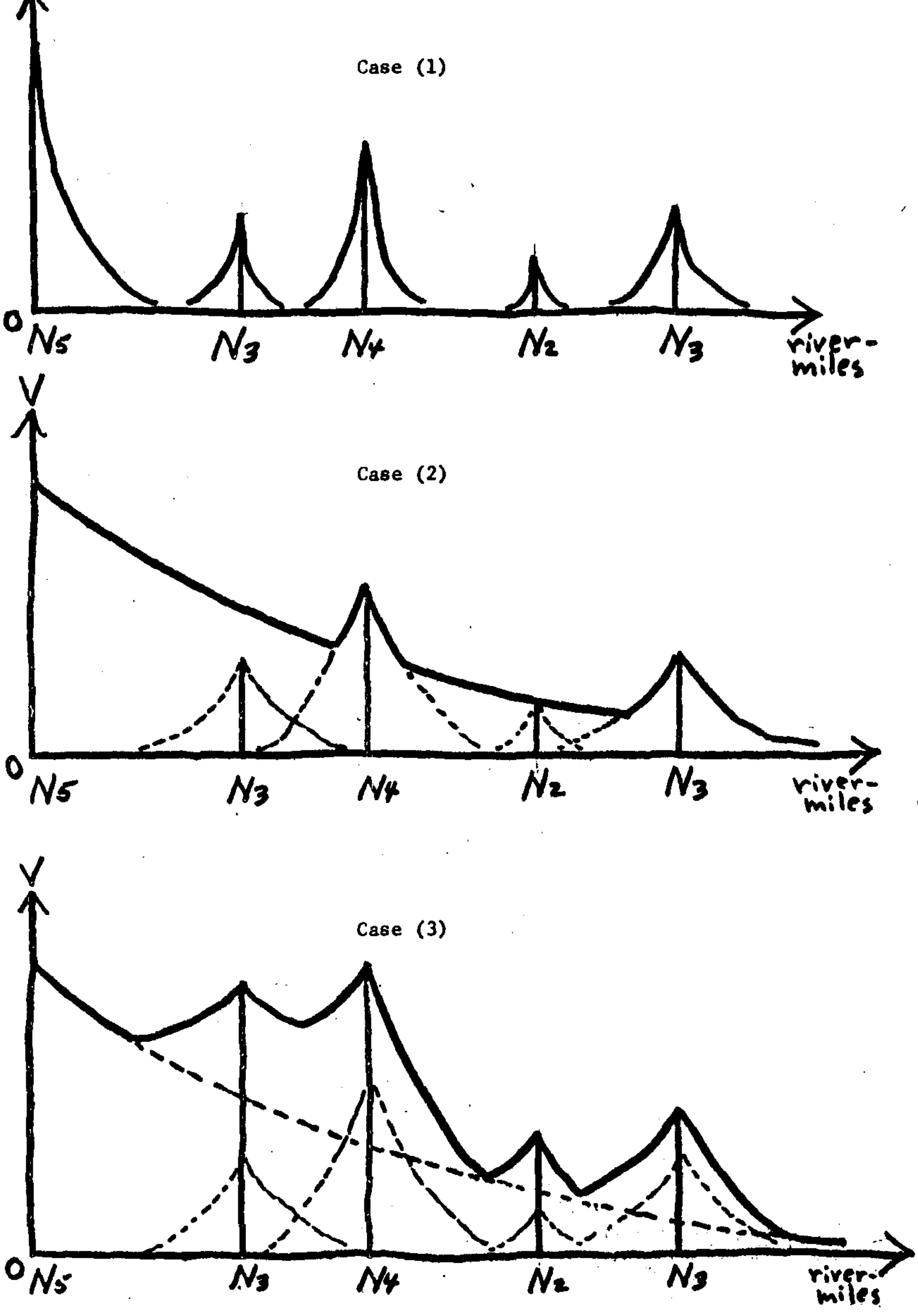
TRANSVERSE CROSS-SECTION RESPONSE



(distance in airline miles)

FIGURE 3

LONGITUDINAL RESPONSE SLICES



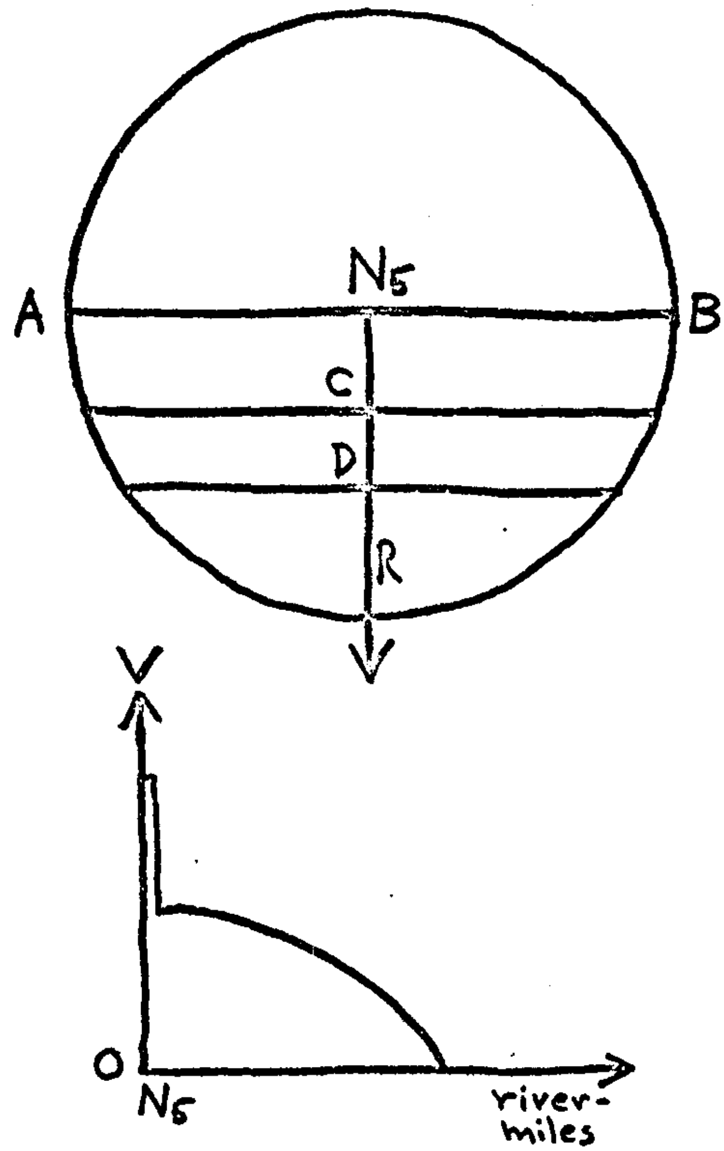
sufficiently high, the distances between nodes sufficiently great, and the rank-order impact of the nodes sufficiently small so that each node has its own independent area of impact. This is not so with case (2). Here the b value associated with the highest order node is so small that this city's impact appears to dominate the whole river-length response line. The impact of two of the nodes is completely obscured by that of the highest-order node; for two others, their effects appear as mountain peaks poking out of a low-lying strata of clouds. Though case (2) is a logical extension of case (1), it lacks an element of realism, for it implies that there are lower-order nodal locations which exert no influence whatsoever upon the pattern of change in land value. A more reasonable proposition is illustrated in case (3) in which, along the length of the waterway, the impact of nodes is additive. In this case the change in land value at i can be represented as the following:

$$V_i = \sum_n V_n e^{-bx}$$

Although the escalloped pattern of longitudinal response slices illustrated in Figure 3 will still exist if the nodal impact of the river itself, N_1, is included, the level and slope will surely be different. Figure 4 illustrates the possible operation of this nodal impact of the waterway per se upon the change of land value. At any point P along the waterway, this impact is a function of a number of points within the plain for which point P is the closest riverine location. With the assumption of a waterway ending at the center of a circular plane, the central node clearly tends to have a great advantage. The entire area above line AB in Figure 4 consists of points for which N_5 is the closest riverine location. At other points along the river

FIGURE 4

THE IMPACT OF THE WATERWAY AS A "NODE"



such as C and D, the number of nonriverine points for which the riverine point is the most proximate is defined by the length of a line running at right angles to the river extending to the perimeter of the plane. This suggests that, save for the intense impact at the center of the plane, the N_1 response line will be concave from below somewhat as illustrated in Figure 4. Note that this impact would be the same whether or not there was a node such as N_5 located at the end of the waterway.

Finally, the longitudinal and transverse response lines are slices from a single, and possibly quite complex, response surface. Nevertheless, the basic hypothetical outlines can be stated simply. The response surface, the change in land value with respect to time, will decrease at a decreasing rate with distance from nodes on the waterway and with distance from the waterway itself, and will decrease at an increasing rate along the waterway with distance from the center of the plane.

Land Tenure Responses

With respect to land tenure, a response surface somewhat similar in appearance to that hypothesized for land value is likely to emerge. The value response is a continuous, cardinal variable. Changes in tenure, however, must be defined on the basis of a classification system. In this model, the surface is created by first assigning ordinal values to classes of owners, and then representing these ordinal positions with cardinal numbers. The cardinal numbers form a surface with the same appearance as a three-dimensional bar graph.

The taxonomic system into which the model landowners are placed is based on the model's own requirements. It has been pointed out that changes in the character of land ownership are likely to be necessary concomitants to changes in land value. The changes in land value caused by the waterway's development reflect the capitalization of new, enlarged flows of net earnings. In a regional and national economy experiencing continuous growth and structural change, the possibility of an economic unit capturing a larger than normal return depends in part on the nature of the options open to it. The more courses of action which can be pursued with owned or controlled resources, the greater the probability of supranormal returns. This kind of reasoning, for example, is frequently given as justification for the growth of the large-scale conglomerate enterprise. The simple classification system used in this model is founded on a heirarchy of the assumed options open to economic units falling in four categories. The categories and their ordinal values are as follows:

Class I - Farming

Class II - Speculation

Class III - Intraregional industrial-commercial

Class IV - Interregional industrial-commercial

The distinction between Class III and Class IV owners is based on the proposition that the multi-establishment enterprise operating in more than one region is likely to face a wider range of opportunity than is the case for the purely intraregional firm. All land owners may, at one time or another, be engaged in speculation in land. To overcome this ambiguity with respect to Class II, it is assumed that this is a residual category encompassing owners whose sole purpose in land acquisition is to achieve short-term gains by accumulating and holding parcels to be sold to owners falling in Classes III and IV.

Although the classification system is derived from private sector counterparts, public sector ownership can be included. For example, ownership by a public industrial finance authority would fall into Class II, ownership for recreation purposes is essentially parallel to commercial recreation and is likely to be in Class III, and use for, say, a publicly-owned steam-electric generating plant falls into Class IV as similar to the operations of a large interregional utility corporation.

A major feature of this classification system is that it also reflects the relative power of economic units to acquire desired resources. Large-scale enterprise is likely to be financially more capable to bid up the price and finally to acquire land which it sees as attractive for future expansion of facilities.[4] Indeed, land along an improved waterway can be likened to the relatively inelastic supply of high quality deposits of a mineral resource. In the minerals industries, a familiar tale is presented by "captive" coal mines, the preemption of bauxite deposits, and the development of high quality foreign oil deposits, all involving large-scale oligopolistic interstate corporations. With respect to commercial land use, the casual observer almost never sees an "independent" oil company with a station at a major interchange along the Interstate Highway system. Thus the classification

[4] A Wall Street Journal feature article described activities of major corporations acquiring sites for expansion and speculation. After emphasizing how this is causing the price of industrial land to rise rapidly in some areas, the article concluded with the following comment on the financial power exercised by large-scale firms. "Even though money is theoretically hard to come by these days, the corporate land buyers seem to have little trouble raising cash for their purchases. Realtors say most deals, even the million-dollar ones, are made for cash, or at least one-third down, and one salesman says, 'Money doesn't seem to be a problem.'" [November 24, 1969, p. 1].

system as a measure of the heirarchy of economic power encompasses not only sheer financial power associated with large asset volume, but also involves relative levels of discretionary freedom to pay well above the market without adverse consequences for firms operating in monopolistic or oligopolistic environments.

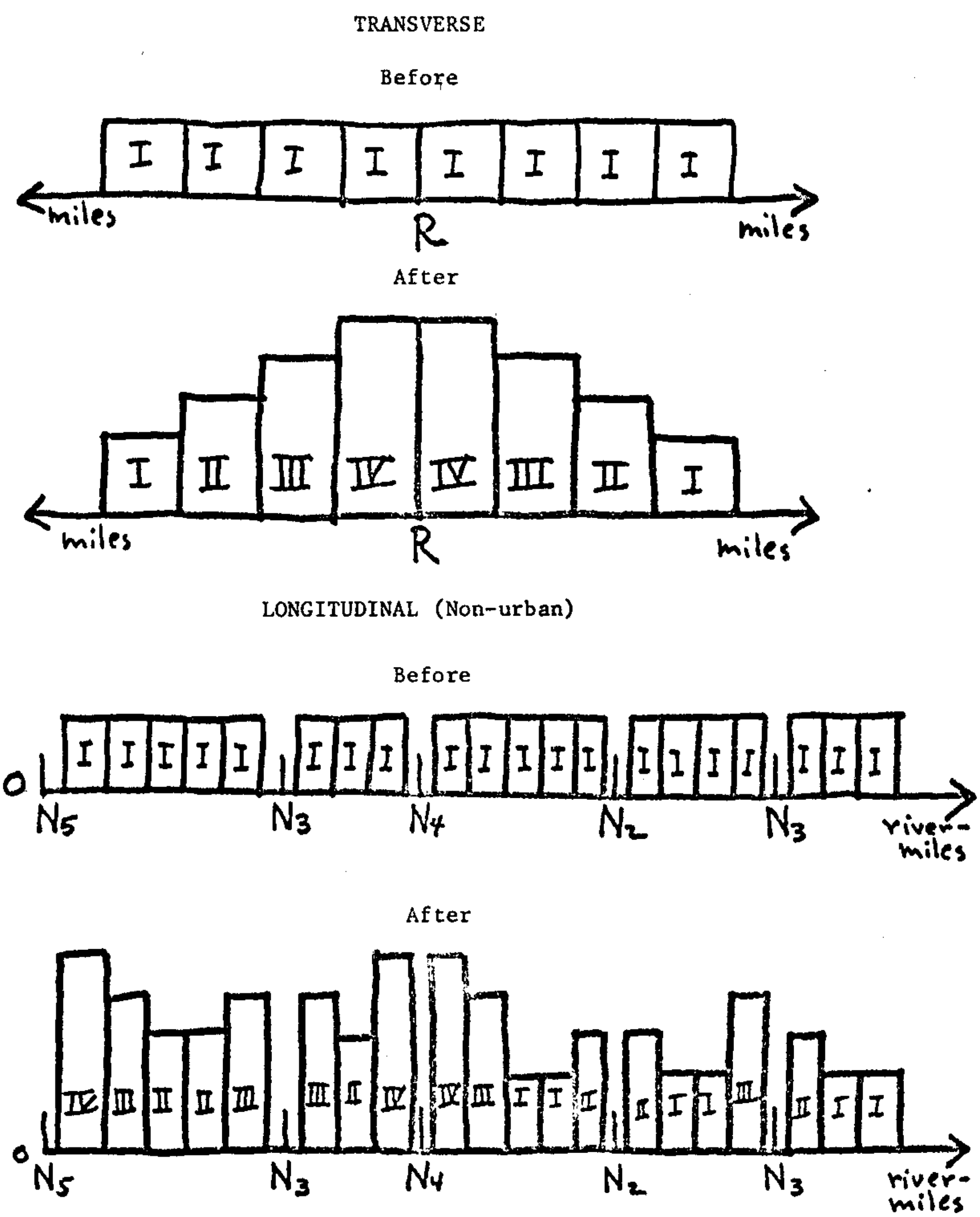
Figure 5 illustrates several hypothetical aspects of the land tenure response surface. In the graphs, Class I uses are illustrated by one vertical unit, Class II by two units, and so forth. Recalling the original assumption that all nonurban land in the plane was initially used for farming (Class I), the surface before announcement of the waterway is perfectly flat at a level of one unit. As time increases after announcement, land will be acquired from farmers by owners falling into higher tenure classes. At any point in time after announcement, it is hypothesized that the order of the class will vary inversely with the transverse distance from the waterway, and will vary inversely with the longitudinal distance from nodal points along the waterway. In other words, the probability that a parcel of land will fall into a higher class of tenure will be greater to the extent that (1) more time has elapsed since announcement, (2) the parcel is on or close to the waterway, and (3) the parcel is at or near a nodal point.

Information Flows, Speculation, and Parcel Size

The above hypotheses with respect to the change in land tenure fit symmetrically with the assumptions relating to the pattern of change in land value. Underlying this fairly neat system of value-tenure hypotheses are further assumptions, implicit till now, concerning information flows and speculation.

FIGURE 5

HYPOTHETICAL LAND TENURE RESPONSE SCLICES



Information about the waterway is assumed to be most readily available to economic agents physically closest to the waterway. Hence the "typical" turnover pattern for riparian land is assumed to be from farmer to speculator, and from speculator to intraregional or interregional commercial-industrial owners, with the frequency of intraregional changes in tenure being higher than interregional changes. This pattern of information flow has a priori appeal on the grounds that economic agents are most familiar with their immediate spatial environment, and experience generally increasing uncertainty about the state of affairs as distance from "home" increases. Moreover, while the large interregional corporation considering site acquisition for future expansion has general knowledge about conditions throughout the regions of the national economy, it may react to a particular cluster of sites only after considerable localized activity in land markets has generated the attention of land speculators operating nationwide.

It must be pointed out, however, that an essentially opposite pattern of information flow may occur. The large firm operating at a distance may be in a position to acquire and assess information more readily than smaller local organizations. Hence the response pattern may involve initial shifts in ownership say from Class I directly to Class IV, with speculative and smaller commercial-industrial units moving into the market later. The final tenure pattern hypothesized above would not look significantly different if this were the case, but intermediate snapshots would indicate a much more irregular pattern of tenure shifts than is hypothesized above.

A further question which arises naturally within the confines of the model is the following: What is to prevent speculative activity from warping the entire response surfaces so that the hypothesized patterns do not emerge at all? [27, p. 315] The driving forces behind the model are changes in the demand for land. Supply elasticities for various classes of tenure are assumed to be sufficiently in excess of zero, and sufficiently stable so that the response patterns work themselves out. As a partial illustration of the reasonableness of this assumption, it may be asked why the original owners of nonurban land, the farmers, do not hold their land for excessively long periods. By "excessively long" is meant beyond the time at which the farmers' gains from further speculative refusals to sell are less than the cost of holding the land for farming purposes. [2, p. 200] Two related features immediately come to mind. First, there is a large number of farmers, and this large number assures considerable variation in the subjective assessment of speculative gains from current decisions to refuse to sell. Second, the process of changes in land tenure is started, if not accelerated, by a tendency for elasticity of land supply to vary directly with distance from nodes, and with distance from the waterway, because the more distant owners perceive the opportunity to promote "leapfrogging" development. This greater propensity to sell by more distant owners, will, without collusion, lead the more advantageously placed owners to be more willing to sell. A similar line of reasoning can apply to the Class II owners, the pure speculators, though this group is likely to be more sanguine about the potential total demand for land related to the waterway's development. [10, pp. 169-70]

Finally, it is assumed that Class III and IV (and possibly Class II) buyers have no special difficulties assembling parcels of land of sizes consistent with their economic strategies. The need for the exercise of the power of eminent domain to assemble parcels of land has long been recognized in the field of urban renewal. Purely private land assembly efforts encounter resistance due to the strong incentive of owners of small plots to demand abnormally high prices, or to refuse to sell at all. [12, p. 111] Although the issue of assembly costs is inherently more important in densely populated urban areas, it is not absent from rural land markets.

Within the framework of the model presented herein, it is probable that initial parcel sizes held by individual farmers are sufficiently large for many Class III or IV uses. Certainly non-urban buyers do not have to deal with the same plethora of individual holders of small plots as is the case in an urban setting. If assembly difficulties were to arise, they would be most likely to be associated with land sufficiently close to the river so that the improvement changed the land's amenity value for residential sites. Farmers along the waterway may choose initially to sell very small acreages to individuals for residential purposes. If such small residential landholding were to arise in sufficient extent along the waterway, future Class III and IV buyers might face considerable land assembly difficulties. There is little that can be concluded, a priori, concerning the propensity of farmers to sell for such residential purposes. It would appear, however, that this propensity would be greater if there was a very long gestation period between the announcement of the waterway improvement project and its final completion. A long gestation period might result in farmers either becoming discouraged or failing to perceive a market with Class III and IV buyers. On the other hand, one of the functions performed by the Class II speculators will be to prevent the breaking up of large agricultural land holdings into small plots.

The Model's Normative Content

The model of land value and tenure response presented above operates at a fairly high level of abstraction. The model will be used as a basis for an empirical research design examining changes in value and land tenure associated with the Arkansas Waterway. Before becoming embroiled in the complications of a real world setting, it is desirable to attempt to assess the importance of the model and the potential usefulness of its empirical application. It has already been noted that the model is an extension of the microeconomic behavior of economic agents in space. As such, the testing of the model for its internal logic, and for its essential correspondence with real world phenomenon may be viewed as any other scientific endeavor. That is, as a form of positive analysis, the model should be rejected or corrected if its internal logic is flawed, and it should be modified or scrapped if its assumptions have no correspondence with real world conditions and its predictions do not describe events at an acceptable level of probability. Important as positive methodology may be to the general advancement of science, it must be pointed out that the occasion for the design of the model, and the model itself, reflect the need for evaluation of public policy decisions involving massive investment of public monies in waterway improvement projects. As a matter of fact, it is seldom possible (and some would assert logically impossible) in the social sciences to disengage positive from normative modeling activity.

As a normative model, failure of the hypothesized changes in tenure and value to occur suggests strongly the possibility that the original decision to undertake the waterway project represented an unwise use of society's resources. It is, of course, possible that all of the benefits of the waterway improvement in the circular plane would flow to existing enterprises at the various nodal points, and to the farming sector in general. In other words, it is conceivable that the project would be socially desirable even though there were no changes in land value and tenure in nonurban areas, except for those associated with a general increase in the demand for agricultural produce. Such a condition, however, is quite unlikely. The public authority charged with making benefit-cost calculations in connection with the decision to either undertake or not to undertake the waterway improvement most certainly will include the kind of nonurban shifts in value and tenure in its calculation in some form or other.[5] Hence, if soon after the announcement of the waterway's construction, no changes in land value are observed, and no shifts in land tenure appear to be associated with the waterway, then the original construction decision may have been in error.[6] Indeed, it is conceivable that the absence of the sort of value-tenure responses posited in this model within some period of time before the projected completion date might suggest the desirability of calling a halt to construction work and reassessment of the entire project undertaking. That is, even after the project is started, total welfare might be increased by (1) ceasing construction entirely, (2) slowing construction with a view to extending the completion

[5] For an extensive annotated bibliography see [15], especially Chapter VIII.

[6] Margolis has pointed out this approach to benefit cost [22, pp. 562-64], but raises the issue that increments in land value in one area may be to the detriment of values in other areas. This is an inherent problem, but is probably a much more serious problem for analysis of projects in the context of a multi-community urban economy.

date to a time in which general economic development will permit much greater capitalization of the benefits of the project, or (3) postponing work on the project until some future date at which the entire undertaking will be reassessed.

Empirical Application: Alternative Strategies

The geographic setting for the Arkansas-Verdigris Waterway bears some similarity to the circular plane described in Figure 1.[7] Of course, the territory affected by the waterway is neither flat nor homogeneous with respect to rural and industrial urban land use. Nor are navigation, water supply, and recreation-amenities the only benefits associated with the waterway project; important benefits are associated with hydroelectric power, flood control, and bank stabilization. Institutional arrangements are unlikely to permit entirely unlimited patterns of land use along the river. Nevertheless, as the project is finally completed in the early seventies, Tulsa, a metropolitan region with a population over a half a million, will for the first time be connected by navigable waterway to the Mississippi River. The history of Tulsa's prior economic development has been that of a land-locked urban area having to rely upon land and air transport

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[7] Several sources are mentioned as providing an overview of the project and some of its more important specific characteristics. A quick summary of the waterway's features in Oklahoma may be found in [42]. A political history of the project, emphasizing the role of the late Senator Robert S. Kerr is presented in [37]. For an administrative study of governmental efforts at planning for the Arkansas-White-Red River basins, see [34]. An early evaluation of the proposed project raising doubt as to its desirability is in [13]. Recent treatments include a massive compilation of background data for the counties adjacent to the waterway in Oklahoma [38], an assessment of the waterway's effect on agriculture in Oklahoma [39], and a journalistic treatment of the waterway's transportation characteristics [14].

for its interconnections with the regional and national economies. Tulsa is over 400 air-miles from the Mississippi River. Lying at the end of the Arkansas-Verdigris Waterway, Tulsa is truly a regional node similar to that lying at the center of the model's plane. The nearest node of comparable size on the waterway is Little Rock, some 327 river-miles closer to the entrance of the system into the Mississippi. Although intermediate nodes do exist along this 327 mile stretch, they are distinctly lower-order places such as Fort Smith and Muskogee.

From the point of view of identifying the kind of value and tenure responses hypothesized in the model, the most promising section of the waterway appears to be the 50 miles of improvement along the Verdigris River extending from Catoosa to Muskogee in Oklahoma. The reason for this relates to the fact that the riparian lands associated with the Arkansas River portion have long been affected by flooding, and by the generally meandering nature of the river. This has not been nearly as true of the Verdigris, which indeed bears a family resemblance to a canal.

The earliest speculative activity with respect to land along the waterway in Oklahoma may have begun during the immediate post World War II period. A plan for Arkansas River improvement was authorized by the Rivers and Harbors Act of 1946. An authorization is not the same thing as an appropriation, and it is probable that if the hypothetical response patterns begin to develop with any discernable magnitude, it would be after appropriations began to flow in 1955. By 1956 there was virtually no uncertainty that the project would ultimately be carried through to completion. Nor was there major uncertainty concerning the physical characteristics of the project. [37] It is also likely that those trading in land assumed that the general timing of project completion was not likely to be very different from that indicated by the Corps of Engineers and Congressional delegations. This time pattern of development suggests that the investigator faces several alternatives with respect to the time span relevant for hypothesis testing. Ideally, data might be collected at annual intervals extending from 1950 to the present. It might, however, be more efficient to begin with 1955 and extend through 1965 and possibly to the present. Or it might be desirable to shift back one year to 1954 so that advantage could be taken of complementary data appearing in the 1954, 1959 and 1964 Censuses of Agriculture.

Those investigating changes in the value of land face a paucity of uniform data. [8, pp. 159-61] The nature of the market in which land is traded and the diverse characteristics of units of land, make it difficult to arrive at data permitting geographic comparisons of price per unit. Four major techniques for empirically identifying land value are (1) assessed valuation, (2) independent appraisal, (3) identification of Federal stamps attached to title changes, and (4) surveys of buyers and/or sellers. [1, 4, 5, 11, 17, 18, 19, 21, 24, 36, 40, 48] Because of the vast number of parcels of land, particularly in urban areas, sampling techniques are almost always used.

Unfortunately each of the four techniques for obtaining data on land value contains major drawbacks either with respect to the cost of research, or the reliability of the data generated, or both. [25, p. 250]

The use of data from county assessors' records suffers the defects of seriously uneven administration of the real property tax. Legislation in 1968 in Oklahoma calls for the reassessment of all real property in the state by contract with independent appraisal firms. Thus, it is conceivable that by the time this effort is completed in the early 1970's, interesting data for a particular set of points in time will be available. Where the differential economic advantage connected with particular plots of land is not changing rapidly, independent appraisal should generate very good information concerning land value. But where relationships are changing rapidly, however, the results of appraisal are frequently inconsistent. Witness the almost interminable series of conflicts over the value of land condemned in connection with public works projects. Moreover, the development of any research design utilizing independent, professional appraisal is posited on the presence of funds available to finance the appraisal. In other words, such methodology is likely to be highly costly.

Until 1968, Federal law required that revenue stamps be affixed to deeds when transfers occurred. Upon repeal of the Federal statute, the state of Oklahoma enacted virtually identical legislation. For each $500 of net sale values, 55 cents worth of stamps are supposed to be attached to the document. If the stamps truly reflect the sale price, and if they are affixed to the deed at the time it is recorded in the county clerk's office, then this can be an important source of data on land values. It would, of course, be necessary to work only with plots of land without houses or substantial improvements, or to somehow adjust for improvements in such a manner that price per uniform unit of land could be estimated. There is evidence that the Federal stamps are in fact a good indication of the true price at which land changes hands, subject to the limit that they are applicable in multiples of $500. [29] On the other hand, buyers may choose to add a greater value of stamps to the title than that which would reflect the true sale value. This is done in order to overstate the cost of the land to the owner at some time in the future when he attempts to sell. Although it is conceivable that this practice is fraudulent, it appears to be widespread, particularly in cases in which very large parcels of land are transferred for speculative purposes. The major advantage of utilizing value information derived from the stamps relates to the low cost of obtaining the information directly at county clerks' offices.

Direct survey of buyers and/or sellers has much to commend it. On a priori grounds it would appear that sellers might be prone to be more open about information concerning the sale of property. Major difficulties associated with this procedure relate to its high cost of administration, and to the possibility that participants in land transfers will not provide accurate information.

Because of these difficulties, it may be argued that any effort at hypothesis testing with respect to changes in land value associated with the canalization of the Verdigris River is likely to either generate wildly inaccurate data, or to be excessively expensive. The best strategy for a project based on a limited budget relates to the use of the documentary stamp tax.

The model developed above posits a tenure response related to changes in value. Because of the difficulties connected with estimating value changes, it appears to be more efficient to focus on patterns of tenure change. This research strategy, of course, does not permit the quantification of value change, it merely infers the direction of value change from the pattern of tenure change. Changes in tenure can be readily identified from county clerks' records. The four-fold system of classifying owners of land developed in connection with the model is tentatively adequate for such an empirical effort. The major difficulty in implementing data collection for this research strategy is associated with placing owners into appropriate classifications. This will require some detective work with respect to tracing agents, subsidiary corporations, and so forth. In many instances, however, the classifications of those involved in a shift in tenure will be relatively easy to identify.

In order to implement the tenure shift research strategy, it was determined initially to examine the longitudinal response pattern rather than to attempt to take transverse "slices." All quarter sections bordering the Verdigris portion of the waterway in Rogers, Wagoner, and Muskogee counties in Oklahoma were listed according to their legal descriptions, and a random sample of fifty of these quarter sections was drawn. This sample could serve as the basis for examining the record books of county clerks in these three counties to record title transfers associated with the sample quarter sections. If this process were to be undertaken, little additional effort would be required to record documentary stamps affixed to titles at the time the titles were recorded.

An alternative to the research strategy based on a random sample of quarter sections was developed. Because Oklahoma has long been the site of extensive oil and gas exploration and development, specialized firms have evolved whose major purpose is the collection and sale of comprehensive information on surface and sub-surface ownership rights. One such firm is the Midcontinent Map Company of Tulsa which prepares maps describing ownership patterns in the area affected by the waterway. Largely as a result of the speculative activities associated with the waterway as it approaches the Tulsa metropolitan area, the Midcontinent Map Company has begun publishing annual catalogues describing only surface land ownership in Tulsa, Rogers, and Wagoner counties. In the summer of 1970 the investigator prepared a listing of all surface land owners with land adjacent to the waterway in Rogers and Wagoner counties. This was undertaken to further the progress of the research described in this report, and also was used in the investigator's work as a member of a four-man task force appointed by the governor of Oklahoma to make recommendations concerning alternative development strategies for the waterway. An example from the listing appears in Appendix A.[8] The listing suggests that the best strategy for hypothesis-testing would be to focus only on parcels of land of, say 75 to 100 acres or greater. The number of these parcels along the waterway is not so great as to create an insurmountable problem with respect to the resources which would be required to carry out the recording of transfers over time, and the identification and tenure classification of owners. Moreover, it appears well within the realm of feasibility to attempt to develop some sort of interview schedule which could be used to survey large-parcel owners to attempt to determine future plans for land use.

Until more extensive field data are gathered, it is difficult to determine the precise techniques by which the value-tenure change hypotheses of this research design can be tested. It is possible that difficulties associated with attempting to identify buyers and sellers so that they can be fitted into the classification system will be so great as to preclude

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[8]The full listing appears in Oklahoma Governor's Study Committee on the Arkansas-Verdigris Waterway, *Arkansas-Verdigris River System in Oklahoma: A Report of the Governor's Economic Study Task Force*, September, 1970.

further progress. It is suspected, however, that the generally rural nature of the area will mean that such information can be obtained fairly readily from local sources. Simple cross-classification of the raw data may provide about as much insight into the reasonableness of the hypotheses as more complex statistical manipulations. For example, changes in value as indicated by the documentary tax stamps can be deflated for the general trend change in value of Oklahoma farm land (though ideally the deflation should be for trend changes in river land similar to that in question). An increase in this deflated value would be consistent with the value change hypothesis. The classification of buyers and sellers over time can indicate whether or not tenure shifts of the sort hypothesized are actually occurring. A simple regression model might also be developed using value or tenure as dependent variables, and distance from nodal points as one of several possible independent variables. Additional work beyond this may involve an attempt to identify a control sample not adjacent to waterway, and examination of samples lying on transverse cross sections.

Conclusions and Recommendations

As industrial, commercial, recreational, and other enterprises begin to undertake physical investments fixing patterns of land use along the McClellan-Kerr Arkansas River Navigation System, it is imperative that some form of public influence be exercised to promote rational patterns of land use. Information on initial patterns of land tenure change should be important to both private and public decision makers whose activities will ultimately determine patterns of development. It is feasible to develop basic ownership information, though it is not easy to identify the owners' economic characteristics. A detailed field study would not only be valuable for planning purposes, but would add to the body of economic information the field of industrial organization suggesting that size of firm and market power are related to the control of the resource base.

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APPENDIX A

ABSTRACT

Annual Allotment Project A-020-OKLA
"A Preliminary Analysis of the Impact of the Arkansas Waterway on Land Tenure and Value in Oklahoma"
Larkin Warner,
Oklahoma State University Water Resources Researh Institute, 1971

Public Investment in excess of $1.2 billion in connection with the McClellan-Kerr Arkansas River Navigation System leads to a set of responses on the part of private economic agents bidding for and holding land. Patterns of land value change are hypothesized similar to those of density gradients in urban analysis. Land tenure along and near the Waterway shifts from initial agricultural owners to real estate speculators to intra- and inter-state corporations. Methods of empirical research on land value are examined, and it is determined that it is more feasible to survey patterns of land tenure. Such a survey would be particularly important as public agencies deal with the problem of land use policy along the Waterway.

PROPERTY OWNERS IN ROGERS COUNTY, OKLAHOMA WHOSE PROPERTY

IS ADJACENT TO THE VERDIGRIS RIVER NAVIGATION CHANNEL

OWNER(s)	SIZE (in acres)	LOCATION Section	Township
		31	21N-15E
Ethel Hughes, Patricia King and Frances Avey	13.5	in NE ¼	
Ralph Hicks	Less than 10	in NE ¼	
J. C. Fidler	23.8	in NE ¼	
		32	21N-15E
Ralph Hicks	93.05	in NW ¼	
L. O. Todd	79.78	in W ½	
Elmer L. McGuire	88.0	in S ½	
C. R. Bachtell, Leroy E. Bachtell, and Donald C. Lane	65.65	in SW ¼	
Clinton N. Merrell	56.49	in S ½	
		4	20N-15E
Elmer L. McGuire	11.86	in NW ¼	
N. H. Mullinax	138.14	in N ½	
*Armco Steel Corp.	153.37	in all ¼'s	
*City of Tulsa (Port of Catoosa)	106.52	in W ½	

*All Tracts marked with an asterisk are known and announced industrial sites.

PROPERTY OWNERS IN ROGERS COUNTY, OKLAHOMA WHOSE PROPERTY

IS ADJACENT TO THE VERDIGRIS RIVER NAVIGATION CHANNEL

OWNER(s)	SIZE (in acres)	LOCATION Section	Township
		5	20N-15E
Elmer L. McGuire	71.17	in NE ¼	
*City of Tulsa (Port of Catoosa)	501.97	in all ¼'s	

Note: The property listed above and on the preceding page is contiguous to the Verdigris River channel proper to a point about one mile north of the Port of Catoosa industrial park site. These tracts are not contiguous to the navigation channel.

The Port of Catoosa and the industrial park site (approximately 1500 acres) are contained within sections 4, 5, 6, 7, 8, and 9 of township 20N-15E in Rogers County and is owned by the City of Tulsa.

Tracts on this and the following pages are contiguous to U. S. Government owned lands bordering the Verdigris River navigation channel, contiguous to the "old" or unimproved Verdigris River channel, or contiguous to both.

OWNER(s)	SIZE (in acres)	LOCATION Section	Township
		9	20N-15E
*City of Tulsa (Port of Catoosa)	18.47	in NW ¼	
Louise S. Bradley	203.11	in N ½	
John P. McGay	140 (approx.)	in S ½	
Yonkipin Association, Inc.	90.0	in S ½	

PROPERTY OWNERS IN ROGERS COUNTY, OKLAHOMA WHOSE PROPERTY IS ADJACENT TO THE VERDIGRIS RIVER NAVIGATION CHANNEL

OWNER(s)	SIZE (in acres)	LOCATION Section	Township
		15	20N-15E
Elemra S. Kelly	85.75	in SW ¼ & NE ¼	
		16	20N-15E
Helen Slemp (3 tracts)	120 (approx.)	in E ½	
A. H. Slemp Jr., Helen Berry, and Annelle Lanford	80 (approx.)	in N ½	
Felitha Jeanguenat	20 (approx.)	in SW ¼	
Jesse W. Raleigh	Less than 10	in NW ¼	
Herman Singer	20 (approx.)	in NW ¼	
Newton M. Foster	Less than 10	in SW ¼	
L. H. Humphrey and James L. Finigan	50 (approx.)	in SW ¼	
		17	20N-15E
I. A. Jacobsen	286.47	in all ¼'s	
James L. Finigan	30 (approx.)	in SE ¼	
Paul Hamilton	100.0	in SE ¼	
		21	20N-15E
R. Paul Henry	394.33	in N ½ & E ½	

PROPERTY OWNERS IN ROGERS COUNTY, OKLAHOMA WHOSE PROPERTY

IS ADJACENT TO THE VERDIGRIS RIVER NAVIGATION CHANNEL

OWNER(s)	SIZE (in acres)	LOCATION Section	LOCATION Township
		22	20N-15E
R. Paul Henry	118.13	in W ½	
Grace E. Conkwright (2 tracts)	50 (approx.) & Less than 10	in N ½	
*John Story (Story Industrial Park)	Less than 5	in SE ¼	
Leflore Land, Cattle, and Investment Co., C. W. Flint, and Allen E. Barrow	80.0	in NE ¼	
Allen E. Barrow	30 (approx.)	in NW ¼	
*Kerr Enterprises	122.88	in SE ¼	
		27	20N-15E
*Jack and John Story (Story Industrial Park)	50.14	in NW ¼	
*Kerr Enterprises	20 (approx.)	in NE ¼	
Nick Robson, et al.	228.70	in all ¼'s	
		23	20N-15E
Glen A. Campbell Trust	180 (approx.)	in all ¼'s	
*J. Story (Story Industrial Park)	17.61	in SW ¼	
Thurlo Cook	18.67	in SW ¼	
C. H. Wright	47.85	in S ½	

PROPERTY OWNERS IN ROGERS COUNTY, OKLAHOMA WHOSE PROPERTY IS ADJACENT TO THE VERDIGRIS RIVER NAVIGATION CHANNEL

OWNER(s)	SIZE (in acres)	LOCATION Section	Township
		24	20N-15E
C. H. Wright	53.23	in SW ¼	
W. M. Dunn Trust	70 (approx.)	in S ½	
L. W. Grant	13.59	in E ½	
Big Lake Club	Less than 10	in NW ¼	
R. W. Triplett	65.16	in NW ¼	
H. G. Irby Jr.	23.71	in NE ¼	
		13	20N-15E
Big Lake Club	320.0	in S ½	
		18	20N-16E
L. A. Riggs	190.83	in S ½ & W ½	
*North American Aviation, Inc.	87.15	in SE ¼	
		19	20N-16E
*North American Aviation, Inc.	212.22	in N ½	
W. M. Dunn Trust	132.57	in W ½	
Andy Anderson	50.93	in W ½	

PROPERTY OWNERS IN ROGERS COUNTY, OKLAHOMA WHOSE PROPERTY

IS ADJACENT TO THE VERDIGRIS RIVER NAVIGATION CHANNEL

OWNER(s)	SIZE (in acres)	LOCATION Section	Township
		7	20N-16E
L. A. Riggs	190.83	in S ½	
		8	20N-16E
Tom Murray	475.32	in all ¼'s	
*Seth Herndon Jr., et al. (Verdigris Ind. Park)	10 (approx.)	in SE ¼	
		9	20N-16E
*Seth Herndon Jr., et al. (Verdigris Ind. Park)	120 (approx.)	in S ½	
Felton R. Couey	160 (approx.)	in NW ¼	
George R. Striplin	160 (approx.)	in NE ¼	
Joe M. Burchan	Less than 10	in SE ¼	
		10	20N-16E
J. Max Murphy	271.76	in N ½ & W ½	
Lee P. Roles Jr.	35.51	in SW ¼	
Allen D. Yocham	40.0	in SW ¼	