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A SITUATIONAL MODEL TO TEST THE EFFECTIVENESS OF A ZONING ORDINANCE IN LANSING, MICHIGAN

By

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ABSTRACT

A SITUATIONAL MODEL TO ASSESS THE EFFECTIVENESS OF ZONING REGULATIONS IN LANSING, MICHIGAN

By

John J. Ford

Geographers have expressed only a limited interest in the zoning process. However, as urban decentralization increases, the need for a rejustification of land use regulation arises. Geographers, urban planners, economists and resource planners by the nature of their methods and perspectives on the urban scene, all have an interest in the redefinition of land use regulations.

This research develops and tests a model that assesses one situational characteristic of a zoning ordinance. This is in contrast to most zoning models that are based on site characteristics. In addition to the development of the model, based on accessibility, this study identifies locations where the zoning regulations impose either positive or negative locational 'spillovers.' The study area is Lansing, Michigan a manufacturing and administrative city of approximately 150,000 in south central Michigan. The hypotheses tested attempt to answer the following three questions: (a) Does situational zoning produce more land value homogeneity than the site-based zoning? (b) Is the homogeneity maintained if the land values are aggregated by concentric rings? (c) Is the homogeneity maintained if land values are aggregated by sectorial corridors?

The first step in the model construction defines by use of grouping algorithms nodes of similar land uses. An accessibility index is then constructed based upon two measures of the situational characteristics of the land use node to another node containing different types of economic uses. The second measure is the time distance to major shopping and employment nodes within Lansing. The accessibility measure for a sample is spatially interpolated to the entire study area by use of the SYMAP mapping routine.

Four zoning classifications are used in the analysis: low density residential, high density residential, commercial and industrial. The results indicate that the accessibility criterion defines more homogenous commercial and high density residential zones than the existing site based zoning. For industrial and low density residential areas, the accessibility index increases the land value mixtures. These results are confirmed when the land values are aggregated by concentric zones. However, when land values are aggregated into sectors, the accessibility based zoning decreases the land value mixture not only in the high density residential areas but also in the industrial areas.

It is concluded that commercial and high density residential zones should be delimited on the basis of their relative and not absolute location. Existing methods for defining low density residential and industrial zones should be maintained unless industrial areas are sectorally arranged within the city. By establishing a model to test, evaluate and update the delimitation of zoning districts within an urban area, potential locational conflict that may arise from land use regulations are reduced. In the end such an approach benefits not only the community but also the citizen by reducing locational spillovers arising from site based zoning.

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Introduction

"When you talk about zoning, you are talking about money and priority of access." (Charles Barr, 1973)

Zoning dictates what can be built and where it can be built. An individual may be able to afford a structure of a certain dimension, but he may find that zoning regulations prohibit such a structure. On the other hand the property owner may find that the floor dimensions of his structure are dictated not by his own desires but by the existing zoning ordinance dealing with minimum floor sizes. An individual may want to build an apartment building in a certain area but may be prevented by the zoning code.

In the above two examples zoning imposes costs upon the property owner; however, zoning regulations can also be manipulated to earn substantial profit for the enterprising land speculator. The latter process involves locating vacant parcels of land zoned for a low density zoning classification, i.e. single family. With proper preparation, the land speculator then prepares a justification and presents his appeal for a higher density use such as multiple family to the local zoning appeals board. If he wins his appeal, the speculator is in a position to resell the land at prices accruing to parcels possessing the higher density classification. Even if the appeal fails, its existence may trigger an increase in that parcel's value or adjacent parcels. Nothing has been done to the parcel except a legal reclassification which in most cases is sufficient justification for higher land costs provided there is a market demand for the parcel.

Zoning is based upon the major assumption of equality of enforcement, that is, zoning should be employed in such a way that its use by a community member does not detract from the use of zoning by another community member. Zoning regulations which impose costs on one party while at the same time earning substantial profit for another do not display complete equality. In the opinion of this author, equality in the distribution of zoning's costs and benefits is not likely to be achieved until a more exact method is developed for the definition of zoning districts. Zoning districts may be defined in a variety of economic and non-economic ways. The research contained within the following pages prescribes one method for an economic definition of zoning districts.

The Pervasiveness of Zoning

Land use control is necessary in just about all types of modern urban societies. Because of its pervasiveness, zoning as a land use regulator is of great interest to lawyers, civil engineers, landscape architects, planners, economists, politicians, sociologists and geographers. Lawyers are mainly involved in the interpretation of zoning ordinances and in the prosecution and defense of contested cases. Civil engineers are interested in the construction requirements and securing easements for utilities, etc. The landscape architect is also interested in the zoning regulations particularly as they pertain to 'set back' open space requirements, light easements and noise control. Planners are keenly interested in the zoning process and districting schemes. A perennial question faced by planners is the location of zoning boundaries, a problem concerned with the partitioning of vertical and horizontal space.[1] More recently zoning within the three-dimensional city has taken on a new meaning and raised some interesting problems for planners. Air rights, vertical zonation and airport zoning are part of the third dimension to zoning.

Economists are interested in zoning as it affects the achievement of the highest economic potential for land. In addition, economists who are interested in industrial and commercial location pay particularly close attention to the permitted uses along with noise and smoke abatement regulations as prescribed in the zoning ordinance. Sociologists and political scientists have an abiding interest in the zoning process. They may be interested in how the value system of the decision makers influence the type and location of zoning districts or perhaps what is the role of partisanship in granting zoning variances, exceptions, etc.

A close examination of the role that each of the above mentioned disciplines plays in the zoning process reveals a number of communalities. One communality focuses on the spatial character of the zoning process and zoning districts. The spatial characteristics are evident in the role that distance, direction and density play in the regulatory and districting schemes. Distance, direction and density emerge in set back, height and bulk regulations, nuisance zoning and use restrictions. The concept of regionalization also has applicability in the delineation of zoning districts. Geographers who subscribe then to the spatial orientation have found or will find that zoning regulations exhibit a sizeable amount of spatial dependency in the specification and administration of the regulations.

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[1]For the purpose of this paper, zoning refers only to the horizontal partition of space.

GEOGRAPHIC PERSPECTIVE IN ZONING

Current Geographical Research On Zoning

Nelson's study of Vernon, California was one of the earliest empirical studies dealing exclusively with the spatial impact of zoning. Vernon was a unique community since it contained land deliberately allocated for the highest possible return. That is, in the vast majority of cases land was overzoned for industrial uses. Nelson correctly points out that in this case zoning was used as a tool to maintain high land prices on the parcel level. The price of land along with the relative location of Vernon in the Los Angeles area made this town an ideal location for the development of industry and transportation networks. By effectively zoning out residential uses the city was able to maintain a relatively low service budget. As a result, the government placed low property tax assessments on the industrial parcels as a further inducement to locate in this area. Nelson concludes that municipal boundaries were thus extremely important in an analysis of land uses within the Vernon area.

Another study of a similar nature was done by Fielding in the Los Angeles area (1964). Once again zoning was used as a tool by private interest (dairy farmers) to obtain maximum profit. Fielding found that dairy farmers tended to locate on land zoned for residential use. As a result their land value increased but so did their taxes; hence, the dairy farmers over the long run received less and less profit. The farmers grouped together and incorporated their land under California law. By incorporating, the dairy farmers were then able to draft their own zoning ordinances, and thereby protect their land from residential intrusions.

One of two recent geographic dissertations devoted to zoning attempted to analyze whether or not rezoning had any effect upon a change in property values (Seymour, 1966, p. 4). The basic hypothesis was that assuming public utilities were established, then a change in zoning affects the market value of land in the direction of the more capital intensive uses. From his research in Pittsburgh, Seymour found that a change in zoning tends to:

a) increase the market value of land in the long run by removing the threat of encroachment;

b) stabilize property values.

One of the more meaningful conclusions arrived at by Seymour was that a threshold of change in "permitted" land uses must be met before any significant change in the overall land values occurs (Seymour, 1966, p. 78). In addition he found that if more than approximately 20% of the zone was rezoned to a higher intensity use, and if a demand for higher intensity use continues, then the change in property values occurs in the direction of the more capital intensive use. For example, in an area zoned for high density residential use, if one or two parcels are rezoned for commercial, then the overall change in land values for the remaining residential district tends to increase. These residential properties will then reflect land values closely approximating commercial values.

Natoli (1967) conducted an in-depth analysis of zoning as an institutional regulator of land use. He attempted to isolate the influence of zoning on developed and underdeveloped land in Worcester, Massachusetts. Like Seymour, Natoli found that zoning tends to stabilize property values over a period of time (Natoli, p. 185). A residential zoning classification tended to stabilize property values in more instances than in commercial or business classifications. He concluded that the less dense residential uses are more affected by zoning changes than commercial and business classifications which tend to require a more dense utilization of space. A conclusion such as this verifies the capital intensification concept of Seymour's.

A study by Yeates on urban land value changes in Chicago (1965a) has added to the knowledge of the spatial effects of zoning on the urban landscape. In the study Yeates comments that land values are affected by accessibility and certain natural amenities such as bodies of water (Yeates, 1965b, p. 321). In earlier years the distribution of land values within a city could have been best described by the distance variable. As distance from the central city increased, land values tended to decrease in a linear fashion. However, now that zoning has left its imprint upon the urban landscape, land values tend to decrease in a curvilinear manner. The relationship between land values and distance in commercial and business districts was almost non-existent according to Yeates (1965b, p. 328).

The effect of land use regulation upon the urban environment was studied by Duncan (1973). He found that wealthy people in his study area supported a restrictive zoning ordinance in order to maintain the value of the neighborhood (Duncan, 1973). A restrictive zoning ordinance usually requires minimum lot sizes which are larger than the average causing the price of new homes within the neighborhood to increase. Duncan's research along with earlier studies by Nelson and Fielding suggest that zoning is a private good which better serves the narrow interest of private landholders rather than the public as a whole.

Limitations of Previous Research

Geographic research dealing with topics of a zoning nature are limited. Only two dissertations have dealt exclusively with zoning (Seymour, 1966; Natoli, 1967). One reason for the paucity of spatial research on zoning may be failure of theoretical constructs to explain the spatial distribution of the data (Natoli, 1971, p. 9). Natoli concludes that "a general systematic approach is precluded (but) it is possible to measure the effect of zoning on the development of urban land use patterns . . ." Another reason for the inadequate geographic research in attributable to the relative haphazardness of the zoning process itself (Yeates, 1965a, p. 317). Zoning is a political process which classifies land often without a definite reason for doing so. Geographers are more accustomed or more familiar with more definitive land classifications arising from human spatial behavior. To put it another way, a zoning classification for a parcel normally incorporates some or all of the following considerations: adjacent land use, subsoil and terrain, value systems of decision makers, and aspects of political compromise (Natoli, 1967, p. 9; Wilhelm, 1962, p. 224). On the other hand, geographers tend to classify urban land by its use, by socio-economic characteristics of the owner or by distance from a central focal point.

A third reason for the apparent lack of geographic interest in zoning may lie in the noncontinuous nature of the zoning data (Seymour, 1966, p. 4). For example, a parcel is either in a classification for single-family residents or not but never in both at the same time. Zoning data contrasts with other types of geographic data such as population or income figures both of which are distributed in a more continuous manner without a strict membership grouping. One problem arising from the non-continuous nature of zoning data is that of varying sized areal units. Most geographers are acutely aware of the importance of spatial autocorrelation arising from the various sized areal units. Without some type of compensation for the size of the unit, such as a density measure, the explanation based on zoning data can be extremely misleading.

A final reason for geographers' seeming lack of interest is that a zoning classification for a parcel may be heavily confounded with many other types of considerations, not the least of which are population density, topography, soil, accessibility and community values. Thus a researcher who intends to explain or predict the distribution of zoning districts would have to construct some type of research design that would control for many if not all of these confounding influences. It appears doubtful that a multi-factor design such as that needed for ferreting out zoning's confounding influences is practical given the present nature of the zoning data.

CONCEPTUAL FRAMEWORK UTILIZED IN RESEARCH

Introduction

The concepts of distance, direction and density are central to studies measuring zoning's influence upon the landscape. However, in this research a new framework based upon the concepts of land use conflicts and externalities is applied to the districting scheme of a zoning ordinance. A land use conflict may arise when one use, due to the nature of its activity, lowers the land value of surrounding parcels.

Externalities or 'locational spillovers' such as poor accessibility, noise, lack of parking, low surrounding land values tend to aggravate land use conflict. The reliance upon the conflict conceptual framework does not in any way imply a subordination of the distance, direction and density concepts but rather builds upon them.

Land Use Conflicts and Externalities

If one examines a community's zoning map, he may notice broad areas of the city designated as single and two-family dwelling areas. He may also notice within one of the single-family residential areas small sections which apparently have been rezoned from residential to commercial. Why this occurs may be difficult to answer, particularly if the rezoned land is presently vacant. Perhaps the most adequate answer is found in the political nature of the present system of urban land-use controls. Allowing small intrusions of variant land uses into areas of relatively homogenous land uses is called spot zoning. In the above example the rezoning to commercial use may possibly foster a land-use conflict particularly if surrounding land values are affected. That is, the new designation may promote locational 'spillovers' or externalities which if negative may impose costs upon the surrounding landscape. Thus, the new zoning designation fails to be completely equitable. Ideally, a public good such as zoning should minimize externalities and maintain as high a degree of distributional equality as possible both in the initial classification and subsequent enforcement (Cox, 1973, p. 10).

Operational Concepts

Only recently have geographers become interested in the identification of land use conflict and its subsequent resolution. A brief examination of utility theory used by economists will underscore the importance of locational externalities. In the context of this research, utility is operationally defined as the satisfaction an individual receives from locating at a particular place within the urban area. Locational 'spillovers' are operationally defined as costs or benefits accruing to the parcel owner because of the relative location of the parcel to other parcels. For example, a parcel of land zoned for light-industrial use adjacent to a residential community may create many locational 'spillovers' in the form of noise, congestion, obnoxious odors which in turn lowers property values. Thus the individual is assessed a cost because of his proximity to the industry. A utility which has a positive influence in the overall land value of an area is defined as a positive externality. A utility which has a negative influence on the overall land value in an area is defined as a negative externality. Furthermore, residentially zoned parcels located adjacent to parcels zoned industrial may possess many characteristics making them relatively similar to the industrial parcels. If this is so, then the industrial district boundaries may need to be redrawn so as to incorporate all or a portion of the residentially zoned parcels. By doing this, the potential negative externality imposed on the residentially zoned parcels by the industrial parcels may be reduced. On the other hand, a church built near vacant land located within a predominantly residential community may impose positive externalities on the vacant land. Thus, future development of the vacant land will be enhanced by its proximity to the church and overall land values may rise. Uses which are less compatible to the church such as drive-in eating establishments or heavy industry uses may be effectively 'zoned-out' of the vacant land by community leaders.

Position of the Research

Like previous studies dealing with zoning, this research begins by assessing the effect of the zoning classification upon the urban land values. However, unlike its predecessors, the research will be based upon a regionalization of land uses. The regionalization will incorporate more situational characteristics than the existing site-oriented zoning regional commonly used today. The new situational classification is derived with the expressed intent of evaluating whether or not selected parcels of land are prevented by the existing zoning plan from reaching a more capital intensive use. For example, this study will determine if there are any residentially zoned parcels of land which possess a relative location more characteristic of commercially zoned parcels. If so then the residential parcels may be inhibited from achieving a more capital intensive use and in the future these residential parcels may become sources of land use conflict. Patterned after the research of Yeates, this dissertation will examine the within-zone variation of land values. At the same time between-zone land values will also be analyzed to either prove or disprove their existence. However, unlike Yeates, this study will also examine the degree of within sector land values found in commercial and industrial land.

The major impetus for this research has come from the exhaustive analysis of zoning, and land values performed in Worcester, Massachusetts by Natoli. In that study, Natoli concluded that property value is more a function of location and less a function of zoning (Natoli, 1967, p. 194). The basic question raised in the study is whether the homogeneity of property values within the study area is more a function of locational attributes of the area or the zoning. It should be noted that this dissertation does not in any way attempt to account for the distribution of zoning parcels within any particular area. The research compares the distribution of land values in the existing zoning districts with the distribution of land values in accessibility derived districts.

Approximately twenty years ago, Ratcliff, an urban economist called for a "refined type of zoning to better adjust economic activities to the environment . . . to exclude inappropriate uses from areas where their presence may increase friction" (Ratcliff, 1955, p. 146). This research will develop and test a new type of zoning district which is more economically based than the existing districts. On a broad scale, the methods and findings will hopefully indicate where locationally inappropriate zoning districts prevent the ordinance from functioning as a public good which increases the likelihood of land use conflict. That is, the research will indicate where zoning imposes externalities either positive or negative upon an urban landscape.

STATEMENT OF PROBLEM

Elaboration

Use of land is decided for the owner by factors exogenous to the site, namely its situation (Platt, 1972, p. 38). Zoning is one of these outside factors influencing the location of activities in the urban area. But what is location?

> Location refers to the unique complex of space relationships within each given point in time . . . relationships to all other people, to other things and to other activities" (Ratcliff, 1959, p. 302).

In the above definition, Ratcliff is actually referring to relative location and not to absolute location. Zoning is merely a regionalization process based upon knowledge of absolute location and adjacent land uses. But what about the relationships between a parcel and other parcels containing similar or even different land uses?

In order to support community welfare and reduce conflict, zoning must place more emphasis on the processes underlying the relative location of economic activities and less on the site characteristics of the parcel. By accomplishing a redefinition in the district classification based upon situation characteristics, zoning may become more an instrument of public policy. The research undertaken here will formulate a process to meet the goal of a more equitable regionalization of land uses within the urban area. In addition, now that geographers are becoming concerned with locational attributes of conflicts and externalities, they are better able to assess the impact of land use regulations upon the value of the property.

Specific Statement

Location rent at a particular point in space is the savings in transportation cost enjoyed by that place in relation to a more distant location. At some distance from a particular node little or no rent accrues since location rent equals net revenue minus transportation cost (Von Thunen, 1826). Zoning by channeling economic development thereby influences the location rent by imposing upon certain places restrictions which require in one way or another higher transportation costs. Certain localities benefit by higher land values solely on the basis of a particular zoning classification. Conversely, certain locations suffer from lower property values principally because of the permitted uses allowed in the area. Therefore an objective criterion is needed in the spatial apportionment of zoning districts; this should have as one of its primary goals the formation of relatively equitable districts.

Literature on zoning reiterates that zoning is a device for securing a pattern of space best suited to the terrain, economic relationships, and social structure of the particular community (Ukeles, 1965, p. 25). Furthermore, the overall rationale of land use controls in the United States has continually supported most if not all of the above goals plus the maintenance of land value homogeneity (Alonso, 1960, p. 152; Natoli, 1967, p. 50; Delafons, 1969, pp. 28-33). Therefore, based on what has been said about the goals and purposes of zoning and operation of the urban land market, the question is can a measure of accessibility be a valid criterion upon which to draw urban zoning districts? If the maintenance of land value homogeneity is one of the major goals of a community's zoning ordinance, then does a regionalization of land uses on the basis of accessibility produce the same homogeneity of land values that exists in the present zoning ordinance? In order to answer these questions, a situational model is constructed which spatially defines new zoning districts. A comparison between land value homogeneity in the newly created district and the existing zoning districts is then performed.

Objectives of the Study

The overall objective of this research is to construct a districting scheme based upon similarity of land uses and accessibility measures. The districting scheme is intended to outline broad areas within a city which best fit a particular land use accessibility regional grouping. Exceptions to this broad classification are naturally expected but will not be of interest in the research; exceptions to zoning law are handled by public decision makers.

By constructing zoning districts on the basis of land use accessibility it is hoped that zoning will be better able to fulfill its function as a public good. Once again a public good possesses equality in its distribution. For the purpose of the research it is assumed that zoning partially fulfills its role as a public good by maintaining homogeneity of land values within a specific zone. Homogeneity of land values is measured and compared within the existing and newly derived zoning districts.

A second objective of this study is to elaborate a technique that is capable of identifying likely areas where future zoning and land use conflicts may emerge. A land use conflict is operationally measured in an area by assessing where the differences in land value homogeneity between the zoning districts and accessibility districts is the largest. This places land use conflicts within the conceptual framework of externalities and attempts to verify that zoning imposes externalities upon certain districts. In turn these externalities may hinder the achievement of more homogenous land values within the district.

A final objective of this dissertation is to develop a procedure to update a zoning scheme for a community. The procedure as outlined in the research is neither overly complicated nor statistically sophisticated. But the procedure does represent a carefully formulated plan for implementation; one that is useful for communities on a broad scale to assess, change or update their ordinance. Many times, it appears that soon after a zoning ordinance is adopted, a major change in land use is suggested for an area. For example, a new highway, a new apartment complex, shopping center, etc. The full impact that the proposed change has upon the zoning ordinance and related development within the area may not be realized for sometime. The procedure outlined in this research allows an evaluation of the proposed change on accessibility and zoning. An evaluation is possible because the procedure relies not only on site characteristics but also the situational characteristics of the parcel.

Chapter Two

The Theoretical Foundation of the Research

OVERVIEW

Research on zoning and accessibility relates a political process, zoning, to an economic process, accessibility. The former involves more value judgments and compromise in the allocation of permitted activities than the latter which allocates activities on the basis of economic efficiency.

The chapter is divided into two sections. The first part begins with an analysis of zoning as the outcome of a political process, then it turns to some externality effects of zoning and closes with a critique of zoning. The second part analyzes the role of the urban land market in general and accessibility in particular.

ZONING: PROCESS, EXTERNALITIES AND CRITIQUE

"In zoning . . . the aim is to minimize the negative externalities resulting from proximity of incompatible land uses to one another." (K. Cox, 1973, p. 11)

Zoning As A Political Process

For the purposes of this study zoning is viewed as an end product of the political process. The discussion will not deal with the political intricacies, conflicts and compromises that a zoning ordinance undergoes in the process of initial adoption. The discussion focuses on the value systems of the various actors when a change is proposed in a zoning ordinance and the ensuing conflict.

Zoning changes begin with petitioners who are normally property owners in the community. There are two types of changes inherent in a zoning ordinance. A variance is granted if the zoning classification imposes unnecessary hardship upon the land owner who normally is the petitioner ("Philadelphia . . ." 1955, pp. 516-555). A rezoning of an area or a parcel may occur if the community or surrounding area are adjudged not to be affected by the presence of the new activity. If one or two parcels are rezoned and if they are enclaves in a larger district, then the rezoning is often called spot zoning. Normally a reclassification of a property is treated as an amendment to the zoning ordinance (ASPO, 1968, p. 25). In either kind of zoning change, the planner is usually called upon to evaluate the proposed change and to make recommendations to the city council or zoning appeals board (Ranney, 1969, p. 131). Before the final evaluation is made, the board or council may consult with the building inspector, housing inspector and local citizens, particularly those most directly affected by the zoning change.

If the zoning change involves a residential area, then the planner and other decision makers are faced with numerous social and ethnic questions. On the other hand, if the request involves commercial and industrial uses, then actors are involved in a cost-benefit type of determination (Ranney, 1969, p. 131). The value system of decision makers and influencers often affects the outcome of a zoning change (Wilhelm, 1962, p. 96). If the actors adhere to an economic value system, then zoning is used to control land values (Wilhelm, 1962, p. 96). Actors who adhere to this value system tend to view zoning as a tool to increase the value of the land. These actors are present oriented and rely upon the market system to determine the best land use of an area. As a result, zoning for economically oriented actors is oriented to the master plan, but they still want the master plan to be flexible enough to adjust to changing market conditions (Wilhelm, 1962, pp. 155-157).

In contrast is the protectionist viewpoint. According to supporters of this position, one of the foremost goals of zoning is not the profit-motive but the protection of the residential community. The protectionist believes that zoning is only one independent variable affecting land values and that zoning should determine what land uses are permitted in an area. Thus the protectionist tends to view zoning as a regulator of development while the economically oriented actor believes that zoning should reflect changing land values (Wilhelm, 1962, p. 96). The protectionist believes that the future is quite predictable and change can occur but only slowly and over time. Thus zoning and not the market system should determine land value (Wilhelm, 1962, pp. 155-157).

Some aspects of the economic and protectionist viewpoints are also found in the value systems of the petitioner and other concerned citizens. The developer or the private individual who wants the zoning ordinance changed usually makes his request for economic reasons (Ranney, 1969, p. 132). In suburbia, the actors who most often object to a zoning change do so mainly for social or community preservation reasons (Ranney, 1969, pp. 30-38). For example, a low income housing project may arouse opposition in certain communities since the social image of the community may be tarnished.

Conflict over zoning may arise very quickly, however, compromise on a zoning change often is quite difficult since the conflict tends to be so polarized (Ranney, 1969, p. 136). Unpopular decisions can be frequently passed from the elected representatives to the non-elected appeals board or to the zoning administrator. However, participant conflict is not of concern in this research. Instead land use conflicts or the disparity between the zoning classification and the situational potential of parcels are analyzed. In order to develop the need for a situational approach, the discussion now turns to the process of drafting a zoning ordinance.

Zoning: Process, Critique and Solutions

The following discussion will trace the formation of a zoning ordinance from the initial field compilation to the adoption process. The first step is to survey and map land uses. The land use classifications for the map are normally catalogued in a rather straight forward manner (Chapin, 1965, p. 273). In addition to the use classification, a land value estimate is made. In lieu of actual market values, the value survey relies on assessed valuations and normally estimates the values to the front-foot. In the urban-rural fringe and in the rural areas, land value estimates are calculated on larger unit areas such as acres (Chapin, 1965, p. 330).

The land use and land value survey are then integrated into the overall master plan for the community and incompatible uses are then determined. Land uses are incompatible if the use endangers the health, safety or welfare of people living in surrounding properties. The aim of the master plan is to maximize the efficiency of land uses by minimizing negative externalities such as friction of distance (Ratcliff, 1955, p. 130). Put another way, the fundamental aim of zoning is to prevent the right use from locating in the wrong place (Ukeles, 1965, p. 38).

The contents of the master plan are comprehensive in nature and include: distribution of houses, businesses, industries, recreation areas, and education centers; standards of population density, use capabilities of non-developed land; and future growth and land use requirement. Also included is a section on the circulation patterns, terminal facilities and utility requirements (Lovelace and Weismantel, 1961, p. 14). Normally a final section of the master plan contains development programs and target years for their attainment (Williams, 1966, p. 4).

Included in and conforming to the master plan is the zoning plan. It allocates external benefits and costs arising from private land ownership by specifying the zoning ordinance and districting schemes. The plan must be an integral part of the master plan in order to give planners the full advantage of land use regulations (Dunham, 1958, pp. 170-186), and also to protect property owners from another's unreasonable use of land (Horack, 1952, pp. 153-161). The zoning ordinance is considered to be constitutional if it is reasonably debated in a public forum and approved by the voters (Mandelker, 1970, pp. 1-7). In theoretical terms the adoption of the ordinance signifies that the people have decided how the costs of friction can be reduced to minimal levels through the use of land regulations (Ratcliff, 1955, p. 129).

The majority of zoning decisions deal with the specific legality of the zoning code as outlined in the ordinance. The day-to-day administration of zoning, however, deals with the mapping of districts and legal questions arising from boundary conflicts (Williams, 1966, p. 259). One reason for this inordinate administrative concern with the boundaries lies in the broad manner in which districts are defined. Zoning administrators are unable to provide a separate zone for each and every parcel (Merrifield, 1965, pp. 548-593). The best that zoning administrators can do is to provide a general location for a boundary along with supportive evidence. The precise location for a zoning boundary along with reasons for it are difficult tasks for a zoning administrator.

> It is obviously impossible to identify each of the individual considerations that cause a technical staff or public officials to propose eight types of districts instead of nine or to draw a boundary along South Street instead of Pine Street (Ukeles, 1965, p. 22).

Two interrelated concepts need to be mentioned as they form the basis for the theoretical framework of this research. Zoning to be effective must exert some type of influence on land uses. One way that the effectiveness of a zoning ordinance can be ascertained is by examining the number and type of changes granted (Wilhelm, 1962, pp. 64-65). This research suggests another method of evaluation. That is, why not examine the effectiveness of a zoning ordinance by looking at the situational characteristics of the parcels?

A second related concept is that planning and zoning require coordination to insure that the land is used most efficiently. However, efficiency is not always fostered by the existing zoning regulations. One reason why efficiency is not continually maintained arises from the imposition of 'locational spillovers' upon surrounding land uses. Therefore the public regulation of land uses should become concerned with these externalities (Mandelker, 1970, pp. 1-7).

Externality Effects of Zoning and Districting

The externality effects of zoning can be subdivided into intentional and unintentional effects. By intentional is meant that the zoning ordinance was written with complete knowledge of the end result. The unintentional effects differ from the intentional in that the former do not possess the random characteristics of the latter. A study of unintentional externalities would involve a comparison and analysis of the legal requirements specified in the actual ordinance. Such a task is outside the scope of the research.

Fiscal zoning is one type of intentional externality which hurts the public welfare of the community. The problem with this type of zoning is that it often fails to provide for the future expansion of the community. One way fiscal zoning is operationalized is by overzoning (i.e. zoning more land for a classification than is actually needed) a community for industrial or commercial in the hope of attracting these activities. However, in the short run, overzoning restricts the selection of available parcels (Williams, 1966, p. 261). The reduced supply of available land often tends to decrease the tax base of the community particularly in the long run (American Society of Planning Officials, 1968, p. 4; Sagalyn & Sternbieb, 1973, p. 3). In other words, overzoning forces the taxpayers to share a greater financial burden since economic activities are limited in the procurement of land; the cost of additional parcel searching and perhaps the price of even another parcel are passed on the consumer (Davis, 1963, pp. 375-86). In addition even if the parcel is rezoned, the cost of changing the boundaries often exceeds the minimal remuneration supplied by the petitioner.

Exclusionary or special interest zoning is another type of intentional externality which occasionally manifests itself as minimum lot size. Exclusionary zoning in the suburbs results in the formation of a band of minimum lot sizes of one or possibly two acres. The settlement pattern in this area takes on a leapfrog appearance because of the large area required between residences (ASPO, 1968, p. 66). Industrial and commercial activities are restricted in their choice of location and may pay a higher price for their eventual choice. Exclusionary zoning is often used as a method of eliminating low income and minority housing because that type of housing requires relatively low-cost parcels.

Another form of intentional externality is the imposition of a non-conforming status upon a structure. A building is considered non-conforming if it fails to meet the requirements of an ordinance adopted after its construction. As a rule once the ordinance is adopted no other non-conforming activities are permitted to locate in the district. Thus zoning gives a monopoly position to the initial non-conforming uses and often its sheltered position is sufficient impetus for sustained economic growth by the non-conforming activity (ASPO, 1968, p. 58; Weimer, 1966, pp. 255-84).

Another type of intentional externality arises from the fact that a plot of land is zoned or rezoned for a use and this fact often provides a sufficient justification for an automatic increase in land value for the surrounding properties (ASPO, 1968, p. 66). For example, agricultural land adjacent to a commercially zoned parcel is often sold at a parcel-rate higher than the average agricultural rate and more comparable to residential or commercial rates. An alert land speculator may purchase the land at an agricultural rate, wait a few years for a commercial intrusion urban sprawl and then sell it at a commercial price. In order to reduce the speculative potential and resulting externality arising from a zoning classification one researcher has suggested that a development tax be levied (Platt, 1972, p. 43).

In summary intentional externalities arising from zoning are often manifested in the districting pattern as outlined in the ordinance. One deficiency in the literature on zoning is a failure to give consideration to the districting problem and to externalities arising from it.[1] The present methods of districting tend to "balkanize our cities into districts with precise and rigid boundaries" (Reps,1964, p. 12). Districts are often drawn on the basis of a distinction of uses rather than interrelationships of uses (Delafons, 1969, p. 94). Often the districting scheme presented in this research stresses the interrelationship of land uses.

Critique of Zoning

The critique of zoning as a process is organized into the following sections:

a) Underlying assumptions of land use regulations;

b) Structural weaknesses of zoning ordinances and administrations;

c) Externality effects of zoning and districting and;

d) Proposed solutions.

In each of these sections the current thinking on zoning is elaborated. At the end of the critique some solutions are proposed which may

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[1]In reference to the districting scheme, it should be clearly stated that the districts are use districts and do not include planned unit development districts.

mitigate some of the obvious defects of the present system of zoning. In the final portions of this section the position of this research in the proposed solutions is mentioned.

Early thinking on land use regulation in the United States was based upon the following assumptions:

a) the city is an integral political unit;

b) the city is a melting pot where ethnic and cultural fusion occurs;

c) the city is capable of financing its own programs with little or no federal or state aid or control and;

d) the city is easily delimited from its support area (Doebele, 1963, pp. 5-13).

Changes have undoubtedly occurred which have rendered many, if not all of these assumptions mistaken. Government fragmentation, racial polarization and suburbanization have reduced the political, cultural and ethnic integration of the city. Cities are slowly becoming bankrupt due to a decreased tax base brought on by the movement of whites and industry to the suburbs. Added to their plight is an increased demand for central city services. Federal assistance is now required to lessen the urban financial blight.

As a result of these changes a new scale of urban living is emerging characterized by an absence of political boundaries (Freidman, 1965, pp. 312-20), hit or miss urban growth (Knetsch, 1962, p. 1217), and economic decentralization (Proudfoot, 1954, pp. 415-9). As a result land uses are emerging which may lead to potential conflicts (ASPO, 1968, pp. 7-8). Zoning ordinances, a method of land use control are becoming obsolete and incapable of handling the resulting chaotic urban land uses (Delafons, 1969, p. 48; Lovelace and Weismantel, 1961, p. 7; Proudfoot, 1954, pp. 415-9). Initially zoning was designed as a holding operation not as an apparatus for resolving land use conflict (Toll, 1969, p. 179). However, in many municipalities zoning is disregarded while in other communities zoning has become a game of municipal "oneupmanship," parochial and exclusive to say the least (Doebele, 1963, pp. 5-13).

The present justification for land use controls in the United States stresses the sovereignty of private property interests which may not be exactly what planners and other municipal decision makers regard as desirable (Delafons, 1969, p. 32). Private property rights are also given priority over the preservation of space for the public such as agricultural land and open space (Feiss, 1961, pp. 121-8; Delafons, 1969, p. 8). However, since zoning is a public good, then private property rights may be legally subverted if the situation warrants it. Sometimes zoning conflicts with the community interests just as it does with the private property interests. A community-zoning conflict often arises when the ordinances are based on an outdated master plan (Shenkel, 1964, p. 58; Reps, 1964, p. 13). Other times injustices may occur when mutually exclusive zoning classifications allow the land speculator to reap windfall profits by the rezoning of vacant land. In these situations the community's treasury does not share in the profit earned by the developer.

Zoning has a diffused power structure. There are few effective planning authorities covering more than one local government in the urban area. There are few regional planning boards and they have only limited power (Delafons, 1969, p. 9). Administration and enforcement are also hurt by the lack of a national scale of planning to regulate urban growth. Where enforcement is present, it is often centered in areas possessing a high degree of racial and economic homogeneity (Siegan, 1972, p. 225). However, enforcement of public good must be equally distributed and often the zoning board of appeals possesses limited discretion in many of its decisions (Reps, 1964, p. 13). For example the lack of specificity, standards and objective criteria often thrusts the planning and zoning commissions into confusion and inconsistent behavior (Whitnall, 1963, p. 9).

Proposed Solutions

Zoning is not without its critics but few if any propose alternative strategies for land use control. The basic thesis of this research is that zoning is required but modifications are necessary. For example, site characteristics are a valid criterion upon which to develop a zoning ordinance but the situational characteristics of a parcel are equally important and demand equal consideration.

Two proposals have been advanced to improve the zoning practice. One proposal suggests that economic analyses and impacts of zoning ordinances be specifically defined to make it "more credible to land buyers" (Clawson, 1971, p. 343). Any new type of district delimitation should also take into account the relationships between the districts (Delafons, 1969, p. 44). Furthermore, planners need to "respond to the needs of interaction, interdependence and unity" (Loeks, 1963, p. 29). Accessibility is an example of one type of economic analysis based upon situational characteristics of a district. Since accessibility is a measure of interaction, it will also indicate the interrelationships and interdependences between the districts.

URBAN LAND MARKET

Models of Urban Land Use

The purpose of this section is to place in perspective zoning and land use models dealing with the urban land market. Analyzing models of land use provides a general treatment of the land market from which a more specific analysis of zoning's impact on land uses can be derived.

Early models dealing with the urban land market paid little, if any attention, to the spatial component of urban economics (Ukeles, 1965, p. 4). Distance along with interaction and regional independence were not values as factors influencing the production and consumption functions. One reason for this shortsightedness was that all suppliers were located at approximately the same point in space (Ukeles, 1965, p. 4).

One of the earliest models stressing a spatial dependency was constructed by Haig (1929). Basically his model explained urban land uses by relating them to underlying economic forces such as accessibility. Later work by Ratcliff (1955) expanded the concept of the urban market by assuming that economic or locational productivity of the land can be assessed by distance from the market. That is productivity is maximized when distance costs are minimized and other locational costs are distributed relatively evenly among users (Ratcliff, 1955, p. 127). Cost provided the controlling force in organization of urban activities according to Ratcliff. Ukeles stated that Ratcliff's model failed to recognize:

a) locational patterns of consumers;

b) distance as only one of a number of locational considerations and;

c) location as possibly being unimportant for certain types of economic activities (Ukeles, 1965, p. 7).

Building upon Haig, Thunen and Ratcliff, Alonso developed a more comprehensive model of urban land use. His model assumed that a location closer to the CBD costs more than a location at a greater distance. In addition a zone of indifference may exist at a certain distance where the consumer is relatively ambivalent to a particular series of locations (Alonso, 1960, pp. 149-57).

Basically the model illustrated how at increasing distances from the market, a firm would trade lower transportation costs and location rent for needed accessibility. At closer distances, a firm would accept less space per dollar and a higher location rent for the advantage of increased accessibility. Reasoning further, he concluded that a series of bid rent curves could be derived for a group of economic activities thus indicating their locational distribution. For instance commercial activities are most likely to pay a higher cost for accessibility than residential or industrial activities. According to Ukeles one major defect of the Alonso model is the failure to accept the multi-directedness of the consumer (Ukeles, 1965, p. 8). The location of residential areas may be explained by factors other than space and distance which are more important in other types of economic activities.

A third model was developed by Herbert and Stevens (1960). They defined site rent as a portion of the total residential rent with the latter equaling the difference between the total costs and the costs of producing the commodity. Herbert and Stevens also subdivided residential rent into dwelling costs, site costs, amenity costs and accessibility costs (Herbert and Stevens, 1960, pp. 21-36). Unlike the Alonso model, this model assumes that if all other factors are equal, the closer to a CBD that a firm is located, the lower is the accessibility costs and the higher is the site cost. This relationship is most valid if one assumes that dwelling costs or space per unit along with amenity costs are held relatively constant.

It is quite evident from the above models that accessibility or the reciprocal of the costs of movement acquires major importance in the explanation of urban land uses. In the sections that follow a fuller treatment of factors influencing accessibility, land uses and land values is provided. Although these factors are not integrated into a model, they will provide background for the development of the problem.

Factors Affecting Land Values

Accessibility to employment, shopping and amenities, both natural and cultural, plays a vital role in explaining some of the variation of land values within the city. However, there are other more salient locational factors also affecting land value. One such factor is the supply of vacant land which determines land value particularly if natural or man-made limitations restrict the supply of suitable industrial and commercial land (Sagalyn and Sternbieb, 1973, p. 10). A second factor is the nature of the site which often limits the permitted use on the site (Yeates, 1965, pp. 57-70). For example, single-family dwellings are often the only permitted use on extremely hilly regions even though the hills may be situated within close proximity to the CBD. If natural conditions do not limit the achievement of a highest use, then the community by regulations or attitudes may inhibit it (Sagalyn and Sternbieb, 1973, p. 9). As previously mentioned, the city of Vernon, California encouraged by zoning regulations and property tax incentives, the establishment of industrial activities in the city. By doing this the value of land was artificially increased. A third factor influencing land values is the amount of public capital investment in planned facilities (i.e. sewer lines, highways, etc.).

A fourth factor influencing land value is the intensity of surrounding development. The higher the intensity, the higher is the value of land. The best example of this concept is found in an analysis of land value within the central business area of a city.

A graph of land values in three dimensions exhibits a variety of cones, nodes and apexes (Seyfried, 1963, pp. 275-84). A cone of relatively low land value near a CBD may indicate the outer fringes of a ghetto. A node of high land values may be found at major intersections while the highest land value within the city is found at the peak-value intersection in the CBD. One underlying reason for such a highly skewed distribution is that land value increases as the costs of overcoming distance decreases (Seyfried, 1963, pp. 275-84). Thus in support of the Alonso model but from a different perspective, land values represent a trade-off between the costs of movement and the importance of contact.

The role of accessibility and land values demands closer scrutiny. It has been found that rapidly growing areas of a city are also highly accessible (Hayes, 1957, pp. 177-81; Hansen, 1959, pp. 73-6). In addition, Hansen found that "accessibility and availability of land for economic growth is a function of the growth in the area during the preceding period" (Hansen, 1959, pp. 73-6). Public capital investment controls the growth in an area. Implied by Hansen's findings is a threshold for developed land. If a threshold is exceeded, then increased accessibility in that area may not increase the economic growth of the area.

Increasing the accessibility to an area may not promote a complementary change in land values and land intensity. In the San Francisco and Oakland area, changes in land value followed less closely changes in accessibility than changes in population, office space and retail sales (Wendt, 1961, p. 32). In Chicago Yeates found that changes in land value were associated with changes in population density, average income and the racial composition of the area (Yeates, 1965b, p. 65). Platt found that if accessibility is controlled, then the land value depends on many of the previously mentioned variables plus the extent of public services such as fire and police.

The direct relationship between land value and accessibility, although influential requires some qualifications. In the long run, as accessibility into an area increases, land values also tend to increase. However, in the short run, other non-economic factors affect the land value and land use intensity. Zoning and other forms of land use regulations are considered by the author to be long term regulations. Most cities in the United States have had some form of a zoning ordinance for well over thirty years. Thus for the purpose of this research, it is assumed that a major influencer of land value in the long run is accessibility and zoning.

Accessibility and Land Use

The term accessibility has been continually used in the preceding sections without an adequate definition. In this brief section a definition of accessibility is provided along with some statements on the need for accessibility by different types of land uses. The next to last section of this chapter will then present a graphic portrayal of many concepts alluded to in the preceding sections.

Accessibility may be defined as the reciprocal of the cost of moving people and goods between points in space (Pendelton, 1963, p. 1).[1] As the costs increase, accessibility decreases. Accessibility is a component of the land rent (Pendelton, 1963, p. 9). Land rent is a function of distance and is not the same as space rent. As evident from the above definition costs of movement are broadly defined. In this research costs are used within the context of opportunities; that is, as accessibility to an area increases, the spatial opportunities for a variety of economic and social activities increases, thereby reducing the costs incurred in travelling to another location which may offer the same types of services.

Accessibility has many different facets such as airline, highway, public transportation and pedestrian movement. In addition, accessibility operates on a variety of scales such as national, regional, interurban, intraurban and personal. Finally different indices may be used to measure accessibility. For example, one could use effective distance travelled to employment or shopping as a measure. Another may be the overall distance from one point to all other points in the area. Time is yet another measure of accessibility particularly in the work trip and in technologically advanced countries.

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[1]Two dimensional urban space is implied by the research. The researcher recognizes the existence of three dimensional space in the city but three dimensional zoning has not yet evolved.

The importance of accessibility also depends upon the nature of the economic activity. Normally industrial, commercial and professional activities place a premium value on high degrees of accessibility whereas residential uses are often far less dependent upon it (Dickinson, 1964, p. 177). As Mitchell states, the "way in which the movement of persons and goods influences an establishment's choice of location is related to its function and type of activity" (Mitchell, 1954, p. 106). Furthermore, transactions or movement occurs continually within the urban area. Understandably, movement between two or more parcels implies a measure of spatial dependency. The work trip is one such example of a transaction linking industrial and residential land uses. Since accessibility varies from point to point in space depending on the mode of movement and since a hierarchy of accessibility may be constructed, then it follows that land uses also sort themselves into various patterns since the latter are in a large measure a function of the movement costs (Dickinson, 1964, p. 194).

A high degree of accessibility is also associated with a high intensity of land use (Hasegawa, 1963, p. 145). Contrasting the land use intensity in the CBD with the intensity in the suburbs illustrates this concept. Since there is an irregularity in the distribution of land uses within a city, then it follows that there is also a similar irregularity in the intensity of land uses. Factors fostering this irregularity include: historical development, site characteristics, building codes and finally zoning. Site factors play a vital role in determining whether or not the activity can perform in the area. Thus it is important in any study of land use regulations to incorporate not only the situational characteristics but also the site variable

(Mandelker, 1972, pp. 121-4). Within this research, site is incorporated into the analysis by selecting land values on the basis of the present zoning plan which is in a large measure, site oriented.

A Model Illustrating the Effect of Zoning on the Urban Land Market

The unit cost of trips from the CBD to a variety of locations is assumed to be a linear function (Figure 1). Therefore at a distance of D_1 the unit costs of the trip equal costs C_1. The location rent curve reflecting the costs of movement is presented in Figure 2. That is, as the cost of additional trips increases, the number of trips made decreases. One assumption for the demand curve is a constant real income.

If one connects the demand curve with the cost curve then the total cost of the trip can be determined. This process involves connecting the point D_1C_1 with the point T_2A_1 and the point D_2C_2 with the T_1A_2. Thus the total cost of the trip from the CBD to D_2 is represented by the area under $OC_1A_1T_2$. Furthermore the locations rent or the cost of accessibility at D_1 is represented by the area $A_1C_1T_2$ which is greater than the location rent at D_2 which equals the area $A_2C_2T_1$. Thus in the words of Pendelton (1963) the location D_1 is more 'superior' than the location D_2 by the area represented by the difference in areas between $A_1C_1T_2$ and $A_2C_2T_1$.

The superiority alluded to above applies only to one activity at two different locations. If a variety of location rents are calculated, then competition for the most 'superior' location will be based not only on distance but also on the profit structure of the activities (Figure 3). The location rent diagram assumes that the trip maker is confronted with varying unit costs per trip based of course, upon the nature of the

Figure 1 COST CURVE

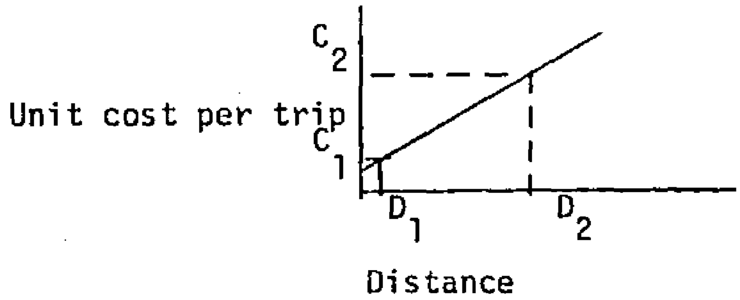


Figure 2 DEMAND CURVE

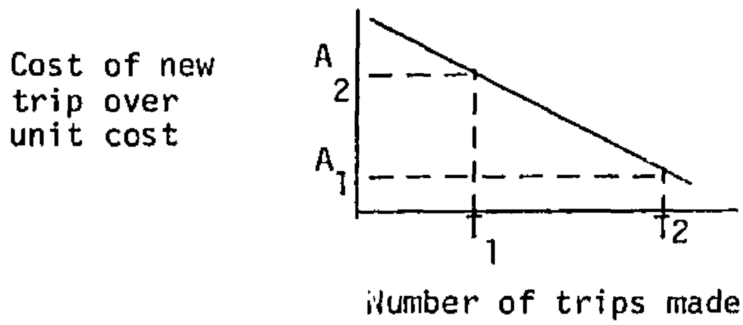
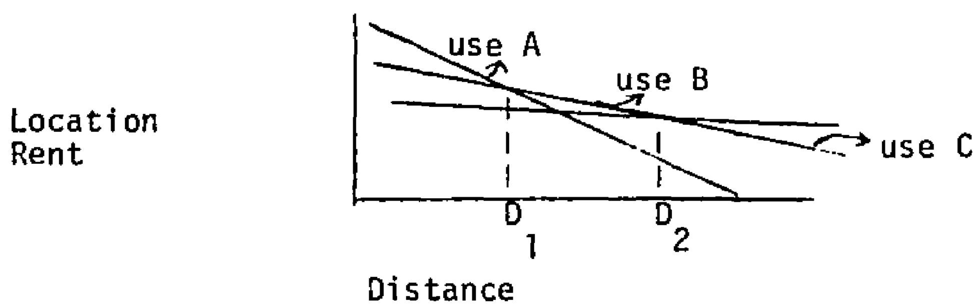


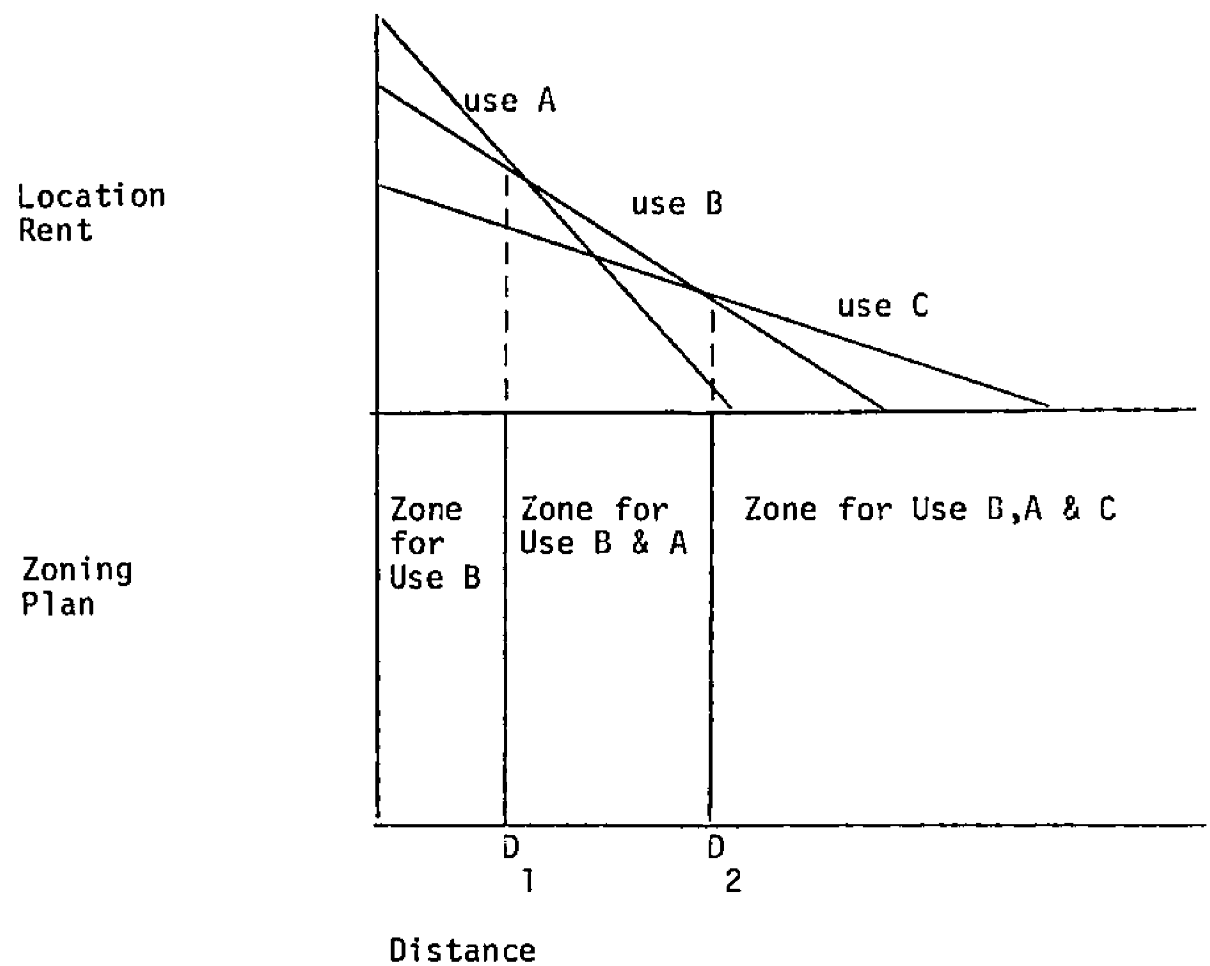
Figure 3 LOCATION RENT



economic activity at the destination. Thus with a variety of economic activities, one gets a number of location rent lines for the uses A, B and C. Putting Figures 1, 2 and 3 together one finds a predominance of land uses supporting activity A. This type of land use would forego lower land costs at greater distances for the advantage of frequent trips and lower unit costs per trip, i.e. accessibility.

The question then becomes--What if some type of land use regulation is introduced into the system? Furthermore, assume that the zoning plan is incompatible with the existing distribution of land uses (Figure 4). In the overall evaluation, use A is hurt by the poor zoning. As it is, use A is either non-conforming or it will have to relocate to another location but where can it go? Assuming that relocation is the strategy chosen then an examination of the graph will point out how activity cannot economically relocate in the BC segment. If it does, then its profit structure will be diminished since it will enjoy less accessibility with an accompanying reduction in total revenue. Activity B under the present regulations may possess a locational monopoly since it can locate in the area AB and still rest assured of a reasonable profit. In summary then the relocation of activity A due to the imposition of the land use regulations represents an example of negative externalities. The second case illustrates that a positive externality was enjoyed by activity B.

Figure 4 ZONING AND LAND USE



Chapter Three

Hypotheses and Data Collection

INTRODUCTION

This chapter presents the research and statistical hypotheses tested by this study. Following the hypotheses is a detailed discussion of the sampling designs for the primary data that were collected. By specifying the design in this way, the complexities and problems involved in the collection of the data will be made apparent.

It should be noted that the research effort is concerned with both the development of a technique to measure the situational orientation of zoning districts and to assess the impact of the new situational zoning upon land values. If it is found that the data fail to support the model, the technique of zoning regionalization should nonetheless remain useful. As stated earlier a survey of pertinent literature has revealed that methods of geographic regionalization have not been applied to the problems of zoning.

STATEMENT OF HYPOTHESES

Hypothesis 1 Homogeneity of Land Values

The delimitation of zoning districts emphasizes more of the site characteristics of a parcel and fewer of its situational characteristics. To the degree that this emphasis occurs, zoning can be said to fail as a public good. That is, site-oriented zoning may impose negative externalities or locational spillovers upon certain parts of a city. In operationalizing this concept of externalities it is assumed that the heterogeneity of various social and economic functions within a zoning district produces heterogeneity of land values. If zoning boundaries were redrawn in a way that incorporates not only the site limitations but also accessibility characteristics of the land, would this strategy increase or reduce the heterogeneity of land values within the zone?

Research Hypothesis

A regionalization or a classification system based upon proximity to spatial opportunities or accessibility, produces more homogeneity in the distribution of land values overall and by zoning district than existing methods of zoning delimitations.

Statistical Hypothesis

The standard deviation of land values overall by district for the situational based zoning is less than the standard deviation of land values by district for the site-based zoning.

Test Statistic

If s_1 equals the standard deviation of land values derived by a situational or accessibility approach and if s_2 equals the standard deviation of land values existing in present zoning schemes, then H_A is accepted if F (actual) = $\frac{s_2}{s_1}$ is larger than $F_{n1,\ n2}$ (expected) where N_1 and N_2 represent degrees of freedom.

On the average commercial activities tend to be located in the most accessible portions of the city; industrial activities on the average tend to be located in the next most accessible portions and finally residential areas are located in the areas of overall lowest accessibility. This assumption is needed to identify the new zoning districts.

Hypothesis 2 Homogeneity of Land Values in a Zonal Aggregation

Land uses tend to vary within a city by a zonal pattern. Land uses are quite similar within the concentrically shaped central business district (CBD) of Lansing (Taylor, 1961, p. 13). As distance from the CBD increases, another circle of relatively similar land uses exists and at even greater distances, other similar land use zones soon appear (Taylor, 1961, p. 12). Since zoning regulates land uses then it should exhibit a relatively similar zonal arrangement. If the zones were redefined to incorporate more of the situational or accessibility characteristics of the land parcels, would the homogeneity of land values within the zones increase?

Research Hypothesis

If land values are aggregated into concentric zones, then their distribution as defined on the basis of situational zoning will be more homogenous than the distribution of land values aggregated by concentric zones for the more site-based zoning.

Statistical Hypothesis

The standard deviation of land values aggregated by concentric zones for the situational zoning is less than the standard deviation of land values aggregated in a similar manner and based on site zoning.

Test Statistic

If s_1 equals the standard deviation of land values in a situational approach and if s_2 is equal to the standard deviation of land values in site based zoning, then F(actual) equals s_2/s_1 and rejection occurs if F(actual) is greater than F(expected).

Hypothesis 3 Homogeneity of Land Values and Sectoral Arrangement

Since land values as a rule tend to be affected by accessibility than a sectoral aggregation of land values defined by major arterials within both situational and site based zoning should produce an even greater degree of homogeneity of land values (Hasegawa, 1961, p. 151). However, the question arises as to whether the degree of homogeneity is greater in the situationally defined zoning districts than in the site zoning.

Research Hypothesis

If land values are aggregated into sections defined by major roads, then the distribution of land values for the accessibility based zoning is more homogenous than the distribution of land values for the site based zoning plan.

Statistical Hypothesis

The standard deviation of land values aggregated by a sectoral arrangement and classified into land use zones by a situational approach is less than similarly aggregated land values classified on the basis of the site based zoning.

Test Statistic

If s_1 equals the standard deviation of land values in a situational approach and if s_2 is equal to the standard deviation of land values in site based zoning, then F (actual) equals s_2/s_1 and rejection occurs if F (actual) is greater than F (expected).

Study Area

The city of Lansing, Michigan was chosen as a study area for the research for the following reasons:

a) Lansing contains a wide variety of zoning classifications. This variety is needed so that the model will have application elsewhere;

b) Lansing contains within its boundaries a variety of functional nodes for residencies, shopping, employment and industry, etc. Thus accessibility indices will show a sufficient pattern of differentiation;

c) Lansing is situated on a network of major north-south and east-west arterials. Therefore potential movement in the city contains a greater degree of variety than smaller cities with only one or two major arterials;

d) Lansing has industry in central and peripheral areas providing for a greater diversity in zoning classifications. Many of these industrial areas lie within close proximity to existing or future residential communities;

e) The author is most familiar with the city and its economic activities. This facilitates in the interpretation of land uses and in their spatial grouping.

f) The author was able to gain the cooperation of local planning officials. Without their help, data collection would have been severely hampered.

DATA REQUIREMENTS AND SAMPLING DESIGN

Types of Data

Land values and land uses are the two primary types of data used in devising the sampling design. Land values fulfill a role as a test variable; they are used in the above hypotheses to determine a within-zone variation. Land uses on the other hand function in a developmental capacity for the model since they form the foundation for the measures used to define the situational based zoning patterns. It is assumed that land uses incorporate a significant portion of the local characteristics upon which centrality can be measured.

Other sources of data for a study of this nature are procured from a secondary source and then modified by the author for the research. An example of the first type are nodes of shopping (e.g. Frandor shopping center) and nodes of employment (e.g. Motor Wheel). The time distances to travel to these and other nodes represent an example of the second type of data.

Sampling Design for Land Values

Land values in Lansing are catalogued on the basis of sections. Sections are individual grid squares of 3500 feet by 3500 feet or approximately two-thirds a mile in either direction. Major north-south and east-west arterials serve as boundaries between sections. However, for the purpose of cataloging land values whole sections (i.e. 3500 by 3500 sections) are subdivided into one-eighth sections of approximately 875 feet by 1700 feet. In their data collections tax assessors combine two one-eighth sections beginning with the top two left sided eighth sections (Figure 5). For example 1/8 section A in Figure 1 is combined with 1/8 section B to form a quarter section.

The procedure for sampling individual land values was subdivided into three stages:

1) superimposition stage

2) determination stage

3) compilation stage

Each of these stages fulfills a specific role in the random selection and evaluation of the land value data.[1]

Stage 1, the superimposition stage, arises out of a need to stratify the land values by zoning type. Stratification is considered important because the proposed regionalization recognizes the importance of the site based zoning regulations. Particular attention is paid to those regulations that prohibit a certain type of land use because of the physical limitations of the land such as multiple floor office building in a swamp. The graphical superimposition of the section map onto the zoning map was the only requirement for this first stage.

The second stage begins with estimating to the nearest 10% the portion of a one-eighth section that was devoted to residential, commercial or industrial zoning. A grid containing a mesh of evenly spaced dots was used to estimate the area. Percentage data for a one-eighth section were averaged with the adjoining one-eighth section to secure one-quarter section data. The final one-fourth

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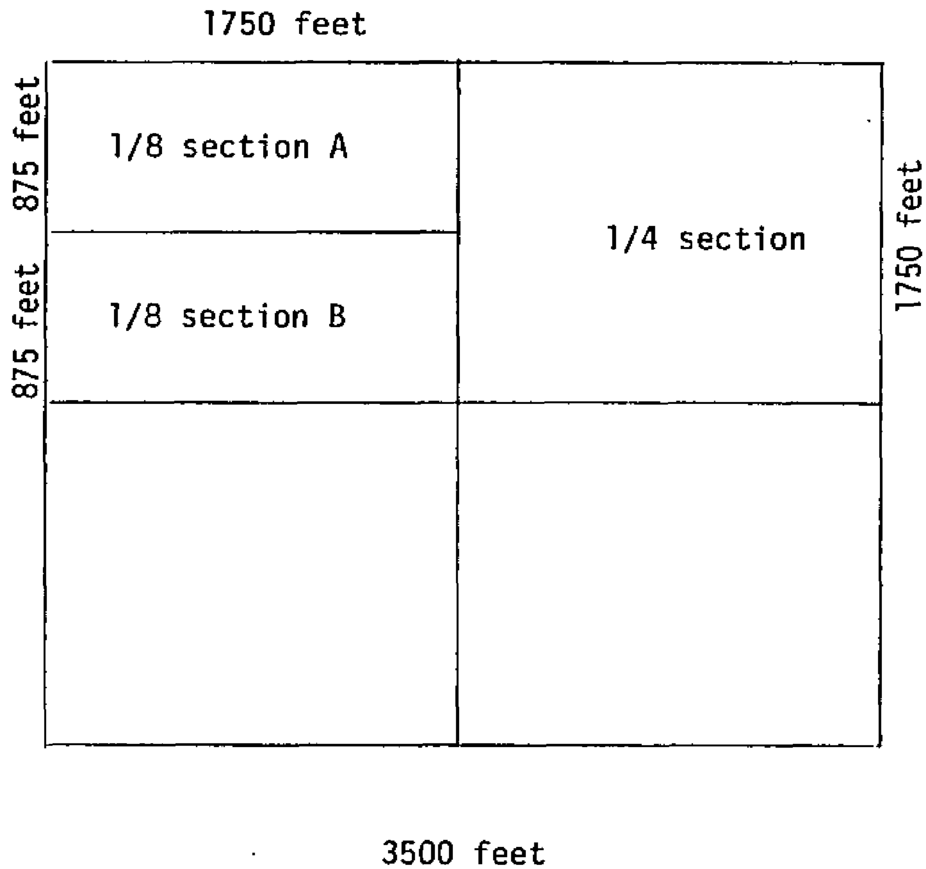
[1]Land values were chosen over total assessed value because the latter includes structural characteristics which relate more to the socio-economic characteristics of the owner and less to the relative location of the parcel.

Figure 5 DEFINITION OF SECTIONS



section figures indicated what percentage of the total land values selected should come from residential, commercial or industrial parcels.

It was assumed that five values per quarter section provides both a relatively even and complete coverage of the entire study area. The actual number of five values per quarter section was determined by the regionalization scheme described in the subsequent chapters. Since there are approximately 118 quarter sections, it was determined that five values per quarter would yield less than 620 land values. Any number greater than five would significantly increase computer analysis and storage along with the costs of the computer drawn maps. 602 land values were selected from a population total of 43,500; thus a sample size of 1-1/2 percent was achieved (Table 1). When examining Table 1 the differences between the expected values and the actual is best explained by parcels being larger in size than expected, particularly in industrial areas. It should be noted that the sample size was considered far less important in the selection of land values than was the stratification of these values by zoning type.

The final portion of the second or determination stage of the land value selection was completed with the randomization of the land values. This was accomplished by first determining what percentage of five parcels would be selected from residentially, commercially or industrially zoned land. Each parcel has an eight digit legal number in the tax assessor's records (e.g. 36-171-101). The final three digits represent a sequential number normally from 101-300. Using a three digit randomized number table that parcel whose legal number came closest to random number was selected for inclusion.

TABLE 1

Comparison of Expected and Actual Land Values

Zoning Type	Expected	Actual
Residential	393	399
Commercial	133	137
Industrial	79	66
Total	605	602

Source: Calculated by author.

Once a potential list of 602 land values was selected, the compilation stage of the design began. At this point some unforeseen problems developed. One such problem was the need to develop land values per standard unit of area. Due to local peculiarities land values within the study area are not consistently given in standard units. Residential properties are listed as land value per front foot while commercial and industrial properties are listed as land value per square foot. Land value per square foot was selected. However, in certain irregularly shaped residential properties square footage was estimated by the longest dimensions in both directions. In all circumstances additions or deletions to land value made by the assessor were deleted. Such changes may occur for excessive land area or for flat land.[1]

Another problem arising in the compilation stage was the unreliability of the zoning classification given in the tax assessor's books. Therefore the selected land parcels were periodically checked with the zoning administrator for a zoning updating. A time lag of approximately a year appeared to exist between the time a new zoning classification was granted and the time the classification was recorded in the tax assessor's book. Interestingly, in Lansing a zoning classification is one of the criteria used to determine the assessed valuation particularly for commercial and industrial property.

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[1]In conversation with Mr. James Meyers, Chief Assessor for the City of Lansing, on February 20, 1974, he stated that these extra calculations were "subjective and subject to change."

Two additional problems incurred in the compilation of land values were missing assessors sheets and vacant land. Due to an updating of assessment values during the time that the land values were selected some of the data for randomly selected parcels were not easily available. After considerable investigation, the author was able to get some of the needed information. Twice the sheets were either not "available at all" or missing. When this occurred the parcel on the preceding page of the assessment book was selected provided that it met the required zoning criteria.

Vacant land was not included in the study for two reasons. First, vacant land within the study area was automatically classified by the assessor as single-family residential.[1] It was felt that this classification was totally unrepresentative of the nature of the land. Second, it is hoped that the technique developed in this research will serve as a tool to evaluate the potential zoning classification of vacant land. By measuring the accessibility of the vacant parcels and comparing this value with values of occupied land, zoning administrators will have more of a substantiative base upon which to determine a new zoning classification for vacant land. Thus including land values for vacant land may distort the overall validity of the technique.

One final problem arising in the data compilation stage occurred when two or more zoning classifications were provided for one parcel. In the majority of such situations, a parcel was designated as "F"

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[1]Approximately 65-70% of the total land area is zoned as single-family residential. This estimate was obtained from the zoning administrator for the city of Lansing.

commercial and "J" parking. When this occurred the "J" parking was assumed to be part of and directly related to the commercial zoning classification. Hence the parking lot area and its land value was included in the "F" commercial lot area and land value for four land values. In two instances, a parcel was designated as "F" commercial and "A-1" single family. In these situations the parcel was designated the zoning classification of the larger lot area. Assessed land valuations in this case were combined and averaged.

Sampling Design for Land Uses

Aerial photographs were used to estimate land uses within the city. This method allows the user to gain an overall appreciation for land uses within the city while at the same time providing sufficient detail around sample points. A field survey, although possibly more accurate, would not afford as comprehensive an approach as the photographs. In addition and perhaps more pertinent to planning agencies, a field survey is extremely time consuming and costly. Aerial photographs or even enlargements as used in this study, are relatively inexpensive and easily procured for the vast majority of urban areas in the United States at a scale of 1:8000.

The basic rationale behind the sampling design was to devise a systematic method to sample land uses that provided both complete coverage of the study area and yet showed sufficient variation. A five point systematic sample concentrating on street intersections was chosen. In the discussion that follows a more complete elaboration of the design is provided.

Since statistical inferences would be derived from the land uses, then strict adherence was paid to the derivation of the sample size. It was assumed that the study area was divided into a finite number of grid squares each of approximately 1000 feet by 1000 feet, with a mean of μ and variance of σ^2. A sample of these grid squares was needed; one which had a mean ($\overline{y}$) and variance (s^2). According to the Central Limit Theorem, in situations where the total number of observations exceeds 30, a sample mean ($\overline{y}$) will be within 2 or 4 units of the population mean, 95 out of 100 times (Mendenhall, 1968, p. 145).

The question becomes then what is the most appropriate valid sample size? In a normal distribution, variance is a function of the number of observations (N). According to the Central Limit Theorem the variance of a normally distributed population also equals four units at a .95 confidence level. Therefore the formula becomes

$$N_y = \frac{\sigma^2}{4}$$

Note the value for the population variance is not known. However, Tchebysheff's theorem or the empirical rule states:

> Given a number, K greater than or equal to 1 and a set of measurements $Y_1, Y_2 \ldots Y_n$, then at least $(1-1/K^2)$ of the measurements will lie within K standard deviations of their mean (Mendenhall, 1968, p. 4).

Thus when $K = 2$, $1-1/K^2 = 3/4$ and at least three-fourths of the measurements will be found within two standard deviations of the mean. Operationalizing these K values becomes the Empirical Rule where given a normal distribution, $\mu \pm \sigma$ contains approximately 68% of the measurements; $\mu \pm 2\sigma$ contains 95% of the measurements; and $\mu \pm 3\sigma$ contains 99.7% of the measurements. Plus or minus two standard deviations actually indicates four standard deviation units. Therefore it is possible to equate one standard deviation unit with one-quarter of the range of the set of measurements.

Returning to the selection of land uses, the goal is to estimate what percentage of a 1000 foot by 1000 foot surface square or a one inch by one inch grid square was devoted to one of four general land uses: residential, commercial, industrial or vacant-public. Thus the range of values was from 1-99 and one quarter of the range was approximately equal to 24.[1] The sample size for land uses becomes:

$$N = \frac{\sigma^2}{4} = \frac{(24)^2}{4} = \frac{576}{4} = 144$$

That is 144 sample points would be needed to derive a statistically valid mean estimate ($\bar{y}$) of the population mean, μ. However, $\bar{y}$ would be valid only for one set of measurements and since four sets are required by the sampling design, then the total sample size becomes 144 X 4 or 576 measurements. With a sample size of 576, the sample mean ($\bar{y}$) of four land use categories will lie within $\pm$ 2 standard deviations of the actual mean land use within the study area 95% of the time.

As previously mentioned, it is important for a sample of land uses to have equal area coverage. The chosen method of achieving equal-area coverage is to stratify the sample according to pre-existing section boundaries. Since there are approximately 29 sections, or approximately 118 quarter sections, then the equal area coverage calls for the 576 samples to be spread evenly over the 118 quarter sections. Thus the final sample size is approximately five per quarter section.[1]

The actual procedure for selecting the land uses began by first

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[1]The actual number of sample points was closer to 542. The difference is due to the fact that certain sections contained vast areas of vacant undeveloped land. So five points per section were reduced to 4 points per quarter section for those sections containing exceptionally large areas of vacant land.

locating the sample point on a base map and then locating the same point on the aerial photograph. Around each of the five points on the aerial photograph, a one-inch square was positioned so that the sample point was located at the mid-point of a side (Figure 6). A one-inch square was chosen because of the relative ease of calculating the area devoted to each of the four uses. Also one inch squares on the aerial photograph or approximately 430,000 square feet on the ground appeared to cover the area around most major two and four corner intersections. Finally by aligning the sample points along streets the possibility of measuring an inordinate amount of vacant land was minimized.

It was assumed that street intersections would indicate land uses most typical of the quarter section area. Also street intersections would provide an indicator of any possible variation in the land use, particularly within residential areas. Most of the time, a two or four corner intersection was present at each of the five sample points since many of the section boundaries within the study area are streets. When the situation arose that a sample point was not aligned with a street, the sample point was moved to the closest road intersection.

The actual determination of the predominant use in an area was made according to the following operational definitions:

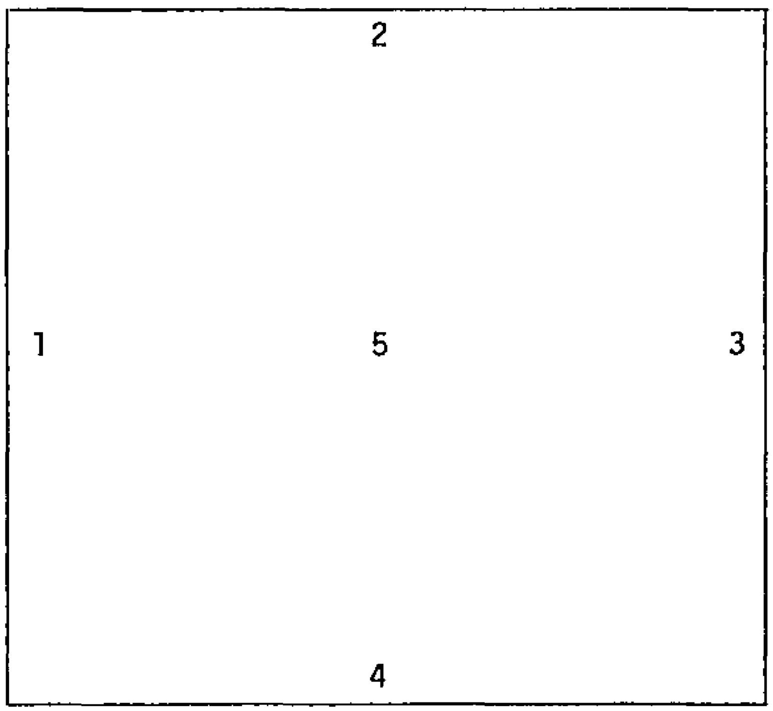
a) residential - any single or multiple family structure shaped as such with accompanying parking space;

b) commercial - any retail or wholesale establishment selling a good or service to another retail store or to consumers. Included in this definition are junkyards and professional office buildings;

c) industrial - any type of secondary transformation of a product requiring addition of power source. Also included are construction companies;

Figure 6 POSITIONING OF ONE-INCH GRIDS AROUND LAND USE SAMPLE POINTS

Quarter Section* 1750 feet



*Not drawn to scale

d) vacant - any area not adjoining residential property of sufficient size with no visible structure on it;

e) public - included areas for general use such as highways, schools, parks, airports, waste treatment facilities and federal and state military installations.

The actual determination of the area supporting a particular type of land use was accomplished by superimposing a one inch by one inch piece of mylar with a grid pattern drawn at one-tenth an inch. The area was then estimated to the nearest whole grid square (i.e. one tenth of an inch grid). Field checks were made when the author was unable to interpret the predominant activity of the structure.

Chapter Four

Development of and Testing the Situational Model

INTRODUCTION

"One of the most common problems in applied geographic research is the partition of an area into a system of regions." (Haggett, 1972, p. 373)

The geographic partition of an area into similarly defined spatial units may appear to be accomplished in a very objective, precise and easy fashion. However, the partitioner soon finds that many subjective evaluations creep into the partition process. These subjective elements are not at all unusual provided that a rationale exists for each one. In this chapter a regionalization process is developed based upon the relative location of land uses. At each stage where subjectivity arises in the scheme, a detailed explanation is provided. By structuring the research in this manner, the magnitude of the problem alluded to by Haggett hopefully is reduced.

The following chapter is devoted to a detailed examination of the regionalization process which measures the relative location of parcels while at the same time incorporating some characteristics of the parcel's absolute location. Land use parcels are grouped according to similarity of composition by a grouping algorithm. Group membership is checked and continually rechecked at each step in the process. The testing of the hypotheses revolves around a comparison of the land value mixture in the existing districts and in the newly defined situational zoning. Finally areas of potential land use conflict are delimited within the study area.

REGIONALIZATION OF LAND USES

Data Simplification and Principal Components

Most of the area devoted to land uses calculated from the 660 foot squares on the aerial photograph belonged to one or two of the land use categories. As a result, the amount of space for the remaining land uses remained quite low (Table 2). Because of a highly skewed distribution of land uses, the variance and the standard error of measurement of the variable were increased. The preponderance of zero percent land uses in the sample served to distort and possibly invalidate the regionalization scheme. One solution to this problem mentioned in the previous chapters was to assume that each land use category comprised at least one percent of the sampled grid area. Therefore the mean land use area was increased by one but the overall variance remained the same. For example, the distribution of land uses in a typical grid may be sixty percent residential and forty percent commercial. The new distribution then becomes residential sixty-one percent, commercial forty-one percent and one percent for each of industrial and vacant-public uses.

Standardization was accomplished by a principal components analysis. Principal components analysis is often labeled as factor analysis. Both techniques are quite similar since they both attempt to delimit the simple structure or communalities from a group of related variables (Gullahorn, 1966, p. 15). More specifically, principal components analysis aims at determining a center of gravity solution in a 'm' dimensional square in which 'm' variables load on 'r' dimensions (Harvey, 1969, p. 343; Brunn et al, 1970, p. 67).

Table 2

Mean Land Use Areas for Lansing

Type	Percent
Residential	56.2
Commercial	13.9
Industrial	5.7
Vacant-Public	24.3

Source: Calculated by author.

According to parameters of this research the principal component analysis attempts to reduce a four dimensional land use classification into a one dimensional measure indicating similar structure.

The starting point for principal components analysis is a matrix of simple correlation values. Within the variance explained by these simple correlations lie a set of common structures of sufficient size to explain part if not all the observed variation (Gullahorn, 1966, p. 15). In order to arrive at the common structure, principal components analysis assumes the following:

a) each set of variables has a set of common factors;

b) the variance of each variable when summed is a measure of the total variance; and

c) the value of the individual observation can be more economically represented by a factor score than by individual scores on each of the factors (Fruchter, 1964, p. 87; Russett, 1965, p. 324).

Statistically, principal components analysis differs in one way from factor analysis. The former assumes that the total variation can be explained by components. Within the context of this study, this assumption means that all of the variation of land uses within Lansing can be contained in at least one of the four land use categories residential, commercial, industrial or vacant-public. In factor analysis, an error term is assumed to exist; therefore all of the variation is not explainable.

If the researcher desires to reduce dimensional variation, principal components analysis is far superior to common factor analysis (King, 1969, p. 157; Kendall, 1957, p. 201). As a rule, common factor analysis is used to test hypothesized relationships. Within the context of this research, no hypothesized relationships were formulated and principal components analysis is employed.

Principal components analysis within geographic research has many varied applications. It is often used to reduce data complexity by revealing the underlying simple structure. A data transformation or data classification is also possible. In either of the above cases, the factor scores for each factor represent independent scalar quantities which are standardized and normally distributed (Rummel, 1967, p. 197; Dingham, 1967, p. 127).

In geographic investigations principal components analysis is generally recognized as a tool for the initial regionalization of spatial data (Carey, 1966, pp. 551-569; Blaikie, 1971, pp. 1-40; King, 1966, pp. 205-224; Moser and Scott, 1961, p. 7). In all of these examples, the principal components analysis functions primarily as a tool to indicate the simple underlying structure. After accomplishing this, statements of statistical association or change through time could be made utilizing other more powerful statistical techniques.

Results of Data Simplification and Components Analysis

The simple correlation matrix is presented in Table 3. The correlations are all negative and not exceptionally strong but they are all significant at the ninety-five percent level of confidence. The correlations appear to suggest that the four land uses are partially exclusionary or distinct from one another.

The principal components analysis extracted one dimension from the total variation. All the other dimensions had eigen values less than unity and were less efficient explainers of variation than the original variables used in the correlation analysis. The one dimension

Table 3

Intercorrelation Matrix of Land Uses

Type	Residential	Commercial	Industrial	Vacant-Public
Residential	1.00			
Commercial	-.41	1.00		
Industrial	-.30	-.05	1.00	
Vacant-Public	-.38	-.05	-.05	1.00

Source: Calculated by author.

accounted for thirty-six percent of the total variation. A relatively low value such as this does not present undue problems as the land uses derived in this research tend to be dichotomous and non-continous. That is the land uses for each parcel was either present or absent within an area. Because of this, the overall variation between the four categories was large. Thus for one component to extract a majority of this variation would indeed raise some questions about the exclusiveness of the land uses.

Could the land uses have been measured differently? For example if they were measured on a binary scale then overall variation may have been reduced. But this would have ruled out any type of internal values which are needed at a latter step in the scheme. However the loss of explained variation was offset by the transformation of the data to common scalar values. Values were needed that were standardized and possessed sufficient variation between the observations to allow a regional grouping.

Data Grouping

The next step on the regionalization scheme called for the land uses to be aggregated into groups. For the aggregation, H-Group or a hierarchial grouping algorithmn was chosen. Contiguity of observation is not incorporated into this grouping algorithmn since within the confines of the research and data, the use of a contiguity measure would imply that zoning districts should be localized for a particular area of the city. Such an assumption does not reflect reality and is contrary to the legal foundation of zoning which is policing power. This power refers to the allocation of a public good without any form of discriminatory bias or locational bias.

Starting with 'n' observations, a hierarchial grouping routine systematically reduces the 542 observations or groups to one observation or group. The reduction proceeds in this manner:

a) two n observations are located and combined if their mean value produces the least loss of the objective function;

b) the n-1 observations are then combined into $\frac{(N-1)(N-2)}{2}$ unions and evaluated to see if there is a third member which can join the first pair with another minimum loss of the objective function (Ward, 1963, p. 238); and

c) as each n-1 group is formed the sum of square deviations about the mean on the sum of square error is increased.

The computer routine providing combinations utilized Euclidean distance as a measure of similarity in one and two dimensional space. The program calculates a distance matrix from one observation to all other observations on the one or two dimensional orthogonal scales. Groups are formed when two observations are separated by a minimum distance and a mean center distance is calculated for the new group.

The use of grouping algorithmns in geography invariably centers around the work of Berry, who used this technique to classify urban centers (1960), and later to define economic regions (1967). King (1962), Spence and Taylor (1970) have all used this type of grouping algorithmns in their research.

One major problem with the hierarchial grouping algorithmn is knowing where to stop the groupings. One has a choice anywhere in the range defined by the parameters n-1 to n-(n-1) groups. According to King (1969, p. 199) there is "not an analytical solution for the problem of deciding how many groups are to be identified, although the step at which the ratio of the increment in the pooled within sums of squares to the total is at a minimum is suggested . . . ." Berry (1967, pp. 77-106) states that "it is possible to select the level deemed most desirable for the particular problem . . . ."

Results of Data Grouping

In the routine used the number of observations increases arithmetically while the number of searches to find a new group increases exponentially. The formula for the number of searches is:

$$N = (n-1)(n)(n+1)/6$$

where n = number of observations and N = number of searches.

If n = 2 then N = 1; however if n = 85 then N soon becomes 100,000. For 400 observations, N = 10,660,000 searches. Therefore with 542 observations there was a need to reduce the number of observations and the resulting searches because of limited computer storage. The most expeditious way was to take the first one hundred or so observations or land uses and thus do the entire operation in five steps.

The total number of observations for each of the five initial groups is presented in Table 4. For group one, the algorithmn defined five subgroups. At five subgroups the error was 0.5586, an increase of 0.2163 from six subgroups or a 38 percent increase in error. The criteria for defining the final groups was operationally defined as:

a) the total increase in error should be less than one-half a standard error unit; and

b) the percent increase of error from grouping was set at less than 50 percent and closer to 33 percent of the total error arising from the grouping.

From Table 4 one can observe that in all cases except Group 2 the overall error is less than one half a unit and the incremental

Table 4

Initial Land Use Groups: Percent Increase of Error

Group	Total Number in Group	Number of Subgroups	Error	Error Increase	Percent Increase of Error
1	103	5	.5586	.2163	38.7
2	105	9	.3384	.2575	76.0
3	100	6	.4130	.1548	37.4
4	116	8	.3231	.1172	36.2
5	118	7	.4526	.0038	00.8

Source: Calculated by author.

increase is around 35 percent overall. Nine subgroups were selected as the optimum for Group 2 because the overall error remained less than one-half a standard error unit in spite of the percent increase of error exceeding the criteria referred to above.

Once the 35 subgroups were identified, the subgroup means were calculated. Table 4 lists these means along with the number of land use points in each subgroup. The mean land uses or mean factor scores were rank ordered and then combined into eleven groups on the basis of minimizing the mean differences. The reduction from thirty-five groups to eleven groups was done to lessen computer storage and costs arising from the next stage of the regionalization scheme. Table 5 indicates the subgroup composition, number in the group and the mean range. For example, group one from Table 6 is composed of three groups formed during the hierarchial grouping illustrated in Table 5. Group 1 is composed of the first two subgroups of H-group 5 and the second subgroup from H-group 4. The total number of observations from these three groups is eight and the mean land uses are found within the range of +2.7 to 3.7. The thirty-five groups from Tables 3 and 4 were combined into eleven groups on the basis of a minimization of the range of mean land use factor scores. In all cases with the exception of the first group, the range of means was less than one-fifth a standard unit; thus indicating a clustering of land use subgroups.

Once the eleven groups were defined, a procedure was needed to test the validity of each group's membership. Classifying on the basis of mean land values is permitted if the distribution is normally distributed about a group mean. However, all of the observations

Table 5

Mean Land Value Factor Scores for Subgroups

Group	Subgroup	Mean Land Value	Number in Group	Total
1	1	+0.72	13	
	2	-1.01	29	
	3	-0.52	29	
	4	+1.31	13	
	5	-0.01	19	
				103
2	1	-0.18	1	
	2	-0.12	1	
	3	-0.13	6	
	4	+1.32	19	
	5	+0.26	8	
	6	-0.57	19	
	7	-1.00	27	
	8	+0.96	11	
	9	+0.59	13	
				105
3	1	+0.47	1	
	2	+0.76	15	
	3	+0.07	16	
	4	-0.43	20	
	5	-0.91	32	
	6	+1.33	16	
				100
4	1	+1.38	1	
	2	+2.70	3	
	3	+1.30	11	
	4	+0.87	11	
	5	+0.62	12	
	6	-1.01	36	
	7	-0.52	23	
	8	-0.25	19	
				116
5	1	+3.70	3	
	2	+2.79	2	
	3	+0.90	15	
	4	+0.24	14	
	5	-0.95	32	
	6	-0.42	27	
	7	+1.25	25	
				118

Source: Calculated by author.

Table 6

Revised Land Use Groups Based on Difference of Means

Group	Total Number in New Group	Initial Group	Initial Subgroup	Range of Mean Land Value (Low-High)
1	8	5	1	
		5	2	+2.70 to 3.70
		4	2	
2	85	3	6	
		4	1	1.25 to +1.38
		2	4	
		4	3	
		1	4	
3	37	2	8	
		4	4	+0.87 to +0.96
4	28	3	2	
		1	1	+0.72 to +0.76
5	26	4	5	
		2	9	
		3	1	+0.47 to +0.62
6	22	2	5	
		5	4	+0.24 to +0.263
7	35	1	5	
		3	3	-0.01 to +0.07
8	27	2	1	
		2	2	-0.25 to -0.12
		2	3	
		4	8	
9[a]	47	5	6	
		3	4	-0.43 to -0.42
10	71	1	3	
		4	7	
		2	6	-0.56 to -0.52
11	156	3	5	
		5	5	
		2	7	-1.01 to -0.91
		4	6	
		1	2	

Source: Calculated by author.

[a]Latter in the analysis Group 9 was combined with Group 10. Thus the total number groups became 10.

were not normally distributed around the group mean; thus a classification on the basis of means was not used. What was needed was a procedure to compare group membership and reclassify observations into new groups if the need arises.

Maximization of Group Similarity

Hierarchial grouping does not give the probability of misclassification. Thus the homogeneity of each of the eleven land use groups was not maximized. In order to optimize the homogeneity of the eleven land use groups, a discriminant procedure was performed. The basic purpose of the discrimination was twofold: to assess if any of the land use parcels should be reassigned to one of the other ten groups; and to determine if that reassignment would make both the losing and gaining group more homogenous. The hierarchial grouping algorithmn used in the preceding stage of the regionalization minimized the distance from one observation to another. The minimization occurred even if one observation was actually composed of a group of observations. Statistically speaking it is possible that a new observation could be assigned to a group of observations on the basis of a minimization of distance to the group's centroid and yet not be at a minimal distance to all other members of the group. When a situation of this nature occurs, intra-group variability is not maximized. It may even be maximized if the observation in question is reclassified in another group. Discriminant analysis provides a statistical method for determining the optimal group for an observation. Optimality in this case is defined as minimizing within-class variability and maximizing between-class variability.

In both the hierarchial grouping and in the discriminant analysis the Euclidean distance formula is used. In two dimensional space for any pair of points the formula becomes:

$$d_{pq} = \sqrt{(X_p-X_q)(Y_p-Y_q)}$$

where X_p and Y_p are coordinates of variable P and X_q and Y_q are coordinates of variable q and d equals the distance between the variables.

Within the context of this research that is an univariate case so the formula becomes:

$$d_{pq} = \sqrt{(X_p-X_q)}$$

The discussion of grouping methods that measures the difference between a grouping algorithmn minimizing observation distance and a discriminant function that minimizes between class variability can now be placed within the context of this research. Land uses are first classified or grouped into many specifically defined groups of uses on the basis of a minimization of the distance between two or more factor scores. However, zoning unlike land uses cannot be defined for a small and specific number of land uses. That is, a particular zoning classification should represent the largest possible number of similarly defined land use parcels. Discriminant analysis performs this broad type classification as it classifies observations into distinct groups. In zoning the specific regulation of individual parcels is left to the governmental bodies to decide. The state of Michigan enabling legislation merely prescribes guidelines for the granting of variances and special use permits. The ultimate decision rests with the local decision makers and not with the urban or regional planner.

Within geographic research, discriminant analysis is commonly used as an optimality check for a regional grouping algorithmn (King, 1967, pp. 336-378). In his study of multifactor uniform census divisions of the United States, Berry employed discriminant analysis to verify within group membership (1961, pp. 263-282). Casetti has done extensive work on linear discriminant functions and iterations (1964a, 1964b).

If a matrix of 's' groups is designated by the symbol A_s and if D is a discriminant procedure, to obtain a classification, then $DA_1 = A_2$, $DA_2 = D(DA_1) = A_3$ . . . (King, 1969, p. 213). With the addition of each new observation, a new iteration is produced with increased intra-group variability. As suggested by King (1970, pp. 373-376) discriminant analysis has a number of varied applications such as:

a) devising an economic development plan for developing countries;

b) delimiting trade areas around market centers;

c) allocating travel mode within the urban area;

d) defining areas of similar residential behavior;

e) identifying areas of a country in need of governmental assistance; and

f) regionalizing an area in order to minimize the costs of misclassification in the allocation of government services.

The use of discriminant analysis in this research most closely parallels the minimization of cost of service type of discriminant application.

Results of Group Maximization

The first stage of this discriminant analysis was applied to land use subgroups of the eleven major groups defined in Table 6 in order to gain insight into their between group variation. Applied in this manner the overall goal of the discriminant function is to demonstrate a relatively small between subgroup variation along with a relatively large within subgroup variation. Thus the F statistic of the discriminant function, the ratio of between variation divided by within variation is low if the subgroups are relatively homogenous. In addition, the number of observations changing subgroup membership should be high if there is low between subgroup variation. Table 6 indicates the results of the first discrimination. The last column of the table indicates the relative stability or the percent mis-classified of the subgroup membership. A high value for this value shows that the classes are exclusive with little if any transfers between groups.

As evident from Table 7 groups 1 through 4 are far less homogenous than groups 5 and 6. One reason for less homogeneity particularly in groups 1 and 2 is the large within subgroup variance. Land use factor scores as high as 3.8 are found in group 1. The overall distribution of land use factor scores for all of the groups is negatively skewed with a disproportionate number of positive land values. For groups 5 and 6 lower F ratios and lower stability values are also found.

The second and third discriminant analyses were conducted for the opposite purpose. During these analyses the goal was to maximize

Table 7

Grouping Results of the Discriminant Analysis of Sampled Land Uses

Discrimination Group	Groups From Table 6	Sums Sq. Within	Degrees Freedom (n-k-1)	Sums Sq. Between	Degrees Freedom (k-1)	F-ratio	Stability Index (Percent of Original Subgroup Classified in Same Group at End of 4th Iteration)
1st							
1	1 & 2	1	83	18.08	9	181.8*	1- 50% 2-100% 3- 0% 4- 4% 5- 40% 6-100% 7- 58% 8- 5% 9- 15%
2	3 & 4	1	60	0.78	4	19.1*	1- 42% 2- 45% 3- 33% 4- 38%
3	5 & 6	1	64	1.38	5	18.4*	1- 13% 2- 73% 3-100% 4- 54% 5- 40%
4	7 & 8	1	50	99.44	6	825.0*	1- 53% 2- 25% 3- 50% 4-33% 5-100% 6-100%
5	9	1	77	0.96	4	2.0	1- 25% 2- 50% 3- 32% 4- 36%
6	10	1	150	0.06	5	2.0	1- 30% 2- 2% 3- 2% 4- 22% 5- 34%
2nd							
1	1 - 9	1	532	1.77	9	197.0	1- 90% 2-100% 3- 89% 4- 87% 5- 97% 6- 87% 7- 81% 8- 73% 9-100%
3rd							
1	1 -10	1	531	2.02	10	200.0	1-100% 2- 97% 3- 82% 4-100% 5- 95% 6- 87% 7- 90% 8- 81% 9-100% 10-100%

Source: Calculated by author.

*Significant at .001 level.

between subgroup variation while at the same time minimizing within group subgroup variation. The second and third analyses were conducted in the manner in which discriminant analysis is generally used. Thus a high F statistic and a high stability figure are needed. According to Table 7 the groupings are relatively heterogenous, particularly once those deviant observations were reassigned during the third discrimination.

Performing additional discriminations beyond the third analysis was not deemed necessary due to the exceptionally high F ratio. Also the high stability measure indicates that the observations were relatively fixed within each group, i.e. they were classified properly. Additional discriminations would only change the stability measures slightly. No matter how close the discrimination became, there would always be certain marginal observations which would shift membership to an adjacent group due to the standardization of the factor scores. Standardization tends to compress the overall variance of the land uses; consequently observations are closer to one another.

Definition of Accessibility Index

Now that the nodes of similar land uses have been defined, it is necessary to assess the situational potential of each of these nodes. Accessibility is one measure of a parcel's relative location. As used in this research accessibility is defined as:

> The reciprocal of the costs of moving people and goods between points in space . . . the lower the cost, the greater is the accessibility (Pendelton, 1963, p. 1).

The operational definition of accessibility utilized in this research relies upon two measures. The first is the proximity from a node of a certain land use to nodes of different land use. A land use node that is located within close proximity to areas of different land uses is a node that is centrally located. For example, a land use node that is located close to the CBD is more centrally located to a variety of different types of land uses than a node located close to the suburbs. The second measure comprising the accessibility index is travel time. Distance alone is not of utmost concern in an urban area if the time to travel that distance is excessive; travel time is more representative of the cost of movement. In the section that follows the procedure used to measure accessibility is discussed.

Construction of the Accessibility Index

The first step in the regionalization involves mapping. Since the land uses were initially measured around a specified area identified on the aerial photograph, it follows that the mapping should logically include this area. However, a change of scale occurred in going from the aerial photographs to the base map. The survey area of land uses on the aerial photograph involved two one-half inch vectors centered on the street intersection. The scale of the photograph was one inch equals 660 feet while the scale of the base map was one inch for every 1000 feet. Therefore, on the air photo the one-half inch vectors should be reduced to an amount proportional to the change in scale. If the change in scale equals 340 feet, then by a simple ratio the change in vector size should equal 1/2-X, where X equals change in vector. Therefore

$$\frac{1/2}{660} \times \frac{1/2-X}{1000-660} = 1/4$$

Thus the vector size on the base map equals 1/4 inch on either side of the sample point and the total size of the area is 1/2 inch by 1/2 inch. Around each of the 542 land use points a square with vectors of 1/4 inch was drawn. When two or more squares of identical land use types overlapped, the areas were combined.

In order to measure the proximity from one land use node to another, given ten different types, derived from the third discrimination (Table 7) it was assumed that the ten groupings represented a continuum of land uses.[1] Table 8 verifies a continuum of land use types from a predominantly commercial-vacant type in group 1 to a single family residential in group 10.

Based upon the concept of a land use continuum for urban areas, compatible and incompatible land use types are defined. A land use type was considered to be compatible to another type if the other type contained basically the same land uses. Table 9 presents a matrix of compatibility based upon the above definition. From Table 8 it is evident that land use group 10 is composed mainly of residential uses with only a limited amount of vacant land. On the other hand, land use group 2 is composed of commercial, vacant and industrial uses with a very limited amount of residential uses. Thus group 2 is not compatible with the predominant land uses found in group 10. In comparing the land use groups from Table 8, it becomes apparent that groups 1 through 4 comprise activities such as commercial, vacant,

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[1]For the purpose of increased accuracy in the specification of the land use types, the original four categories were expanded to six. Residential was subdivided into single and multiple and vacant-public was broken down into vacant and public.

Table 8

Percent Land Use Composition

Group	Single Family	Multiple Family	Commercial	Industrial	Vacant	Public
1	13.5	0.0	37.0	0.0	50.1	0.0
2	0.5	0.7	30.4	18.4	31.6	18.0
3	12.2	15.4	25.2	4.5	25.0	18.0
4	19.7	11.4	22.1	7.8	33.2	5.8
5	32.4	9.3	21.6	5.8	12.5	16.5
6	49.8	0.1	15.9	0.0	13.4	19.9
7	60.0	1.9	13.3	4.5	13.3	8.8
8	73.9	1.9	7.2	0.6	12.6	3.8
9	88.3	1.3	4.1	0.0	4.7	1.8
10	95.0	0.8	0.6	0.8	2.4	0.1

Source: Calculated by author.

Table 9

Matrix of Land Use Compatability

Land Use Group Number	1	2	3	4	5	6	7	8	9	10
1	C									
2	C	C								
3	C	C	C							
4	C	C	C	C						
5	I	I	C	C	C					
6	I	I	C	C	C	C				
7	I	I	I	I	C	C	C			
8	I	I	I	I	C	C	C	C		
9	I	I	I	I	I	I	C	C	C	
10	I	I	I	I	I	I	C	C	C	C

Source: Calculated by author.

C--Compatible
I--Incompatible

industrial and public uses on predominantly non-residential land uses. Groups 5 and 6 appear to be a transition land use types between residential and non-residential. These two groups are most unlike the four extremes of continuum, that is groups 1, 2, 9 and 10. Groups 7 through 10 then are predominantly single-family residential land use types.

Proximity between land use types on the base map is determined by drawing a radius of one-half mile around the midpoint of each land use node. It was assumed that within a radius of one-half mile in urban areas, land use would show some meaningful spatial variation if indeed it exists. Interestingly the central business district of Lansing can easily be circumscribed by a circle with a radius of approximately one-half mile. The proximity of different or incompatible land uses was tallied according to the following formula:

$P = T + 3D + C - S/10$

where T = total number of land use nodes within one-half mile circle;
D = number of uncomplementary land uses;
C = number of complementary land uses;
S = number of identical land uses;
P = proximity of the node to nodes of different land use type.

For example one land use node located approximately along North Grand River between Logan and Cedar Streets, had the highest proximity value in Lansing. In this situation $T = 11$, $3D = 30$, $C = 1$, $S = 0$ so $P = 4.2$. At the other extreme, a land use node located at the intersection of Aurelius Road and Interstate 96 had the following values: $T = 2$; $3D = 0$, $C = 2$, $S = 0$ so $P = 0.2$. As defined in this research the first land use node is located closer to nodes of different types than the second node which is relatively isolated from the various land use types.

In developing this model incompatible land uses are weighted by a factor of three because a land use node that is centrally located is one which is relatively close to different types of land uses. The actual value of three was arrived at by sampling approximately one-half of the land use nodes and counting the number of incompatible uses within the one-half mile radius. A little over one-third of the land uses were found to be incompatible so a reciprocal weighting of three was used. In addition this fifty percent sample indicated that the largest number of adjacent land use nodes was approximately equal to 10.

Dividing the proximity value by a constant of 10 is done for the ease of calculating. Thus a proximity value greater than 1.0 indicates a land use node with a relatively high degree of overall centrality. A value less than 1.0 indicates a lack of centrality in the location of the node. The total number of nodes (T) along with the number of compatible uses (C) was added to the proximity value in order that a node within close proximity to a small number of incompatible nodes would have a proximity value less than a node close to numerous compatible and incompatible uses. By adding T and C to the equation, a North Grand River node obtained a higher proximity value than a Aurelius Road node even though the latter had a larger C value than the former.

The second component of the accessibility measure is travel time. For this research five shopping and five employment nodes within Lansing are defined. The shopping nodes are the primary business district, a secondary business district in North Lansing and three major shopping centers, Frandor, Logan Center and Meijers of

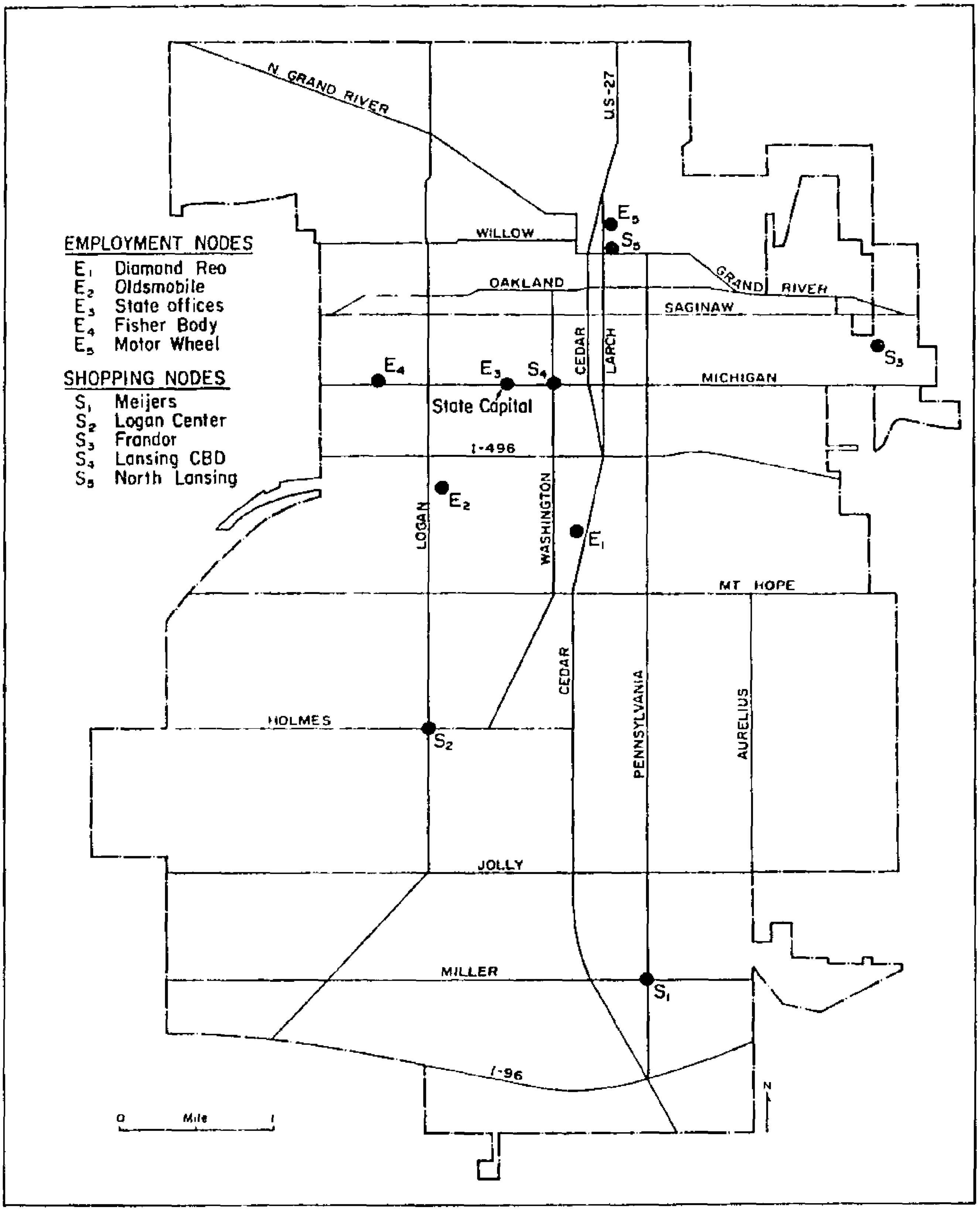

Figure 7 LANSING, MICHIGAN

Pennsylvania Avenue (Figure 7). The employment nodes are the State Capitol complexes and the four largest factories, Oldsmobile, Fisher Body, Motor Wheel and Diamond Reo. In choosing the shopping and employment nodes, care was taken to define only those nodes located within the legal boundary of the city.

Distance to each of the above ten nodes from a series of section midpoints and corners was calculated. The total number of such points was 71. For each section midpoint or corner the distance to each of the five shopping and employment centers was calculated. The employment and shopping distances were then summed and averaged respectively. The two averages were then summed and averaged thereby obtaining one value for each of the seventy-one points. That average distance was then converted to travel time by assuming that the average travel time within Lansing was approximately 15 miles per hour.[1]

The distribution of travel times is presented in Table 10. The overall range is from twelve minutes for locations close to the primary business district to fifty-four minutes for locations in the southern portions of the city. According to Table 10 and Figure 8 travel times less than one standard deviation unit below the mean value are generally found north of the CBD. Travel times greater than one

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[1]The same conversion was made in a recent traffic study conducted by the Planning Department for the City of Lansing. The reference for the report is City of Lansing, Michigan, Department of Planning, Trip Distribution Analysis 1970, City of Lansing, Michigan.

The author realizes that the use of the conversion provides a gross transformation of distance into the time needed to cover the distance. However by using the conversion, a measure of the gross costs of covering that distance in terms of the costs of movement is obtained. It is beyond the scope of this research to measure actual travel time from a sample of points within the study area.

Table 10

Travel Time to Major Lansing Nodes

Mean travel time for all sample points to Lansing nodes is

30 minutes

Variance 12 minutes

Standard Error 9 minutes

Number of Values	Range of Travel Times[a]
38	30 to 54 minutes
33	12 to 30 minutes
27	30 to 40 minutes
23	20 to 30 minutes
18	30 to 35 minutes
9	25 to 30 minutes

Source: Calculated by author.

[a]These ranges represent limits defined by the mean travel time plus twice the standard error. The next range is the mean time minus twice the standard error. The third range is the mean plus one standard error and the fifth range is the mean plus one-half standard error.

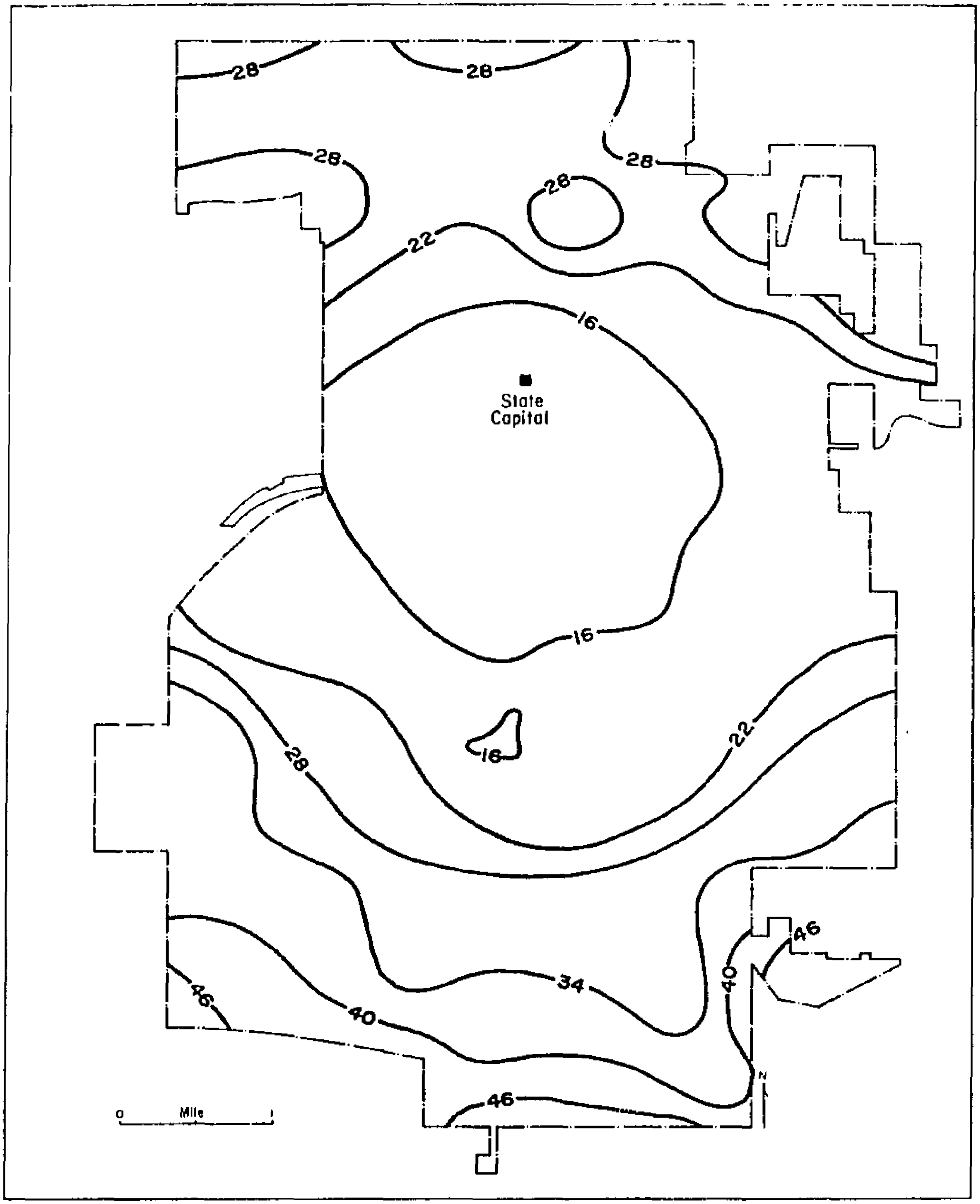

Figure 8 TRAVEL TIME TO SELECTED LANSING NODES

deviation unit above the mean are found in the southern portions of the city. It should be noted that these travel times represent the average time to travel to one of five shopping and employment nodes but not to any one in particular. The actual distribution of travel times along with the mean is given in Table 10.

The two measures of accessibility are combined into one index by the following formula:

$$\text{accessibility} = \frac{\text{proximity of land uses}}{\text{time distances}} \times 100.$$

The data value extremes for the accessibility index were 22.99 in the southern portions of the city to 1111.11 for a land use node north of the CBD along Cedar Street. These values along with the remaining 304 values were used an input into a computer mapping routine called SYMAP.[1] Given a sample number of data points along with their X-Y coordinates the mapping routine defines an initial search radius based upon the number and spread of the data points. A maximum search radius is extended to but not exceeding the location of the farthest data point. Using these two radii, the computer locates a minimum of four and a maximum of ten data points and with an average of seven points it interpolates the average value within the prescribed area. Three types of maps can then be drawn: a contour map, proximal map and a conformant map. In order to show the outline of the study area, a conformant map was requested. The user may specify categories for the data fed into the program. In this case

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[1]The SYMAP mapping routine is detailed in Technical Report 100 of the Computer Institute for Social Science Research, Michigan State University. The routine at Michigan State was originally adapted for use by C. Young with latter revisions by Donald Dugger and Robert Wittick of the Institute.

six categories were used and the number of data points were evenly divided among the categories. Six categories were mapped since there are six major zoning classifications used in Lansing: low density residential, high density residential, commercial, professional, light industry and heavy industry. In requesting that the observations be evenly divided into the six categories, it was assumed that accessibility is a continuum with all locations possessing a certain amount of accessibility. To put it another way, accessibility is a continuum since every location is accessible to some degree even if that place is classified as remote or inaccessible. The concept of accessibility as a continuum elaborated here is consistent with the earlier statements regarding the land use composition of the ten land use types.

The map produced by the SYMAP routine represents a situational approach to the delimitation of zoning districts. It depicts in a broad way six accessibility based zoning districts (Figure 9). The highest accessibility areas as expected are around the primary business district. Surrounding this area is a band of less intensive land use with a lower degree of accessibility and relatively low amounts of travel time. A few enclaves of lower values are found to the west (ghetto area west of capital), to the southwest (low income housing area south of Oldsmobile plant) and to the southeast (along Kalamazoo Street close to East Lansing). It is noted that a zone of relatively intensive commercial-industrial uses with high accessibility extends into North Lansing (near the Motor Wheel Factory) and also along North Grand River Avenue (Figure 10). A few isolated enclaves of the three most accessible commercial-industrial-

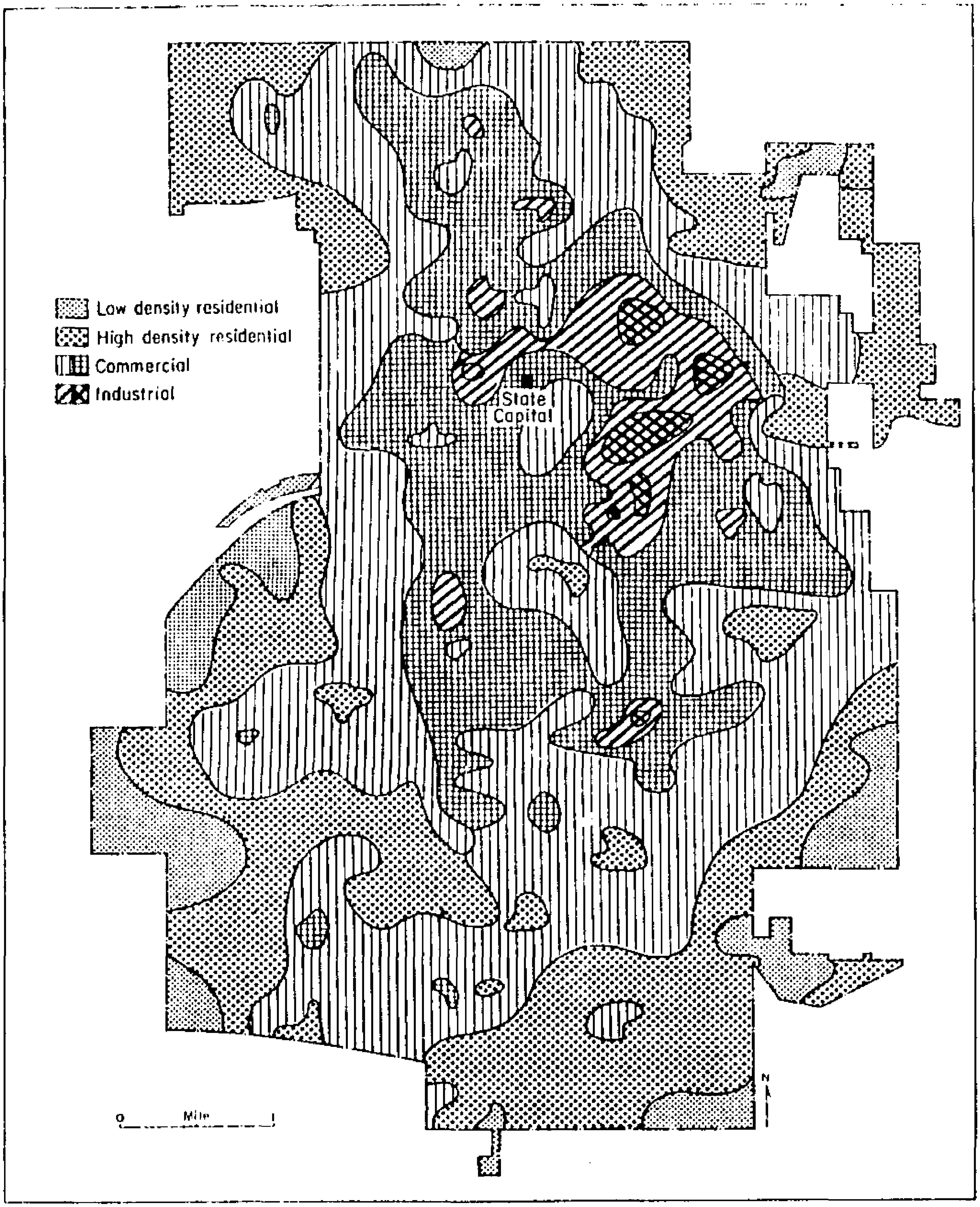

Figure 9 SITUATIONAL ZONING SCHEME

residential zones are found in south Lansing, particularly along Pennsylvania and Cedar Streets (Figure 10). The least accessible of land uses are generally found along the peripheral locations in the southern portions of Lansing. These less intensive areas represent zones of relatively high travel time and little if any land use differentiation. As a result these areas would tend to be the least likely locations for those activities requiring high amounts of accessibility. Likewise those areas with large variation in land use types and low travel times are likely locations for economic activities requiring such mixtures.

In the following section the new zoning-accessibility map of Lansing is compared with the existing zoning map.

TESTING OF THE HYPOTHESES

Introduction

As stated in the previous chapter, one of the primary goals of this research is to test the validity of regionalization scheme for an urban area. The basic tests of that validity revolve around the comparison of land value homogeneity. The central question then becomes--Is the variance of land values zoned according to the new regionalization scheme less than the land value variance existing under the current zoning plan?

Variance of land values is preferred over the mean since it tells about the spread of the distribution. A mean value may be sufficient if the subcategories contain a relatively equal number of observations and if the means are equal. However, when grouping occurs, as is the

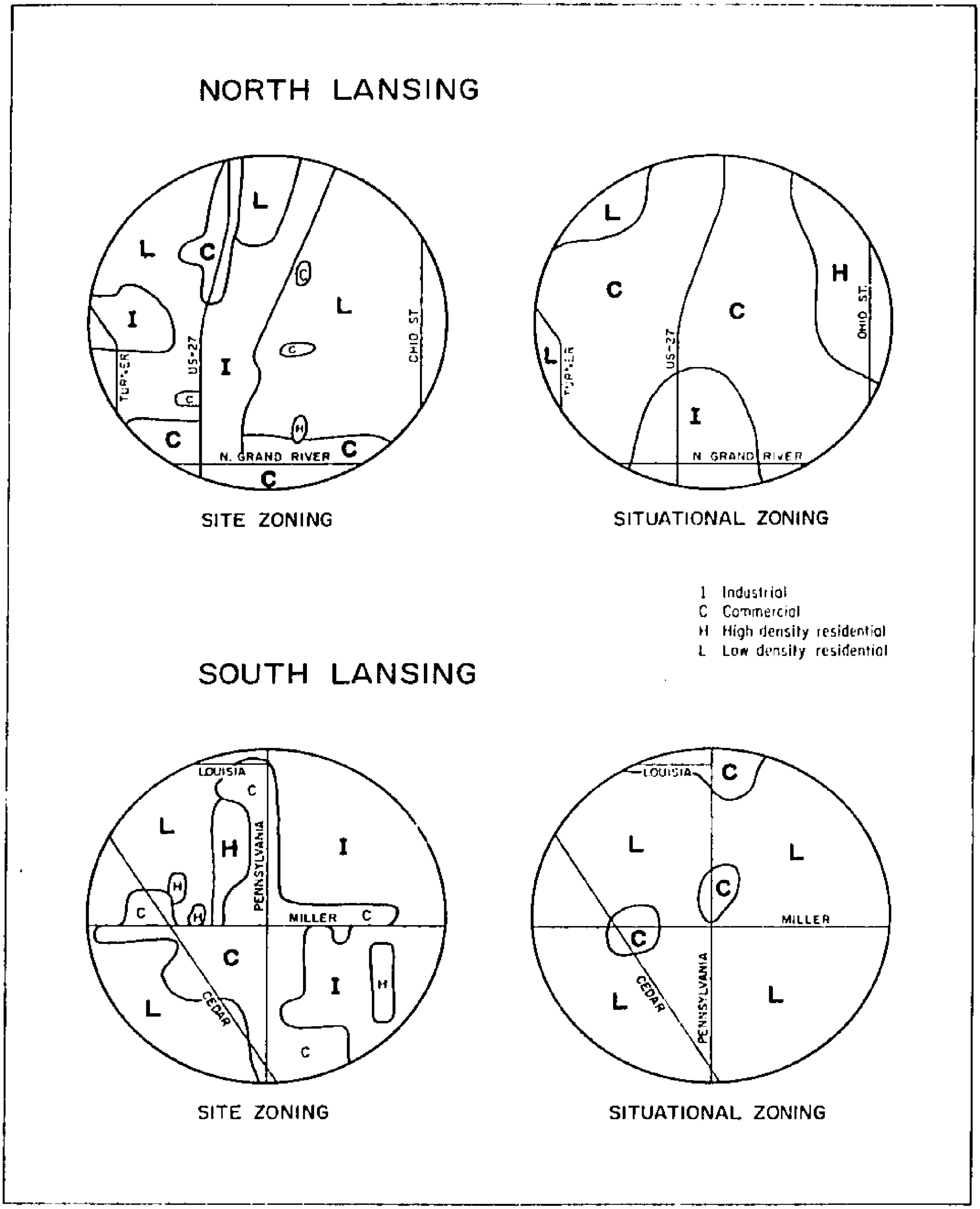

Figure 10 COMPARISON OF OLD AND NEW ZONING SCHEMES

case with this research, frequencies often vary. Therefore, a comparison of the mean differences may be misleading. For this reason the dispersion of land values was considered to be far more representative and less prone to misrepresentation due to unequal frequencies.

In the sections that follow each of the three stated hypotheses is analyzed by comparing the mean sum of squares (MS) which is the pooled sum of squared deviation from the mean. A ratio of two mean squares approximates an F-distribution governed by the respective degrees of freedoms (Mendenhall, 1968, p. 347). According to statistical methods, one degree of freedom is lost for every population parameter estimated. The sample variance of land values collected for Lansing is used as an estimate of the population variance.

Calculating an F-ratio first requires the formation of a null hypothesis (H_o). If the F-ratio exceeds a certain value (normally prescribed in a table of F-values), then the null hypothesis is accepted. The following null hypothesis is used throughout the following sections:

$$H_o = \sigma_a^2 < \sigma_b^2$$

where σ_a^2 represents the variance of land values under existing zoning and σ_b^2 is the variance of new zoning land values. If H_o is accepted then $MS_a/MS_b < 1.00$. Likewise if H_o is rejected, then the F-ratio is greater than 1.00 and MS_a/MS_b is greater than 1.00.

Mean squares are first calculated by deriving the pooled sums of squared deviation for each category. The following formula is used in the calculation of the pooled sums of squares:

$$\frac{(n_a-1)\sigma_a^2 + (n_b-1)\sigma_b^2 + (n_c-1)\sigma_c^2 \ . \ . \ . \ (n_z-1)\sigma_z^2}{n_a + n_b + n_c \ . \ . \ . \ n_z-Z}$$

where σ_a^2 is the sample variance of category a, n_a is the number of land values in category a and Z is the number of categories. Pooled variance actually is the average variance for each category. By pooling the variance a more representative estimate of the population variance is obtained. Also the degrees of freedom in a pooled estimate are larger than in each individual sample variance.

Results of Overall Comparison of Land Values and New Zoning

The mean, variance and number of land value parcels in the existing zoning and in the newly defined scheme are shown in Table 11.[1] Mean land value is provided but comparisons particularly in the first two zoning types should be approached with caution due to the unequal frequencies. For low density residential (LDR) the situational zoning increased the mean land value and the variance. Similar results occurred in high density residential and industrial zones. Only in commercial zones does the new zoning produce less land value

[1]In Chapter Three it was assumed that the area of highest accessibility on the new zoning map would be the commercial district. After comparing the results of the land value mixtures in the site and situational zoning (Tables 12, 14 and 16), it is apparent that on the average the commercial and industrial districts in both site and situational zoning schemes contain a relatively equal number of parcels on the average. If the assumption made in Chapter Three was maintained, then the similarity of numbers would not exist. Therefore the results advanced in this chapter are based on the assumption that industrial areas require the highest amount of overall accessibility. Commercial areas require the next highest amounts of accessibility and then residential areas. Since a large portion of the industrial land in Lansing is located within close proximity to railroads, interstates and major arterials, then this assumption appears valid.

variation (Table 11). However, the F-ratio for commercial and high density residential zones indicates that the new scheme produces less land value heterogeneity than the existing zoning (Table 12). These results are not unexpected, particularly for high density residential areas which appear to have expanded at the expense of low density residential areas in North Lansing (Figure 10). However, such a generalized comparison may overlook other possible trends or relationships. A more specific model is needed to ferret out such trends if they exist.

Results of Ring Model of Land Value Aggregation

In order to get a better fit of the situational model, seven concentric rings were defined at one-half mile radi centering on the State Capital complex (Figure 11). Land values are classified into one or another ring and then a comparison of land value homogeneity is undertaken. Again it was the purpose of aggregating land values into rings to assess if there is a stronger relationship between land values in the new zoning scheme or in the existing one.

The results of the concentric aggregation are given in Table 13. As expected commercial and industrial zoning account for a large number of the land parcels within the first two rings. In ring one the commercial and industrial variance under both the new and old zoning type is larger than in any other ring. This high variance indicates a large range of land values in the primary business district. The business district in Lansing is composed of governmental offices to the west of the primary CBD. To the south of this complex and at approximately one mile lie industrial areas. As

Table 11

Comparison of Land Values: Overall

	Site Zoning			Situational Zoning		
	Number	Mean	Variance	Number	Mean	Variance
Low Density Residential (LDR)	385	$0.41	$0.11	156	$0.62	$0.50
High Density Residential (HDR)	14	1.13	0.27	232	0.74	0.85
Commercial (COM)	137	2.10	9.92	159	0.82	1.89
Industrial IND	66	1.30	1.68	55	1.94	18.54

Source: Calculated by author.

Table 12

Mean Squares of Land Values for Zoning Schemes: Overall

Zone Type	Pooled Variance[a]		Pooled Number[b]		Mean Square[c]	
	Site	Situational	Site	Situational	Site	Situational
LDR	.110	.501	385	156	.0002	.0030
HDR	.270	.850	14	232	.0201	.0036*
COM	9.920	1.890	137	159	.0729	.0119
IND	1.680	18.580	66	55	.0258	.3440

Source: Calculated by author.

*Significant at .001 level.

[a]The pooled variance is defined in the text and is designated by S^2.

[b]The pooled number (P) equals the total minus number of estimators.

[c]The mean square equals $S^2/P-1$.

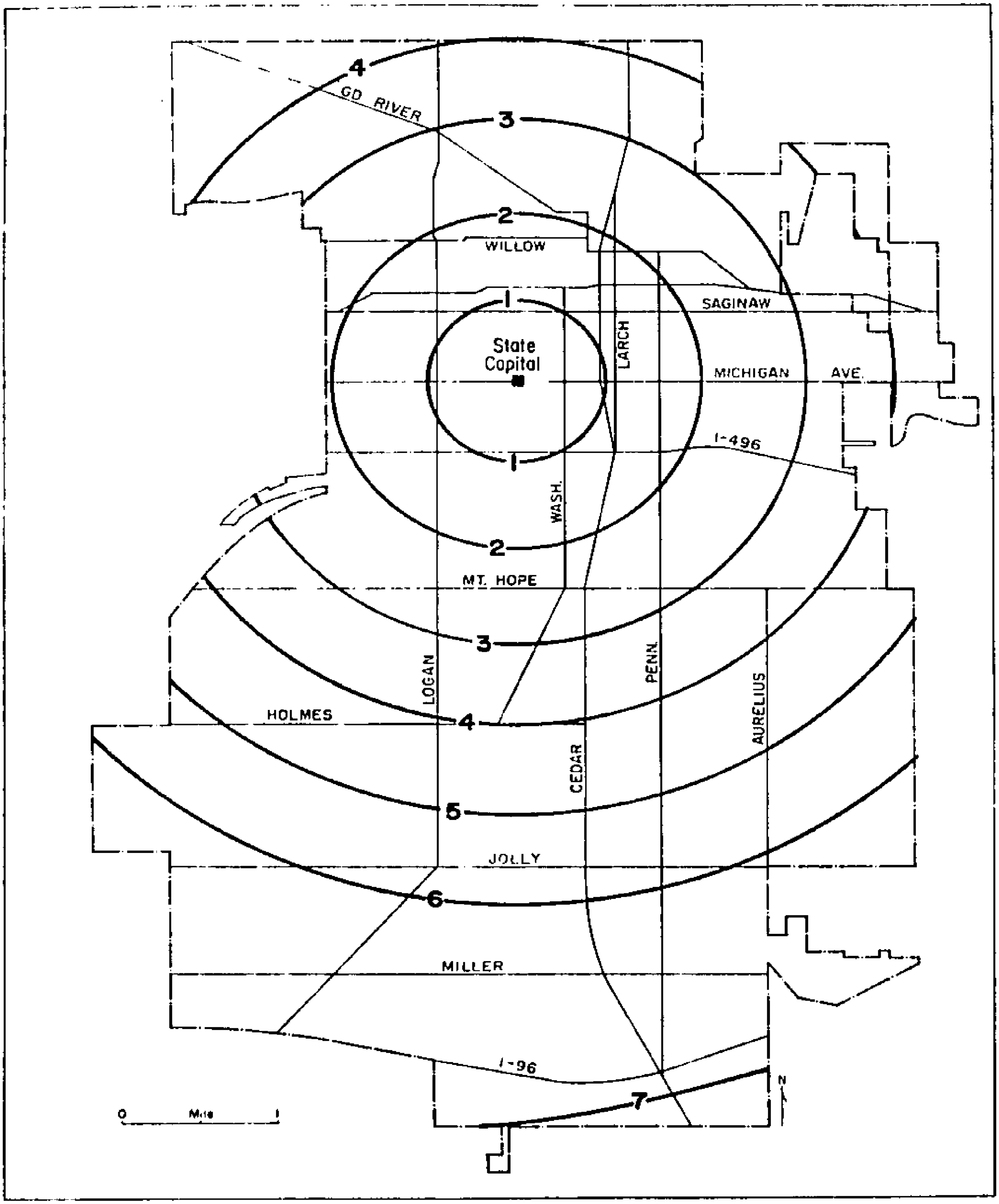

Figure 11 CONCENTRIC RINGS

Table 13

Comparison of Land Values: Concentric Rings

Concentric Ring	Zoning Type	Site Zoning		Situational Zoning	
		Number	Variance	Number	Variance
1	LDR	1	0.00	2	1.30
	HDR	2	0.00	6	8.45
	COM	14	48.34	4	32.00
	IND	10	0.15	15	50.47
2	LDR	41	0.04	4	0.08
	HDR	4	0.15	27	0.89
	COM	23	1.01	42	0.58
	IND	13	0.65	8	0.09
3	LDR	86	0.14	17	0.55
	HDR	1	0.00	44	0.39
	COM	26	0.32	44	.46
	IND	20	4.08	28	2.46
4	LDR	93	0.19	43	0.91
	HDR	0	0.00	52	0.95
	COM	36	1.40	43	0.86
	IND	13	1.12	4	0.08
5	LDR	89	0.08	36	0.39
	HDR	3	0.33	50	0.22
	COM	16	0.32	23	0.07
	IND	1	0.00	0	0.00
6	LDR	37	0.04	29	0.15
	HDR	4	0.25	21	0.13
	COM	6	0.07	3	0.02
	IND	6	0.00	0	0.00
7	LDR	46	0.05	25	0.08
	HDR	0	0.00	30	0.09
	COM	8	0.11	2	0.00
	IND	3	0.06	0	0.00

Source: Calculated by author.

distance increases from the primary node, land value variance in the low density residential zones tends to increase at first (rings 3 and 4) and then gradually it declines (rings 5, 6 and 7). This trend is evident in both types of zoning.

In comparing the number of parcels by zoning type in each ring, it becomes apparent that the situational zoning increases the areal spread of high density residential areas. That is there is more high density residential land uses than expected from the actual land use. The increase occurs at the expense of the lower density residential areas. The same trend was evident in the preceding section which analyzed the overall effect before the data were disaggregated.

According to Table 14 the ratio of mean squares for the low density residential and industrial zones is not of sufficient size to reject the null hypothesis. Therefore the differences are not great between site and situational zoning as defined by the concentric ring analysis. However the same is not true for high density residential and commercial areas. The high F ratio in the latter situations indicates that the accessibility regionalization has in effect decreased the land value mixture. When the results of the ring analysis are compared with the results of the overall model it becomes evident that the strength of the F ratio increases as the land values are disaggregated, particularly for the high density residential and commercial areas.

Results of the Sectoral Model of Land Value Aggregation

The ring model of land value aggregation was unable to account for the increased variation of land values for industrial and low

Table 14

Mean Squares of Land Values for Zoning Schemes: Concentric Rings

Zone Type	Pooled Variance[a]		Pooled Number[b]		Mean Square[c]	
	Site	Situational	Site	Situational	Site	Situational
LDR	0.108	0.458	386	149	0.0002	0.0039
HDR	0.326	0.658	8	223	0.0461	0.0029*
COM	5.834	1.154	122	154	0.0479	0.0075*
IND	1.710	15.222	59	51	0.0280	0.2980

Source: Calculated by author.

*Significant at .01 level.

[a]The pooled variance is defined in the text and is designated by S^2.

[b]The pooled number (P) equals the total minus number of estimators.

[c]The mean square equals $S^2/P-1$.

density residential. Sectors or corridors are constructed around six of the major arterials in Lansing. The following streets were chosen: Grand River, East Saginaw, Oakland, Cedar Street, Pennsylvania Avenue and Logan Road (south of Saginaw). A corridor was operationally defined 500 feet either side of one of these major arterials (Figure 12). This distance would incorporate almost all abutting or adjacent blocks boarding the arterial. In only one instance, at Saginaw and Oakland near the Frandor Shopping Center did the 500 foot spread overlap.

The analysis of land value mixtures in the sectoral model was conducted at two different levels of aggregation. Level one was composed of all the arterials grouped into one sector (N = 1) plus nine non-arterial sectors (Figure 12). Level two divided the above arterial sector into its six components and then analyzed the arterials with the non-arterial sectors (N = 15).

The results of the sectoral aggregation are indicated in Table 15. For example, sector one, a non-arterial sector, the situational zoning scheme decreased the number of low density residential parcels and increased their variance. A similar decrease in numbers in the situational zoning is also evident in the high density residential and commercial zones although in these areas the new zoning reduces the variance of land values. Notice how in all sectors the total number of parcels per sector remains the same.

The ratios of the mean squares for high density residential zones and for industrial zones is of sufficient strength to warrant a rejection of the null hypothesis (Table 16). However, the null hypothesis is accepted for low density residential and commercial areas.

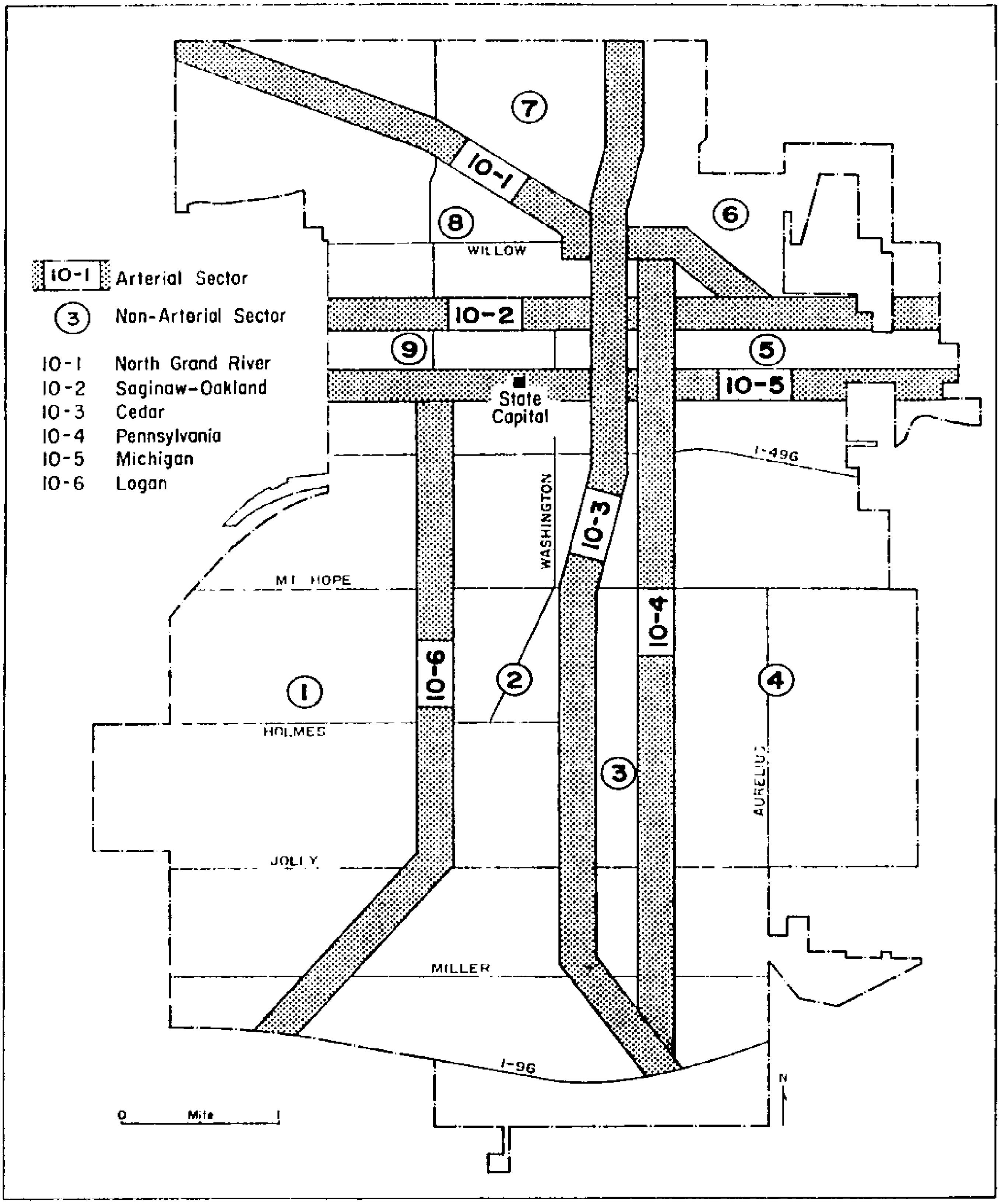

Figure 12 MAJOR ARTERIAL CORRIDORS

Table 15

Comparison of Land Values: Sectors

Sector	Zoning Type	Site Zoning		Situational Zoning	
		Number	Variance	Number	Variance
1	LDR	66	0.04	39	0.45
	HDR	4	0.37	32	0.11
	COM	16	0.79	19	0.51
	IND	5	0.01	1	0.00
2	LDR	58	0.03	18	0.10
	HDR	1	0.00	35	0.22
	COM	17	0.25	19	0.17
	IND	6	9.20	10	6.03
3	LDR	11	0.12	4	0.07
	HDR	0	0.00	6	0.18
	COM	3	0.42	1	0.00
	IND	0	0.00	3	0.38
4	LDR	52	0.14	17	0.37
	HDR	1	0.00	29	1.00
	COM	9	7.65	19	0.17
	IND	5	2.43	2	25.68
5	LDR	7	0.00	3	0.00
	HDR	1	0.00	3	0.34
	COM	1	0.00	1	0.00
	IND	1	0.00	3	0.07
6	LDR	7	0.00	5	0.00
	HDR	0	0.00	2	0.00
	COM	0	0.00	0	0.00
	IND	0	0.00	0	0.00
7	LDR	21	0.02	11	0.07
	HDR	0	0.00	16	0.25
	COM	6	0.22	5	0.02
	IND	5	0.01	0	0.00
8	LDR	29	0.04	9	0.21
	HDR	2	0.06	15	0.04
	COM	7	0.42	21	0.49
	IND	7	0.30	0	0.00

Table 15

Continued

Sector	Zoning Type	Site Zoning		Situational Zoning	
		Number	Variance	Number	Variance
8	LDR	9	0.01	1	0.00
	HDR	0	0.00	3	0.05
	COM	1	0.00	9	1.35
	IND	3	0.06	0	0.00
10-1	LDR	28	0.79	18	1.78
	HDR	1	0.00	20	0.36
	COM	8	1.60	8	201.89
	IND	10	167.31	1	0.00
10-2	LDR	13	0.05	1	0.00
	HDR	0	0.00	5	0.92
	COM	3	52.63	7	0.49
	IND	4	0.02	7	36.17
10-3	LDR	39	0.13	17	0.35
	HDR	1	0.00	24	0.40
	COM	19	36.16	12	16.06
	IND	4	1.62	10	56.36
10-4	LDR	23	0.06	2	0.01
	HDR	0	0.00	9	0.22
	COM	14	1.19	19	1.11
	IND	6	0.02	13	0.14
10-5	LDR	5	0.01	5	1.03
	HDR	3	0.27	11	5.45
	COM	10	3.93	1	0.00
	IND	4	0.11	5	0.37
10-6	LDR	32	0.09	3	0.00
	HDR	0	0.00	23	0.13
	COM	8	0.70	20	0.70
	IND	6	1.06	0	0.00
11*	LDR	140	0.27	46	1.08
	HDR	5	0.24	92	1.50
	COM	62	17.25	67	30.15
	IND	34	52.57	36	24.14

Source: Calculated by author.

*Represents the aggregation of groups 10-1 to 10-6.

In high density residential and industrial areas the aggregation of land values into sectors appears to have increased the strength of the hypothesized relationship.

In utilizing the fifteen districts in the sector analysis, there is a decrease in the homogeneity of land uses as evident in F ratio (Table 16). However, the net change to sectors from rings is not of sufficient size to result in any explanation for the low density residential even though all others are accounted for by the model. It is possible, however, to state that the sectoral aggregation appears to have fulfilled its basic function by accounting for increased variation in the high density residential zones.

Identification of Locational Conflicts

Within the context of this chapter, a high ratio of mean squares indicates locations where the accessibility derived zoning is needed because of the obviously high mixture of land values in the area. That is, in these areas land use conflicts arise from spillovers, be they positive or negative. In these locations the existing zoning scheme hinders the formation of land value homogeneity with accompanying similarity in economic functions. As evident from the above Tables 12, 14 and 16, by deriving a zoning plan on the basis of situational characteristics, land value homogeneity is increased and similarity in economic function is encouraged in certain types of districts especially commercial and high density residential. On the other hand, those locations which have an exceptionally high mean square ratio represent areas of potential land use conflict between drastically different land values. The exact location of the conflict

Table 16

Mean Squares of Land Values for Zoning Schemes: Sectors

Zone Type	Pooled Variance[a]		Pooled Number[b]		Mean Square[c]	
	Site	Situational	Site	Situational	Site	Situational
LDR (a) 10	0.133	0.554	386	137	0.00033	0.0040
(b) 15	0.105	0.471	391	143	0.00073	0.0032
HDR (a) 10	0.438	0.832	6	218	0.0872	0.0038*
(b) 15	0.255	0.554	8	223	0.0363	0.0024*
COM (a) 10	10.030	15.70	108	129	0.0928	0.1226
(b) 15	8.37	12.40	113	134	0.0740	0.0932
IND (a) 10	32.48	20.13	53	46	0.6246	0.4473*
(b) 15	26.42	16.50	58	49	0.4635	0.3437*

Source: Calculated by author.

*Significant difference at the .01 level.

[a]The pooled variance is defined in the text and is designated by S^2.

[b]The pooled number (P) equals the total minus number of estimators.

[c]The mean square equals $S^2/P-1$.

Table 17

Mean Squares Within the Concentric Rings by Zone Type

Ring	Pooled Variance		Number		Mean Square	
	Site	Situational	Site	Situational	Site	Situational
1	27.381	36.780	23	23	1.210	1.590
2	0.415	0.590	80	80	0.005	0.007
3	0.755	0.838	129	129	0.005	0.006
4	0.574	0.366	138	138	0.004	0.002*
5	0.119	0.245	105	105	0.001	0.002
6	0.510	0.139	49	49	0.001	0.002
7	0.059	0.085	53	53	0.001	0.001

Source: Calculated by author.

*Significant at .001 level.

Table 18

Mean Squares Within Sectors by Zone Type

Sector	Pooled Variance		Number		Mean Square	
	Site	Situational	Site	Situational	Site	Situational
1	0.179	0.146	88	88	0.002	0.001*
2	0.662	0.831	78	78	0.008	0.100
3	0.170	0.182	12	10	0.015	0.202
4	1.239	0.992	63	63	0.019	0.016*
5	0.010	0.136	6	6	0.002	0.027
6	0.000	0.000	6	5	0.000	0.000
7	0.055	0.161	28	28	0.002	0.005
8	0.134	0.216	41	42	0.003	0.005
9	0.012	1.090	10	10	0.001	0.109
10-1	35.778	33.726	43	43	0.851	0.803
10-2	6.198	13.978	17	16	0.387	0.931
10-3	11.197	11.840	59	59	0.192	0.204
10-4	0.422	0.601	40	39	0.101	0.015
10-5	2.015	3.334	48	48	0.118	0.196
10-6	0.302	0.375	43	43	0.007	0.008

Source: Calculated by author.

*Significant at .001 level.

parcels cannot be discerned given the nature of the data aggregation. Future research on a finer scale and additional data on changes in land uses is needed to pinpoint the exact location of the conflict.

From Table 17 it is apparent that in only ring four do areas of potential land use conflicts exist. Ring four encompasses a few areas of mixed and competing land uses such as: South Washington Avenue between Mt. Hope and Holmes Roads and the portion of U. S. Route 27 north of Motor Wheel and south of Sheridan Road (Figure 13). In both areas examples of light and heavy industrial zoning along with high and low density residential zones are within close proximity. As indicated previously the existing zoning regulations in these areas are hindering the economic viability of the area as a whole by not recognizing completely the accessibility requirements and limitations of the area's commercial, industrial and residential properties. One final point concerning the ratios indicated on Table 17 needs to be made. The heterogeneity of land values tends to decrease as distance increases for both types of zoning methods as expected from the Burgess model. Such a trend indicates that as distance to the CBD decreases, the diversity of economic functions increases which in turn contributes to a wider range of land values.

The sectoral model indicates three areas where potential land conflict exists (Table 18). The first area is on Logan Road west of Cedar and south of the CBD (Figure 13). Some heavy manufacturing along with single family residential areas and commercial establishments are found in this area. In fact a large portion of the southern half of ring four is found within this rectangle thus reinforcing the results of the ring model.

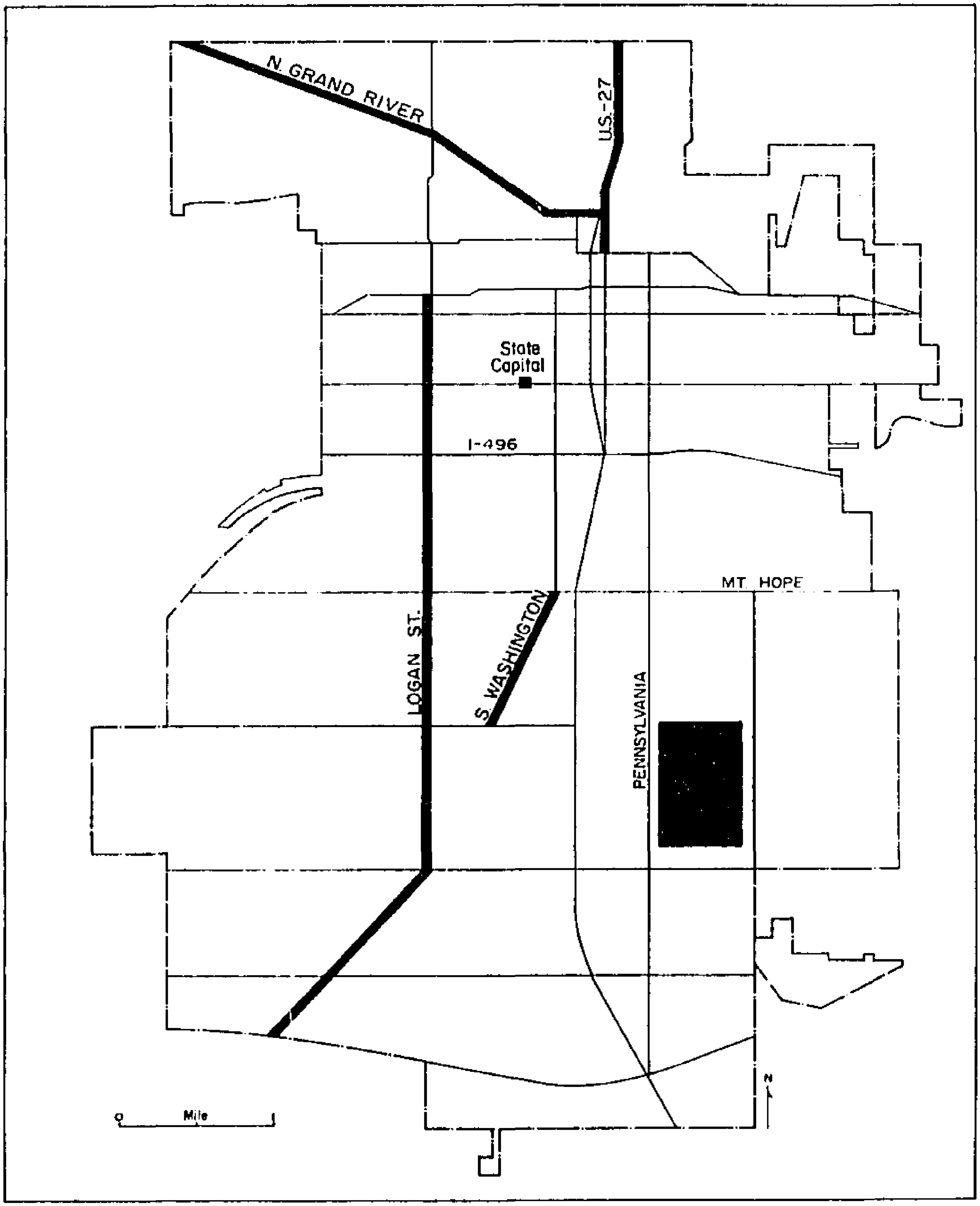

Figure 13 LOCATION OF POTENTIAL LAND USE CONFLICTS

The second area of potential conflict is located east of Pennsylvania Avenue and to the west and south of I-496. To a large extent, this sector has the lowest population density in all of the study area. An extensive portion of the total vacant land in Lansing is located here in this area. That this section may endure future land use conflict is not at all surprising. Presently the area has both relatively low and high density residential land uses but along with some light manufacturing and commercial establishments, particularly in Midway Center and in the southern portion near the intersection of Cedar and I-96.

The last area to be singled out in the determination of likely locations of conflict is the Grand River corridor, west of U. S. 27. Grand River approximately bisects the northern portion of the study area from the northwest to the southeast, and it contains almost all types of zoning classifications found in Lansing. In the east, high density residential apartments are found; in the middle portions, commercial activities predominate, while east of the Logan Road area some light manufacturing is found. Unlike the preceding two examples of potential land use conflict, this area is highly accessible. However, a high accessibility corridor may foster demand for change of zoning classification to more intensive uses. Thus, pressure for changing the zoning ordinance may appear along selected points of Grand River, particularly as the demand for highly accessible land outstrips supply of the land which is occurring now.

Summary of Chapter Findings

The results of the comparison of land values overall indicate that the situational zoning decreases the mixture of land values in high density residential and commercial zones. Similar results are obtained when the land values are aggregated by concentric rings. The reduction of land value variation for the high density residential and commercial uses confirm the findings of the Burgess model of land use. Evidence for the Hoyt model of land uses is also found in the results of the sectoral aggregation of land values particularly for the high density residential and industrial zones. The situational model developed in this chapter does not account for variation of land values in the low density residential areas. The final portion of the chapter analyzes areas of potential land use conflict. It occurs where the disparity of land values between the site and situational zoning is the largest.

Chapter Five

Summary, Conclusions and Implications

SUMMARY

The research problem attempts to answer the following question: Does a delimitation of zoning districts on the basis of a situational characteristic produce more homogeneity of land value than the existing site based zoning? A model was developed to measure the situational characteristics of sampled land use parcels. Prior to the construction of the accessibility index the land use characteristics of the parcel are identified and measured. Then the parcels are grouped according to similarity of land uses. Two statistical grouping algorithmns, H-group and discriminant analysis, are employed to minimize within group variability and to maximize between group differences.

The accessibility index is composed of two measures. The first calculates the proximity of a parcel to other parcels with different types of land uses. The second measure is based upon the time needed to travel from a sampled land use node to major shopping and employment nodes within the Lansing area. A computer mapping routine, SYMAP is utilized to construct a new regionalization scheme based upon values of an accessibility index for sample points. The routine spatially interpolates the sample set of accessibility values in drawing regions for the entire study area.

Following the construction of this situational model the major hypothesis for the study focuses on a comparison of land value variation, the actual and expected variation after the application of the situational model. Subsequent hypotheses represent a disaggregation of land value into various rings and sectors in order to account for variation of existing land values. A similar pre-post land value comparison is then performed for these latter hypotheses. The results of the research indicate that situational characteristics produce homogeneity of land values in commercial and high density residential zones. On the other hand, situational zoning increases land value mixture in low density residential and industrial zones.

CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

A careful examination of the data does not support an overwhelming acceptance of any of the three hypotheses dealing with explanation of land values. The most valid conclusion reached is that situational or accessibility based zoning produces more homogeneity of land values for commercial and high density residential areas. In Lansing's industrial and low density residential areas, the heterogeneity of land values in the situational zoning model actually increases. It appears that industrial and low density residential lands are less dependent on situational or accessibility measures for the maintenance of land value homogeneity than are commercial and high density residential areas.

For the industrial and low density residential areas, accessibility increases the heterogeneity of land values. Therefore, if these zoning districts are defined by an accessibility criteria, then the property owners will be assessed unneeded locational costs i.e. negative externalities, and will realize a more distorted land value than locations not undergoing the negative externalities. Land values are distorted by a range of factors such as the market, distance, accessibility, social costs and amount and type of facilities available.

One exception to the above conclusion is found in the analysis of industrial land values. When industrial land values were grouped into sectors, the new zoning decreased the land value mixture. However, the overall lack of land value homogeneity for the industrial parcels was evident in the overall and concentric portions of the analyses.

One recommendation for future policy formulation and urban planning in Lansing is that the districting or regionalization for commercial and high density residential areas should be derived more on the basis of situational characteristics.

As indicated by the empirical results of the study, if commercial and high density residential areas are defined by situational criteria, then property owners in these zones will likely enjoy a positive locational spillover or positive externality.

Positive locational 'spillover' is an important concept in urban zoning. It is defined here as a location with a high degree of centrality or accessibility. Because of their need for high degrees of centrality, commercial and high density residential districts defined on the basis of situational characteristics produced a decrease in the land value mixture. When districts are defined in this way, the individual property owner can better realize a less distorted land value. If a situational approach is not followed in the delimitation of commercial and high density residential areas, a mixture of values will occur and the zoning will cease to be completely equitable in the distribution of the locational 'spillovers.'

In arriving at these conclusions and recommendations some degree of caution is in order when applied to other cities. The model and conclusions are based upon one study in one city of approximately

200,000 people. The city is primarily a manufacturing center but also is an administrative center. Manufacturing nodes in Lansing remain relatively close to the central business district and there has been little movement of these nodes to outlying areas. Therefore, many of the employment and shopping nodes remain concentrated in a relatively small area of the city. If the techniques used in developing the situational zoning model were applied to other cities, particularly a city that has major employment and shopping nodes on the periphery, then the results of the research may differ. That is, low density residential areas within close proximity to peripheral nodes, if defined on the basis of situational characteristics, may yield more homogeneity of land values. Also if leisure time or lifestyles within the urban area were to change, then the results may differ.

These conclusions require a degree of tentativeness because of some structural limitations in the research. First, limited computer storage required a step-wise approach to the initial grouping of land uses. Also, the determination of land uses are subject to a degree of individual interpretation. Another limitation in the study was a lack of base maps at a scale and size suitable for published research. For example, a zoning map for Lansing that is sufficiently generalized and of the proper size for publication does not exist. One final limitation of the study is the assumption that fifteen miles per hour represents an average rate of urban travel. Such an assumption for all sections of the city may be misleading since all sections are not equally accessible. The ideal index would be travel time contours measured over existing arterials. However, this type of data was not available.

RELATIONSHIP OF FINDINGS TO OTHER RESEARCH

These conclusions are partially supported by previous work performed by Seymour in Pittsburgh.[1] He found that during changes in a zoning classification a mixture of land values resulted and the preponderance of land values went in the direction of more capital intensive use (Seymour, 1966, p. 87). One may assume that the situational zoning model devised in this research is similar to rezoning. According to Seymour if residential land is rezoned to industrial, land values of certain parcels will tend to increase and overall heterogeneity increases. The situational zoning devised in this study tended to reduce the overall number of parcels in the lowest capital intensive positions (i.e. low density residential) and at the same time to increase the number in the more intensive zoning types (i.e. industrial and commercial). However, the heterogeneity of land values was found only in industrial zones. In high density residential and commercial zones, the situational "rezoning" decreased the heterogeneity of land values. Therefore, the capital intensive movement of land values as a result of rezoning, a notion alluded to in the first chapter, is not completely verified by this research.

In his research on zoning and land values in Worcester, Natoli implies that land value is more a function of location, that is, a geographic factor, and less a function of zoning which is a political factor (Natoli, 1967, p. 194). If this were true for Lansing then

[1]The research by Natoli and Seymour represents two exhaustive treatments of the empirical relationship between zoning and land values. Other geographers have also looked at the same topic but their research lacked this type of extensive empirical treatment (Cox, 1973; Harvey, 1972; Soja, 1971; Yeates, 1965b).

there should have been increased land value homogeneity in a regionalization scheme based upon economic factors, that is, proximity to different land uses and time distances. Only in commercial and high density residential areas was the homogeneity of land values increased. On the basis of this investigation of Lansing it is concluded that the land value mixture is both a function of location and zoning, depending upon the nature of the predominant activity. Caution is needed however since generalizations concerning determinants of real property values always require consideration of factors ranging from national economic trends to local supply and demand factors (Ukeles, 1965, p. 46).

Additional research on zoning is needed to investigate the effect of zoning on land values over specified time periods. A study of time-based change should substantiate or disprove many of the conclusions derived in this study and in previous studies by Seymour and Natoli. Furthermore, if a zoning regionalization scheme were developed and implemented over time, it may prove to be a most effective tool for updating of many communities' zoning ordinances. Many smaller communities, particularly those located within close proximity to the advancing wave of urban settlement, are reluctant to adopt new zoning ordinances. The justification for urban zoning changes would appear to be stronger if the decisions were more oriented around a historical perspective.

THE FUTURE OF GEOGRAPHIC INVESTIGATIONS IN URBAN ZONING

Geographers have made only limited contributions to the study of zoning processes and decisions. The question that might arise is whether the geographic contributions will increase in the future. In the author's opinion geographers will increasingly become aware of the need for professional-level analyses of land use regulations because of the process of decentralization which has been underway for several decades in urban areas.

Decentralization refers to a spatial spreading out of the population along with the accompanying desire for increased per capita consumption of land. As a result the need for a dispersal of urban employment nodes, services and facilities from a central node to peripheral locations increases. Often these urban services and facilities stimulate land use conflict in the receiving area. In Lansing the proposed suburban location for a sanitary landfill had aroused the concern of many of the affected property owners.

The decentralization of the urban population also induces major confrontations over social values and land uses between the existing residents and the new arrivals. In particular when central city residents desire to live in low or medium income housing in the suburbs, but are prevented due to large lot zoning restrictions or minimum floor requirements, the aura of confrontation increases significantly. In these situations, a rejustification for the zoning regulations must be undertaken.

The decentralization of population has historically lead to a multiplication of governmental units (Kasperson and Breitbart, 1974, p. 30). The consequences of land use decisions that need to be made, such as a new zoning delimitation, or the development of a zoning ordinance may not receive as complete an evaluation in smaller-sized governmental units as in larger ones such as Lansing. Many of the smaller communities do not have the trained personnel or the extensive budget needed to investigate all of the social, economic and environmental consequences of a particular land use decision. Furthermore, with increased citizen participation and responsiveness, the likelihood of public opposition to major changes in zoning or land use regulations increases. What decentralization ultimately leads to is an increased demand for professionals in geography, urban planning, resource development and urban politics to investigate, interpret and draft acceptable land use regulations and master plans. Finally decentralization of the urban population often leads to increased land pressure on the urban-rural fringe.

A population tidal wave moves outward from the city; growth rates are declining behind the crest and increasing as the crest advances (Blumenfield, 1949, pp. 209-212). According to Wolf, the end result of "tidal wave" urban growth is a hollow metropolis "becoming bigger, more diffuse and more hollow in the future" (Wolfe, 1969, p. 153). Speculators and developers often purchase large tracts of vacant land on the fringe and hold it for a few years until the advancing wave moves closer. Then at the right time they sell it often at highly inflated prices. The land is originally purchased at a relatively low cost because of its lack of facilities and its low density zoning classification. These future commercial or industrial sites are thus purchased at the price determined by the existing not potential use and the existing not potential zoning classification. The public suffers when these situations arise not only from the loss of tax revenues but also from declining open space for present and future generations to enjoy. Unfortunately the development of the municipality precedes the enactment of zoning regulations (Ranney, 1969, p. 11). Some type of 'a priori' land assessment and land use controls are needed but often the planning budgets for full time personnel in these embryonic communities is quite limited. Professionals are needed but on a limited basis only.

However, the situation may change in the future. The U. S. Congress is currently considering legislation requiring states to develop some type of land use plans with accompanying use regulations. Once the law becomes enacted and funds are made available a need for professional level land use consultants will arise.

The dispersal of urban populations and the accompanying social, political and economic problems that arise increases the role of the geographer as an advocate planner or as a traditional planner. The conventional planner as defined by Kasperson and Breitbart "approaches planning issues as problems requiring a choice among various technical solutions" (Kasperson and Breitbart, 1974, p. 43). On the other hand, the advocate planner seeks to solve ethical planning issues by assuming a partisan position and hopes to change the inequity and inequality existing in the present political system (Kasperson and Breitbart, 1974, p. 43).

Regardless of which role the geographer assumes, it is the opinion of this author that geographic knowledge and training can be applied to an analysis of land use planning and regulations in general and zoning in particular. The research contained within these pages has proposed a scientific solution to zoning delimitation. Such an approach philosophically aligns the author with a more conventional solution to planning. However, regardless of the philosophical orientation of the individual geographer, zoning is a process that incorporates many aspects of economic, political and social geography. Following is a list of research topics and questions on zoning that merit further geographic research:

a) Analysis of the locations of zoning variances and special use permits;

How do these distributions correlate with the existing distributions of population, interest groups, economic wealth in a city?

b) Analysis of property owners reaction to requests for zoning changes;

Does the reaction support or refute the existing geographic theory on the friction of distance?

c) Analysis of the location of non-conforming structures;

How does the distribution correlate with areas of limited housing, minority residents and crime?

d) Analysis of the value systems of zoning appeals boards;

How do they differ within the metropolitan area and between rural and urban areas?

e) Analysis of vacant land and zoning classifications;

What is a 'highest and best' zoning classification for vacant and idle land or land surrounding 'new towns'?

f) Analysis of the "friends and neighbors" model of interaction within the context of the zoning decision-makers;

Does the distribution of zoning variances and residencies of local decision makers exhibit a "friends and neighbors" distance bias?

CONCLUDING REMARKS

Zoning,politics and economics are inextricably linked. As evident from this research zoning can be manipulated by the skillful politician or professional planner who wishes to earn a monetary profit for himself, a corporation or a community. On the other hand, zoning regulations can impose both monetary costs and social costs upon property owners or renters living in the community or upon prospective owners desiring to live in the community. Thus the apparent arbitrariness of many zoning boundaries imposes both positive and negative externalities upon property owners. Since zoning allocates current and future site values, then the imposition of positive and negative externalities may sometimes be unavoidable. A redistribution of the public wealth may be needed in order to compensate those land owners who are forced to accept the negative externalities. However before a redistribution occurs, a determination of whether or not the externality is avoidable must be made. The model developed in this research prescribes one method for assessing the locational spillover arising from the zoning ordinance.

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