EVALUATION OF MICHIGAN PREFERENTIAL TAX ASSESSMENT LEGISLATION AS LAND POLICY TOOLS

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ABSTRACT

EVALUATION OF MICHIGAN PREFERENTIAL TAX ASSESSMENT LEGISLATION AS LAND USE POLICY TOOLS

By

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The objective of this thesis is to examine and discuss H.4100 and H.6229, which are examples of preferential tax assessment, primarily as tools of land use policy to control the development of rural lands for urban oriented use rather than as a taxation policy. The problem of urban sprawl is cited by the Governor's Special Commission on Land Use Report as an important land use problem. Sprawl is one aspect of the process of urban expansion and change characterized by decentralization of economic activity and scatteration of residential uses along the urban-rural fringe. Harvey and Clark describe three types of sprawl: (1) low density development, (2) ribbon development, and (3) leap frog development.[1] Speculation and appreciation of land values are characteristic of the land market in the urban-rural fringe.

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[1]Robert Harvey and W.A.V. Clark, "The Nature and Economics of Urban Sprawl", Land Economics, ILI (February, 1965), p.2.

Craig Dennis Osteen

Economic concepts are used to discuss the institutional characteristics of the market for land in the urban-rural fringe and conceptualize the problem of sprawl. Sprawl is a problem of inefficient land use pattern and sub-optimal population density. Inefficient land use pattern occurs when the rent bids expressed for each land use at each distance from the urban center does not express social value of marginal product of that use at each location. Pricing techniques of transportation and utilities as well as the non-exclusion characteristics of open space and residential development contribute to the problem. Market imperfections also contribute. Sub-optimal population density results when the pricing techniques of transportation and utilities encourage dispersion of population over space in the urban-rural fringe. Rent bid diagrams are used to demonstrate these trends. The Coase Rule demonstrates the importance of the definition of property rights concerning the externalities of open space and housing production on rent bids and land use.

The different types of preferential tax assessment schemes and specifics of H.4100 and H.6229 are presented. Geometric analysis employing rent bid functions is used to show that preferential tax assessment does not necessarily result in efficient land use pattern. Mathematical analysis employing rent bid functions shows that preferential tax assessment does not affect the rate of land use conversion

but does affect the location of the margin between rural and urban land uses. Roll-back procedures in H.4100 and H.6229 increase the effectiveness of preferential tax assessment. The effectiveness of preferential tax assessment in containing urban development within certain bounds decreases as the rate of urban growth which affects expectations of urban growth increases. The implication is that the results of preferential tax assessment as a tool of land use policy in areas of rapid urban growth may not be worth the cost of implementation.

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by

Craig Dennis Osteen

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To Audrey Moses whose ever-present kindness

helped me to complete this thesis.

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INTRODUCTION

> If we are concerned about the loss of prime agricultural, forest, unique open space, and recreational areas by urban and suburban incursions; and if we feel that our best natural resource lands should be preserved for future generations; and if we feel that open space and rural landscape around our cities should be protected as part of our environmental heritage through a more orderly and efficient process, then we must review those policies that govern the development of rural lands for urban oriented use.[1]
>
> --Governor's Special Commission on Land Use

During the late 1960's and early 1970's, environmental quality has become a major political issue. In 1973, the environmental movement does not seem to be as much of a fad as it seemed in 1970, but there still remains a core of political interest in environmental quality. Concern regarding the use of land has become a major facet of environmental concern. William G. Milliken, Governor of the State of Michigan, was prompted to issue an executive order in October 1970 which created a commission to study land use problems in Michigan and recommend ways to handle these problems. It appears that many people are concerned about the process of urbanization and how it affects the pattern

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[1]State of Michigan, Governor William G. Milliken, Governor's Special Commission on Land Use Report (1972), p. 3.

of land use. This concern was reflected in the Governor's Special Commission on Land Use Report. Of particular concern are urban sprawl and the decrease in open space.

Urbanization and Changing Land Use in Michigan

An urbanized area is defined to be a central city or twin cities of a population of 50,000 or more plus the surrounding closely settled incorporated and unincorporated areas which have a population of 2,500 or more or have a density of 1,000 people per square mile or more.[1] Michigan has ten of these urbanized areas plus parts of the Toledo and South Bend urbanized areas. Eighty percent of Michigan's population increase occurred in urbanized areas from 1950 to 1970. Of the state's total population, fifty-three percent live in the seven metropolitan counties of St. Clair, Macomb, Oakland, Livingston, Washtenaw, Wayne and Monroe counties.

Population in Michigan increased by 69 percent from 1940 to 1970.[2] Michigan's population is expected to increase by 33 percent, approximately 3,000,000, from 1970 to 1990. Average family income is expected to increase nationwide between 1960 and 1980 by 61.5 percent in constant value

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[1] Governor's Special Commission on Land Use Report, Appendix A, "Task Force One Report, p. 5.

[2] Ibid., p. 1.

dollars. Leisure time is also increasing. People are expected to become more mobile with the car being the major means of transportation. These changes are expected to have an impact on land use.

Land use changes were predicted by Task Force One of the Governor's Special Commission on Land Use. Agricultural land is expected to decrease at a rate of 34,200 acres per year between 1970 and 1990. In 1945, 49.5 percent of all Michigan land was devoted to farming. In 1990, it is expected that only 31 percent of Michigan land will be devoted to farming. Farmland is expected to decrease by 8.3 percent in the counties south of a line from Bay City to Muskegon, excluding the previously mentioned seven metropolitan counties. Agricultural land is expected to decrease by 19.7 percent in those seven metropolitan counties.

Urban land within the ten major urban areas in Michigan increased at a rate more than twice as great as population from 1960 to 1970. Urban land increased by 30.4 percent, while population increased by 13.4 percent. In 1940, 669,000 acres out of a total of 36,000,000 acres in Michigan were in some urban land use. In 1955, 1,058,000 acres were in urban land use. In 1961, urban land use increased to 1,722,000 acres. Population densities in urban areas have decreased. In 1960, there were 3,800 people per square mile. Density decreased to 3,100 per square mile

in 1970. In 1990, it is projected that the figure will decrease to 2,765. It is estimated that approximately 30 percent of incorporated places in Michigan decreased in population. The pattern tended to be a population decrease in a central city with an increase in adjacent areas.

Urban land use is expected to increase from 1970 to 1990 in Michigan. In Michigan counties north of the Bay City-Muskegon line, land use in small urban places is expected to increase by 11,240 acres or 14 percent. Total land in urban use in those areas is expected to be 0.4 percent of the total acreage in 1990. In the counties south of the Bay City-Muskegon line, excluding the metropolitan counties, land in urban uses in large urban areas is expected to increase by 53,000 acres or 33 percent. Total land in urban uses will increase by 34 percent. Out of the total land in this area, 7.2 percent will be in urban use if these projections are correct. In the seven metropolitan counties, it is expected that land in large urban places will increase by 473,000 acres or 66 percent from 1970 to 1990. Land in minor urban places is expected to increase by 64 percent. In 1990, the total amount of land in urban use, according to these estimates, will be 42.5 percent of the total amount of land in the seven metropolitan counties.[1]

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[1] Ibid., pp. 5, 11-15.

The Commission states that an increase in demand for private recreational and urban land is to be expected. Task Force One of the Commission states that the area of deterioration in the cities and the area of urban land use conversion surrounding the urban areas combine to make the developing urban land use pattern one of the most important socio-economic problems confronting present and future economic growth in Michigan.[1]

Land Use Problems and Recommendations of the Commission

The previously stated figures mean little by themselves. People, however, are expressing dissatisfaction with the land use situation that appears to be developing. It is this dissatisfaction that makes the situation a problem.

The Governor's Special Commission on Land Use expressed concern for the pattern of rural to urban land use conversion (often known as sprawl), open land preservation, and property tax reform. The following statement was made about the value of open land:

> Open land should be preserved for a variety of objectives, economic and otherwise--some only vaguely articulated thus far; to 'shape' or 'time' urban growth and thus prevent development from

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[1] Ibid., p. 5.

> spreading out, or too fast, into areas where it will produce high public cost for community services or hasty ill planned sprawl today which will be blight tomorrow; to preserve nature and natural amenities; to relieve urban congestion and create more cohesive suburban communities; to reserve large accessible areas for outdoor recreation and neighborhood playgrounds of parks; to preserve sites for environmental importance; to conserve wildlife habitats, water supply areas, valuable forests, and agricultural land; to minimize water run-off, soil and shoreline erosion and flood damage in critical areas; to protect health against hazards of inadequate waste disposal; and to reserve adequate land for the development of facilities, public and private, that careful estimates suggest will be needed in the future.[1]

The Commission also expressed concern over urban sprawl by citing traditional subdivision design, zoning, and the fragmentation of powers, policites, and governments in the implementation of powers and policies as causes of the sprawl situation. Taxation is cited by the Commission as a cause of land use problems. The dependence on the property tax and the fragmentation of governments often results, it is claimed, in fiscal zoning. Fiscal zoning is an attempt to zone in land uses that will result in high property tax yields. The Commission feels that such practices encourage land uses that would not satisfy the needs of larger associations of communities and the state. It is also claimed that assessment at potential use often

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[1] Ibid., pp. 18-20.

land uses into more intensive uses due to increases in holding costs.[1]

The Commission made several recommendations that are of particular interest. They concern land use in the developing areas around urban areas:

1. The Commission recommends that a land use agency be created to provide comprehensive reviews of state land use programs. That agency would have the authority to approve all local comprehensive planning and zoning acts.
2. It is recommended that the state develop and map open space districts.
3. It is also recommended that legislation be enacted to make counties responsible for the formulation and adoption of comprehensive land use plans. The state should have the authority to approve the plans to make sure that the plan protects state designated land uses and adheres to state land use policies.
4. Preferential tax assessment was recommended in place of potential value assessment in some cases.
5. The Commission recommended that there be a shift from local property taxes as a major source of revenue for local governments.
6. It is recommended that the Michigan State Housing Authority be expanded to a community development organization.[2]

Preferential tax assessment proposals, which propose that land be taxed at values in present use rather than at potential highest and best use, have been introduced several

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[1] Ibid., pp. 18-20.

[2] Governor's Special Commission on Land Use Report, "Summary," pp. 1-4.

times in the Michigan Legislature in recent years. House Bill No. 4100 was introduced before the Land Use Commission released its report, while House Bill No. 6229 was introduced after the report was released.

Objectives of the Thesis

The Governor's Special Commission on Land Use Report provides evidence that there is a problem of sprawl in Michigan's urban areas and that there is dissatisfaction with the current mechanism of rural to urban land use conversion. The Commission has also recommended preferential tax assessment, primarily as tools of land use policy to control the development of rural lands for urban oriented use rather than as legislation to provide sources of revenue for governmental units or to redistribute income to owners of land in certain less intensive uses such as agriculture.

This thesis will be oriented toward the economic aspects. A discussion of the economics and institutions of the urban-rural fringe that affect rural to urban land use conversion and a discussion of the process of sprawl will be presented. An attempt will be made to view the problem in several dimensions. Finally, a discussion of the effectiveness of preferential tax assessment as proposed in H.4100 and H.6229 in controlling the development of rural land for urban oriented use will be presented. The discussion will concern itself with the ways in which the proposed

legislation will affect the economic processes and institutions involved in converting rural land to urban oriented use. By developing a concept of land use conversion, this thesis is oriented toward professionals interested in land use. However, the conclusions concerning the effectiveness of H.4100 and H.6229 are oriented toward the legislature, the land use commission, and others interested in using the preferential tax assessment for controlling rural to urban land use conversion.

CHAPTER I

ECONOMICS OF THE URBAN-RURAL FRINGE

A discussion of the economics of the urban-rural fringe area is necessary for understanding the problem being dealt with in this thesis. It is difficult, indeed research is scarce, to give more than an abstract discussion of the urban-rural fringe and present some of the characteristics of the land market and processes in operation. Suburbanization is a post-World War II phenomenon. It is one aspect of the process of urban expansion and change. There has been an increase in urban land uses, such as residential, commercial, or industrial uses, along or near the edge of mature urban areas. There has been a tendency for these activities to decentralize. The more intensive uses have taken place on lands where previously less intensive uses such as agricultural or forestry activities took place. Urban land use development in these areas tends to be discontinuous. Densely settled areas are mixed in with idle lands and other less intensive land uses. Marion Clawson claims that there is no conscious plan in many cases where this development occurs. There is land speculation in these

areas which some people claim results in higher costs to those who eventually settle in the urban-rural fringe area. While large areas of land are too high priced for non-urban uses, urban land usage is often delayed for periods of time.[1]

In order to make further discussion clearer, some terms will be defined. The urban-rural fringe area is an area of land use conversion from less intensive uses such as agriculture or forestry to more intensive urban uses. Speculation is an activity through which land is supplied for urban land use development. This activity takes place in the urban-rural fringe area and results in appreciation of land values. This activity is often characterized by profit-seeking individuals with expectations of land rent increases in future time periods attempting to make capital gains. Sprawl is a process of land use conversion in the urban-rural fringe which results in a land use pattern characterized by what some people think to be an over-allocation of land to certain uses such as private residential lots and parking lots and an under-allocation of land to uses such as park and wild lands and agriculture. The process of sprawl also results in scatteration of urban land use. Harvey and Clark describe three types of sprawl: (1) low density continuous development, (2) ribbon development,

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[1]Marion Clawson, "Urban Sprawl and Speculation in Land", Land Economics, XXXVIII, (May, 1962), p. 99.

and (3) leap frog development. Low density continuous development often consists of large private residential lots with single family homes. Ribbon development is composed of compact areas of development that extend along a major transportation route. Large areas of land are often left undeveloped between major transportation routes. Leap frog development is the most criticized type of development because it is characterized by patches of urban land use scattered throughout the urban-rural fringe area, a pattern of land use some people consider wasteful and unattractive. The developed areas are separated by areas of less intensive land use.[1]

The so-called process of sprawl is one aspect of the change through which urban areas are going. Sprawl is most noticeable during periods of urban expansion. Usually, there are areas of idle or less intensive land use mixed in with urban land uses in an unplanned and uncoordinated pattern. Population density in these areas is often less than in more mature urban areas. Marion Clawson claims that this process of sprawl is the logical result of speculation given the institutional characteristics of the land market in the urban-rural fringe area.[2]

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[1]Robert Harvey and W.A.V. Clark, "The Nature and Economics of Urban Sprawl", Land Economics, ILI, (February, 1965), p. 2.

[2]Clawson, p. 111.

Urban Expansion and Change

The purpose of this section is to present a general discussion of the processes occurring in urban areas that have an effect upon the demand for land in the urban-rural fringe area and on the configuration of urban land use development. One of the most imporant changes in American and Michigan is the increasingly urban character of its population. A once rural nation is now urban. In 1970, 70 percent of the nation's population resided in urban areas. Ninety-seven percent of the nation's population growth occurs in urban areas.[1] Rural and small town whites have been migrating to metropolitan areas throughout the twentieth century. Whites have been moving from the central city area to the suburbs, an area which includes the urban-rural fringe. Negroes have been migrating in from the rural south and have been populating the urban centers of northern cities such as Detroit. Segregation by income and race has occurred in the suburban migration. There is a tendency for upper-income families, particulary those with children, to live farther from the urban center or central business district; that is, in or near the urban-rural fringe. People with lower incomes occupy the housing left behind by the suburban migrants.[2] A large

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[1]James Joseph Shomans, Open Land for Urban America: Aquisition, Safekeeping, and Use, (Baltimore: John Hopkins Press, 1971), pp. 3-6.

[2]Dick Netzer, Economics and Urban Problems, (New York: Basic Books, 1970), pp. 13, 14, 21.

percentage of the lower income groups are Blacks and Spanish-speaking people.

As a result of these migrations, population densities have changed. Doxiadis, in a study of the Detroit metropolitan area, showed that in an area inside a radius of six miles from the central business district, residential density decreased from 1940 to 1960. Beyond that six miles, residential density increased. In Flint, Michigan, residential density increased beyond a one mile radius from the central business district, while residential density decreased inside the one mile radius from 1940 to 1960.[1]

Residential location decisions, it is claimed by Hoover, depend upon access to desirable locations; that is, time and transport costs and costs of space including environmental characteristics. Hoover proposes that the income elasticities of housing and access are different. He claims that income elasticity of housing exceeds one while the income elasticity of access is less than one. As income increases, people will sacrifice access for better and more spacious housing and environmental characteristics. On the

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[1]C. A. Doxiadis, Emergence and Growth of an Urban Region, (Detroit: Detroit Edison Co., 1967), Vol. 2, p. 116, cited by Edgar M. Hoover, An Introduction to Regional Economics, (New York: Alfred A. Knopf, Inc., 1971), p. 305.

whole, the incomes of large groups of people in the United States and in Michigan have been increasing. It is also suggested that people with higher incomes prefer modern structures. These people also tend to be more mobile. As a result, those people with lower incomes tend to cluster toward the center as they are outbid for housing toward the fringe. Racial discrimination acts to prevent minorities from moving away from the urban center.

It is also contended that when considering residential locations, distance to central business districts and places outside the central business districts, such as schools, is less important for upper income people than for blue collar workers. There seems to be little attraction to locate near the centers of cities in America by people with higher incomes. Suburbanization of residences seems to be a function of higher incomes, automobile ownership, and preference for space and amenities.[1]

There appears to be an area of new housing construction surrounding urban areas. The new residences house high income whites. There is a tendency for these homes to be built on large sites. However, inside this area, closer to the downtown areas, there are the so-called "grey-areas". Homes in these areas are deteriorating in quality. There seems to be high risk involved in reinvesting in these buildings. The

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[1]Edgar M. Hoover, An Introduction to Regional Economics, (New York: Alfred A. Knopf, Inc., 1971), pp. 335-340.

houses are occupied by lower-income and elderly people. Toward the urban center, there are large numbers of non-white and Spanish-speaking people confined to what some people call sub-standard housing.[1]

There has been decentralization of economic activities as well. The suburban areas around industrial cities show faster industrial growth. Changes in manufacturing technology have favored extensive plant layouts. The use of electricity and assembly lines has been important. Transportation technology has widened the choice of locations. Highways provide a finer transportation grid than railroads. There may also be an attempt to avoid congestion in the urban centers by locating outside of them. The suburbanization of the population gives these economic activities a closer source of labor. Provision of parking space for motorized population also increased the need for large quantities of land which are available in suburban areas.

Recent changes in information transfer and data processing have encouraged the process of conglomeration of corporations. Management tends to be centralized in downtown area office buildings. However, the clerical and research facilities of these organizations tend to be decentralized. Such facilities are near a labor force desirable for such activities and are located in areas with certain amenities.

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[1]Netzer, pp. 23-24.

Transportation technology and the decentralization of residential areas have been conducive to decentralization of consumer-oriented activities. There has been a tendency for daytime and nighttime populations to increase in the suburbs providing potential market areas for shopping centers and other commercial activity. Increased mobility allows many people to reach these consumer-oriented activities. The need for land for parking lots is added incentive to decentralize.[1]

Transportation is one of the most important factors of decentralization. Increases in mobility have decreased time costs allowing people to move further out. Also, greater dispersion of economic activities is possible making provision of public transportation difficult. The construction of high capacity expressways is an important process in Michigan cities. Pricing practices and capital markets have favored highway construction over public transportation investment. The declining importance of public transit may influence the type of urban development that takes place and makes it difficult for those without cars to get around.[2]

Development in the urban-rural fringe is interrelated with changes in the central city. These changes are products of similar social, economic, and technological forces.

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[1]Hoover, pp. 327-334.

[2]Netzer, pp. 145-152.

Control of sprawl in the urban-rural fringe is one component of a systems-problem. The decline of economic activity in the urban center and suburban sprawl are related through involvement in the urban system.

The Demand for Land

A more analytical approach to the land problem in the urban-rural fringe area will now be taken. Land is a resource and the demand for it is a derived-demand concept. The categories of land to be discussed are residential, commercial, industrial, and agricultural. Land use classifications could be broken down further, but the decision has been made to stop at this classification to simplify the analysis.

Residential Land

People buying or renting residential land are assumed to be utility-maximizers who are buying an entire unit of house, lot, amenities and access. A utility-maximizer will compare various alternatives and choose that alternative which maximizes utility subject to an income constraint.

The demand for residential land is derived from the demand for housing and access to certain destinations. Utility maximizers will choose that bundle of goods such that the marginal rate of substitution is equal to the ratio of

prices.[1] Such a situation can be represented through an indifference curve diagram. Indifference curves describe quantities of various goods between which a consumer has no preference. Each consumer could be perceived as having a family of such curves. The following assumptions will be made concerning indifferences curves: (1) non-intersection with other curves, (2) convexity to the origin of commodity space, and (3) downward slope from left to right.

In this case, there will be a trade-off between housing and all other goods. In this abstraction there will be standard units of housing which the consumer can purchase. Access costs which include the costs of transportation and lost time, known as time costs, involved in going to various destinations affects income. Standard units of housing will be purchased during a single time period such as a year. In Figure 1, income is represented by OG. If all income was spent on housing, OA units of housing would be purchased. The price of a unit of housing is OG/OA. Line GA is the income constraint defining the combination of housing and all other goods an individual can purchase when there are no access costs and the price of housing is OG/OA. Given the consumer's preferences, OB units of housing will be purchased. The highest level of satisfaction that can

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[1]Marginal rate of substitution (MRSxy) is the ratio of marginal utilities of two goods (MUx, MUy). Marginal utility is the first partial derivative of an individual's utility function. When utility is maximized: MRSxy=MUx/MUy= Px/Py where Px and Py are prices of goods x and y.

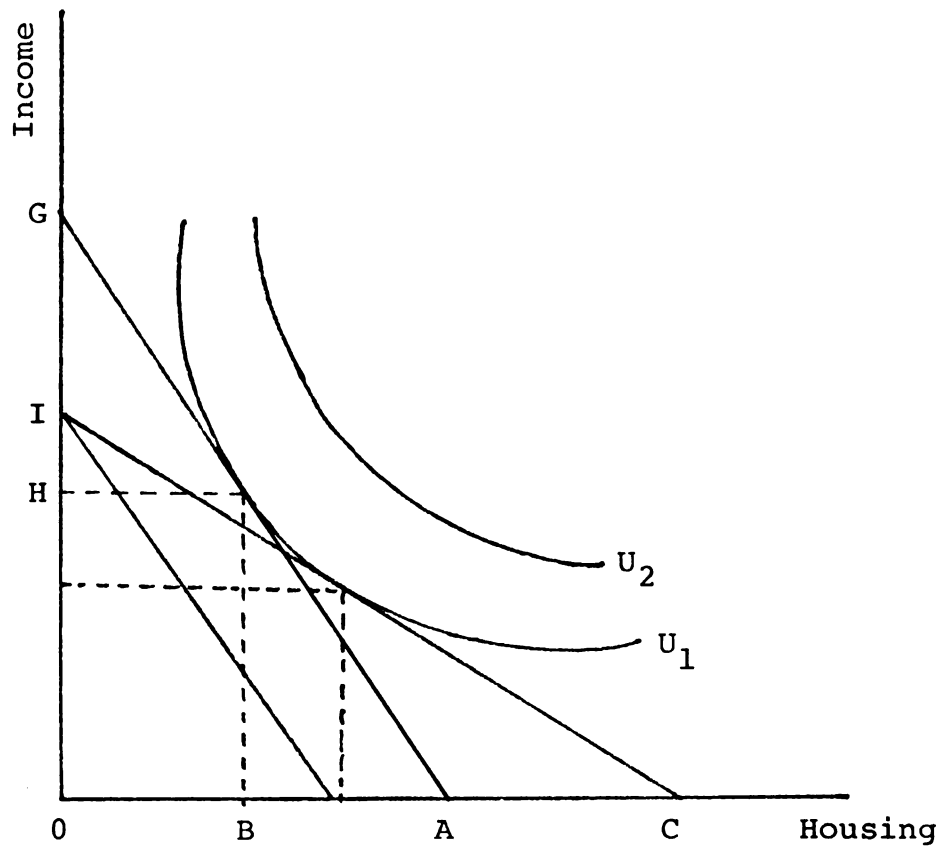

Figure 1.--Indifference curve diagram for residential land demand.

be reached is represented by indifference curve U_1. The expenditure on housing is HG while the expenditure on other goods is OH. If transportation and time costs were incurred to go from the residence to other locations, income would be lowered by GI which is equal to access cost. If the price of housing is reduced to OI/OC, such that IC is a new income constraint line, at the point of greater access cost, the consumer would be indifferent between the two sites when the site with no access costs has a price of OG/OA per unit and the site with access cost GI has a price of OI/OC per unit. If it is assumed that only the price of land varies between sites, rent at the site where access costs are incurred would decrease since the total amount spent on housing decreases at the site with greater access costs.

A demand curve for housing could be derived from the consumer's indifference curves. The price of housing would be determined by the intersection of this demand curve and a housing supply curve. From this a rent-bid curve could be derived. Since access costs will tend to increase as distance from the central business district increases, the rent bid will slope downward as distance from the central business district increases. Individuals will be indifferent between the different combinations of price and housing at different distances from the central business district that are on the rent curve. This

analysis assumes that individuals have identical preferences, but a similar rent bid curve could result even if this assumption does not hold.

Access costs and population affect the rent bid curve. As population increases, the demand curve for housing, which is the sum of individual demands at each price, will shift outward increasing the price of housing assuming that supply does not shift. As a result, the rent bid curve will increase or shift upward at every distance and to the right for every price. A change in transportation or access costs will change the slope of the rent bid curve without affecting rent where there is no access cost.[1]

Agricultural Land

The rent on agricultural land is determined differently. At any rate of production, a producer acting rationally as a profit-maximizer will minimize costs by obeying the equi-marginal principle by setting the value of marginal product of all inputs equal. The value of marginal product is the price of the output multiplied by the marginal physical product of the input. The marginal physical product is the first partial derivative of the total physical product function which relates

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[1]The residential land discussion is based on Hugh O. Nourse, Regional Economics: A Study in the Economic Structure, Stability, and Growth of Regions (New York: McGraw-Hill, Inc., 1968), pp. 110-114.

outputs to inputs. Land rent is assumed to be the value of marginal product of land.

Prices of agricultural goods are set by the market which is competitive and at the urban center. Price multiplied by quantity sold determines the total revenue function. The price per unit received by the farmer is the market price per unit minus transportation costs per unit. The contract rent assumed equal to land rent that a farmer is willing to pay is derived from a production function assuming other costs equal. Agriculture will be treated as if one good is produced. Cost curves are derived from expansion paths of production functions.

In Figure 2, curves Q_1, Q_2, and Q_3 are isoquants; that is, levels of agricultural production resulting from various mixings of inputs. They are analogous to indifference curves. Lines AD, BE, CF and others represent levels of expenditure. They are known as isoquant lines. The slope of the line equals the wage/rent ratio. Least cost combinations are determined by points of tangency between isocosts and isoquants. The expansion path defined by these tangencies defines a cost curve in price-quantity space. Line AG represents an isocost with a higher rent than line AD. Expansion paths at both rents can be drawn. The implication is that given other costs, a family of cost curves can be drawn with rents varying. The maximum

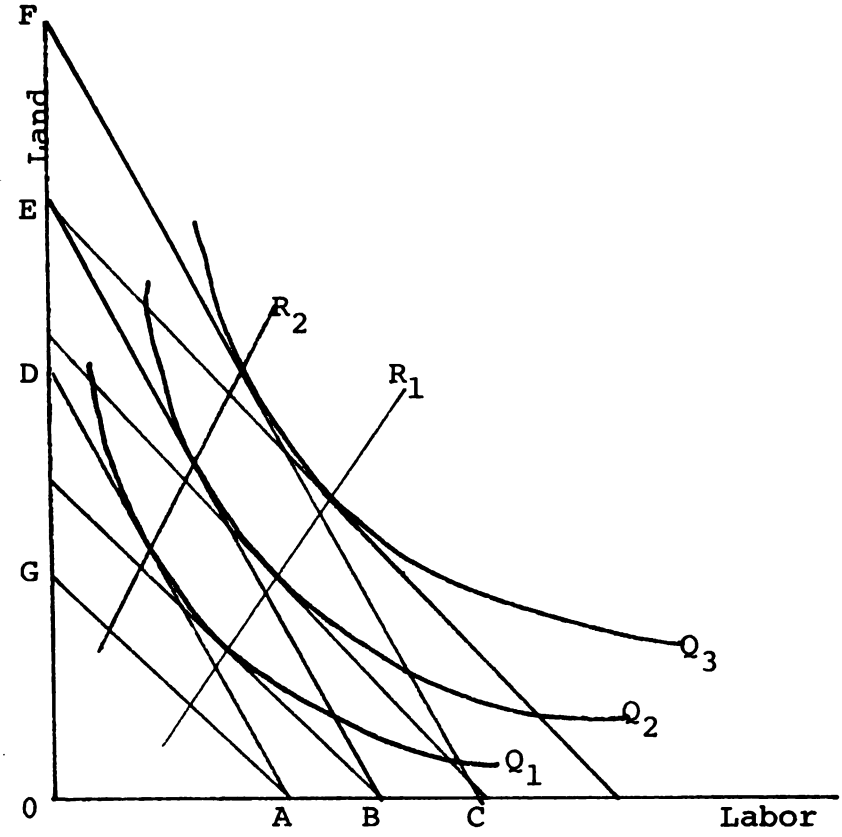

Figure 2.--Illustration of a production function in an isoquant diagram. R_1 is an expansion path that results from a series of isocosts where Price of Labor/Price of Land = OG/OA. R_2 is an expansion path that results from a series of isocosts where Price of Labor/Price of Land = OD/OA when the price of labor is constant, the price of land will be greater for R_1 than for R_2.

rent that could be paid is determined by the cost curve that is tangent to the total cost curve faced by the farmer. In Figure 3, TR_m is the total revenue function faced by a farmer at the market. Curve TC_{R1} is the cost function at the market site where there are no transport costs. The tangency between TC_{R1} and TR_m occurs where land rent is bid up to the value of marginal product on land. Curve TR_1 is the total revenue curve at distance 1 from the market. The existence of transport costs decreases the revenue to the farmer. The revenue per unit of output is price per unit minus the transport costs per unit. The farmer will only bid up the rent until TC_{R2}, the total cost function at distance 1, is tangent to TR_1. The rent bid at distance 1 will be less than the rent-bid at the market due to the existence of transport costs. As distance from the market increases, the rent-bid decreases. A rent bid function will be described by the following equation:[1]

$$R = E(p-a) - Efk$$

where

R = rent per acre

E = yield per acre

p = market price of the commodity

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[1]Nourse, pp. 96-105.

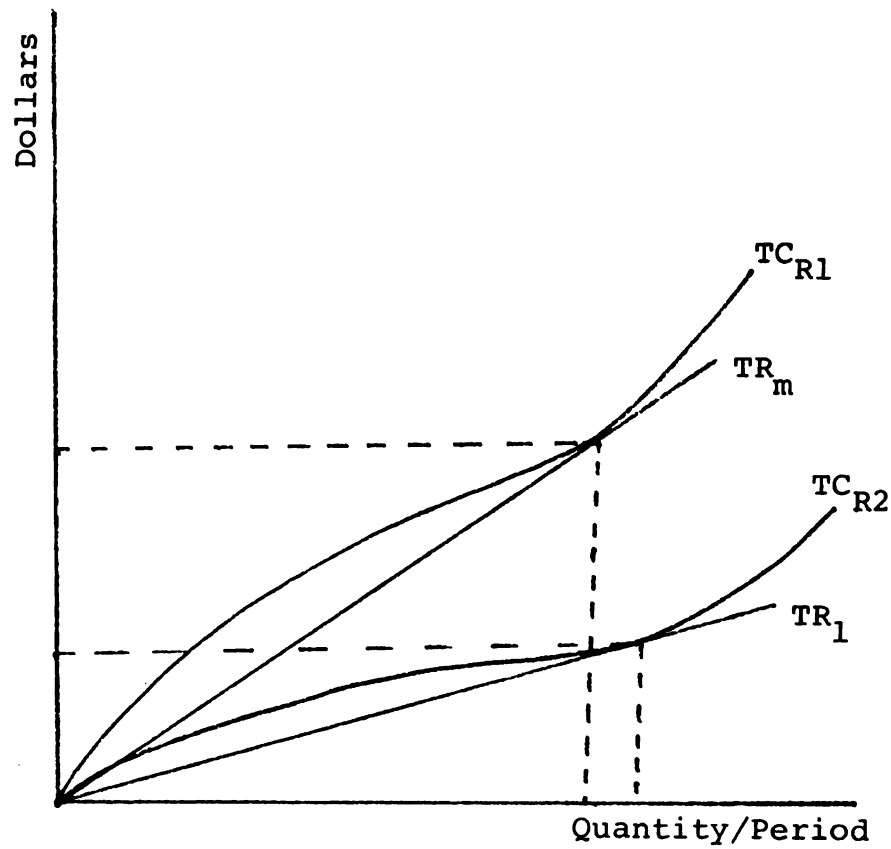

Figure 3.--Cost and revenue functions. TR_m is the total revenue function at the market. TR_1 is the total revenue function at distance 1 from the market. TC_{R1} is the total cost function when R_1 is the price of land. TC_{R2} is the total cost function when R_2 is the price of land.

a = production cost per unit excluding rent and transport cost to the market

f = transport rate per mile

k = distance in miles.

Commercial Land

Determination of a rent bid curve for commercial land uses such as retailing and wholesaling is similar to determination of the agricultural curve. Total revenue depends upon the number of transactions which depend upon daytime population. Moving away from concentrations of daytime population entails greater costs of attracting customers which are netted out of the total revenue function. The total revenue curves in Figure 3 would represent such a case if the horizontal axis represented the number of transactions. If interdependencies are observed by the entrepreneurs, the total revenue functions would become curved. The production function diagram in Figure 2 could be used to derive cost curves. Curves Q_1, Q_2, and Q_3 would be levels of transactions, the axes remaining the same. Rents vary while other costs do not. A set of cost curves will be derived for commercial land use similar to agriculture. As distances from the centers of daytime populations increase, the maximum rent offered will decrease. Changes in daytime population and transportation costs will affect the total revenue function and therefore the rent bid function.[1]

[1]Nourse, pp. 105-107.

Industrial Land

Manufacturing might be considered to be less dependent on local population if it is an exporting activity. Total revenue will not change much as plant location varies in distance from a given urban center. Total revenue is derived from sales to several metropolitan areas by an exporter, so the effect of sales to local population will not be as important to an exporting manufacturer as to a commercial enterprise. Transportation costs are also assumed equal in every direction. In Figure 4, the total revenue is independent of distance to the central business district. Total costs change as distance from the central business district changes. Rents and wages are the costs to be concerned with. Other costs are assumed to be equal over space. Locating away from concentrations of population might result in wage increases to compensate for travel costs incurred by people travelling to the location. Higher wages would tend to be associated with a lower rent bid, since total revenue will not change much. Isocosts with "kinks" to represent this association are shown in Figure 5. When plant location is near the outskirts of an urban area, assembly line operations are favored since more land is available. Economies of scale resulting from assembly lines favor high rates or production. Assembly lines may not be economical for lower rates of production. For high

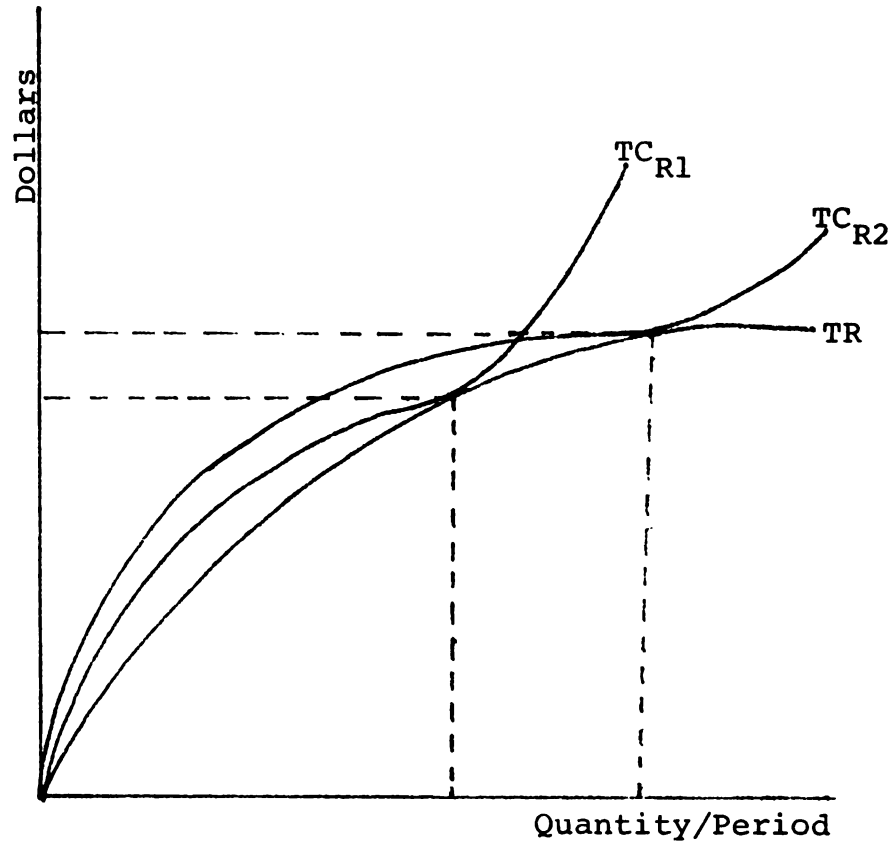

Figure 4.--Total cost and revenue functions for the manufacturing case. TR is the total revenue function at all distances from the urban center. TC_{R1} is the total cost function at the urban center where R_1 is the price of land. TC_{R2} is the total cost function in the outskirts of the urban area where R_2 is the price of land.

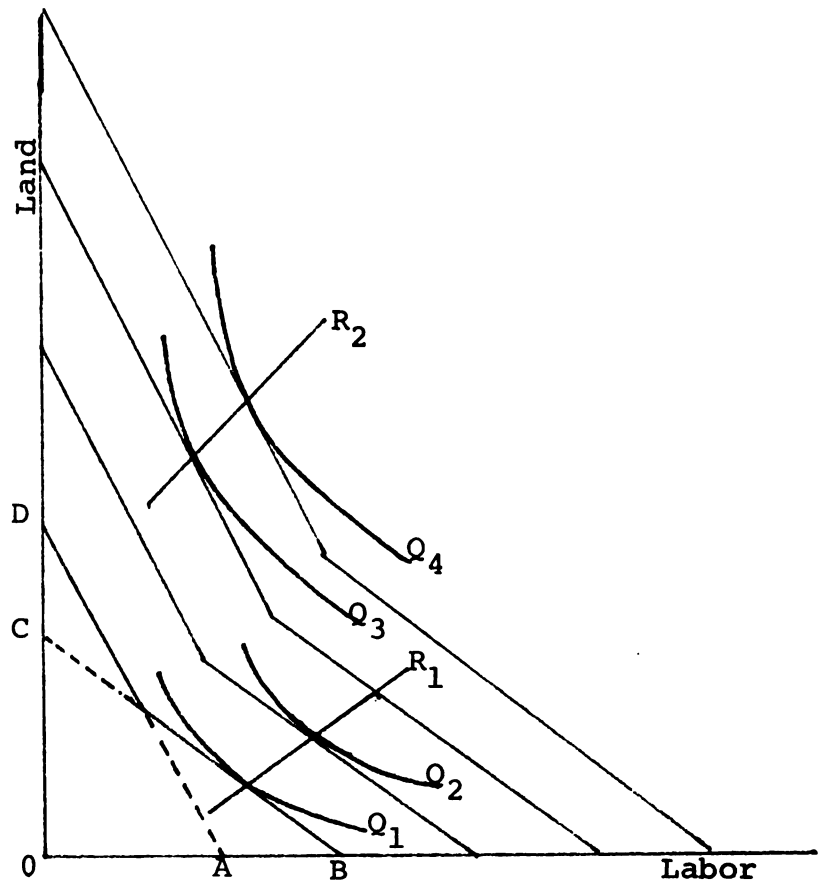

Figure 5.--Isoquant diagram for the manufacturing case. R_1 is an expansion path where the price of labor/price of land = OC/OB. R_2 is an expansion where the price of labor/price of land is equal to OD/OA. The relative price of land is greater for R_1 than R_2.

rate of production, the least cost combination might occur where wages are high and rents are low, that is, in the outskirt of the urban area where the assembly lines are favored. At lower rates of production, the least cost combination might occur where wages are low and rents are high: that is, relatively near the central business district. The rent bid function for manufacturing will tend to slope downward as distance from the central business district increases. The slope depends upon the increase in the wage rate, the decrease in rent per acre necessary to offset the wage increase, and economies of scale resulting from substitution of land inputs for non-land inputs.[1]

Spatial Equilibrium and Urban Expansion

The rent bid functions could all be superimposed in the same space. Land will go into that use which can pay the highest rent at a given location. In this way land will be allocated to different uses over space. Following are the assumptions used in this analysis which draws from Nourse's chapter on land use:[2]

1. Land is homogeneous. The only variables are land use distance from the central business district.

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[1]Nourse, pp. 107-110.

[2]Nourse, pp. 93-125.

2. All people have the same preferences.

3. There is no collusion among buyers and sellers.

4. The supply of land at any distance from the urban center is infinitely inelastic.

5. Rent bid functions reflect indifference between sites at the various bids.

6. Markets are in equilibrium at the point in time when the rent bid functions are drawn.

7. Producers maximize profits by using the least-cost combinations and the scale that maximizes profits.

8. Transportation costs are the same in all directions.

Figure 6 indicates a case of spatial equilibrium and shows how land is allocated to various uses. Point 0 is the central business district. Area OA is allocated to commercial land use, AB to manufacturing, BC to residential use, and CD to agriculture. This land allocation may be considered to be an efficient land use pattern when rents expressed by the rent bid functions equal the social value of marginal product of a given location in the various land use categories. An inefficient land use pattern occurs when the rent bids at each location do not equal social value of marginal product.

Economies and land use allocations are not static. The process of sprawl is a dynamic concept. Changes in population will affect rent bid functions of the commercial sector through changes in transactions, the manufacturing sector through changes in the supply of labor and changes

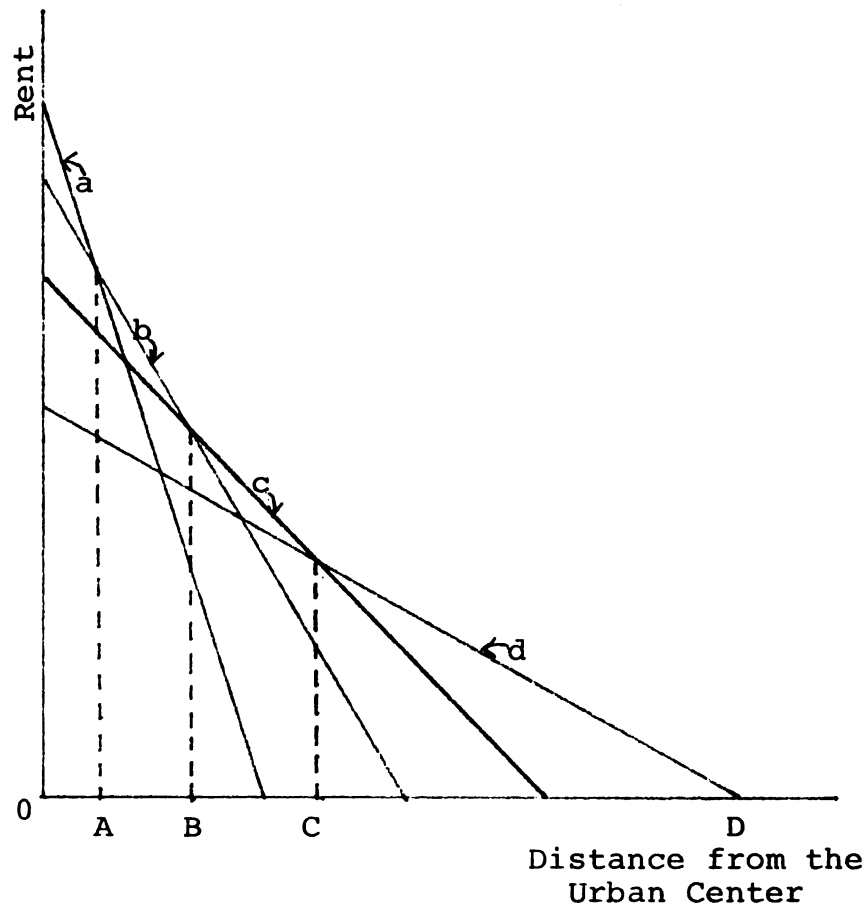

Figure 6.--Illustration of spatial equilibrium. Line a is the rent bid curve for the commercial sector, b for the manufacturing sector, c for the residential sector, and d for the agricultural sector.

in wages, and the residential sector through changes in demand for housing. Agriculture is assumed to equilibrate at previous prices. Figure 7 represents the changes in land allocation due to an increase in the population of the urban area. A population increase will cause the rent bid functions of the commercial, residential, and manufacturing sectors to shift outward. Area CD is the area of conversion from rural to urban land use, the urban-rural fringe area. Area EF might be slum or "grey" areas. If there is an increase of mobility; that is, a decrease in transportation costs at the same time that population is increasing, there will be a greater tendency toward decentralization as shown in Figure 8. All sectors are affected in this case. Commercial, manufacturing, and residential rent bid curves increase at the central business district. All four curves show a decrease in slope due to a decrease in transportation costs. Area CD is the urban-rural fringe in which rural to urban land use conversion takes place. The drawing shows the potential of greater decentralization with lower transportation cost. Residential rent bid functions will shift outward whenever there is a factor change that will increase housing demand. An increase in income of an urban area affects primarily the commercial and residential sectors causing their rent bid curves to shift out, also encouraging decentralization.

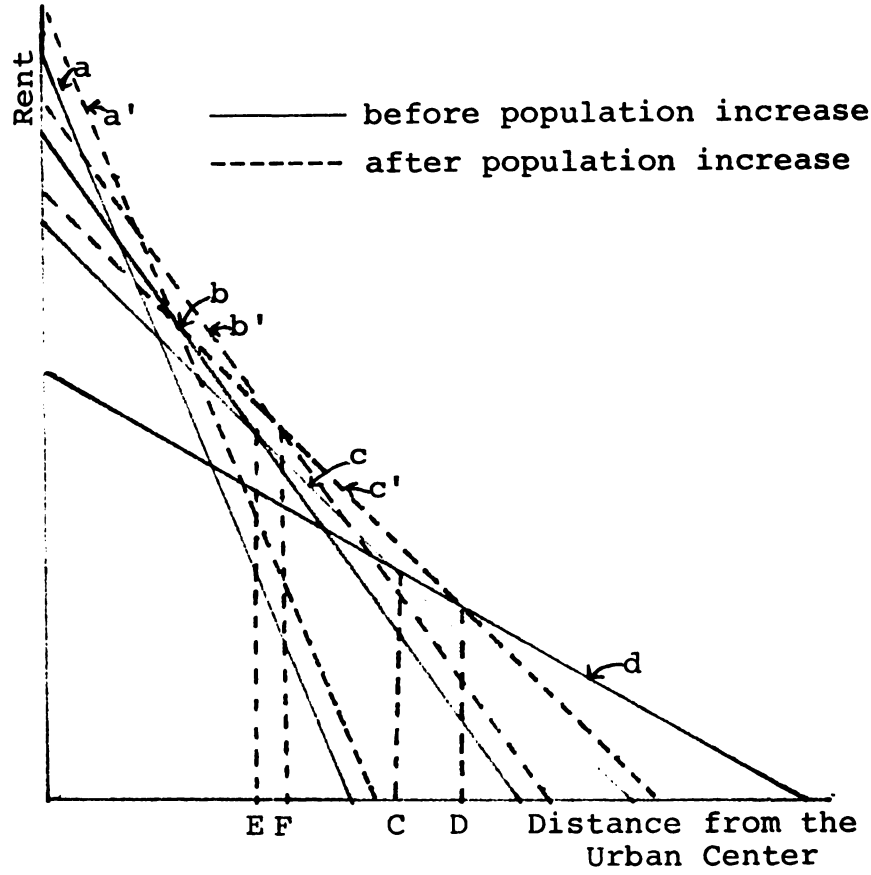

Figure 7.--Spatial equilibrium before and after a population increase. The broken lines show the rent bid functions after a population increase. Line a is the function before, line a' is the function after, etc.

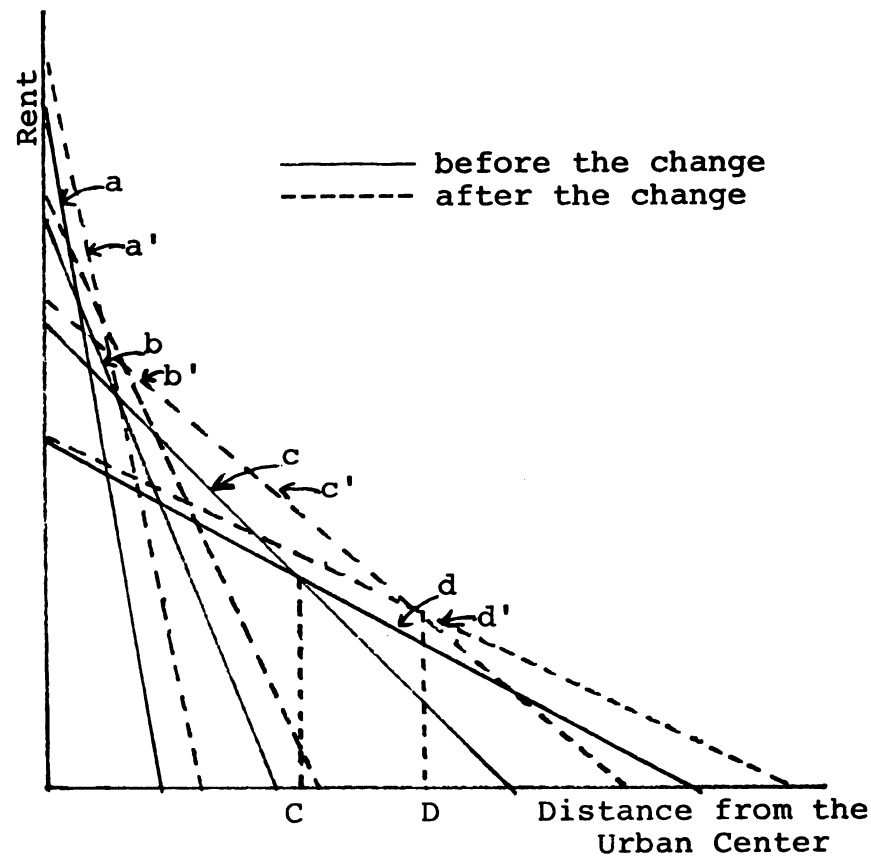

Figure 8.--Spatial equilibrium before and after a population increase and mobility increase. The broken lines represent rent bid functions after the change. Line a represents the commercial rent bid curve before the change; line a' represents the rent bid curve after the change, etc.

Factors of decentralization that have been dealt with directly are: (1) population growth, through natural increase or migration, (2) transportation technology, (3) income growth, and (4) manufacturing technology. The income elasticity of demand for space and environmental quality were mentioned previously. Changes in consumer preference exert a force but are hard to demonstrate.

Urban growth is much more complex than previously described. There are differences in the topography of the land and the fertility of the soil over space. Transportation costs are not the same in all directions. There are different modes of transportation and configurations of transportation routes. Often, there are a number of centers of urban activity in an area. The growth of such centers is predicted in some theories. These centers will complicate the configuration of the rent bid curves. However, relaxing some of the simplifying assumptions should not radically change this analysis of the urban-rural fringe.

Sprawl

Sprawl, which was defined earlier, is a dynamic concept. At various times, patterns of land use development may be illustrated which reflect sprawl, but sprawl is a process of land use development so that patterns may be in constant change. In order to control this process to obtain a so-called desirable pattern of land use, the characteristics of this process should be understood.

John Edward Smith, in a master's thesis for the University of North Carolina, presents a conceptual model of the residential land development process which seems to be an important process contributing to urban sprawl.[1] The model has two basic approaches: state-of-the-land stages and a series of decisions. Given a peice of land in some less intensive use than urban or suburban use, Smith claims that the following stages take place: (1) urban interest, (2) active consideration for development, (3) program development, (4) active development, and (5) residence. With urban interest, a decision agent has expectations concerning future development possibilities. With active consideration, a decision agent has contacted another decision agent regarding possible purchase or sale of land. Under programmed development, a decision agent has a definite idea about the timing and character of the development. With active development, physical development of the land begins and the house is built. The house and lot are purchased in the residence stage. There is also a series of decisions presented by Smith: (1) the decision to consider land for urban development, (2) the decision to purchase land, (3) the decision to develop land, and (4) the decision to purchase a home.

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[1]John Edward Smith, Toward a Theory of Landowner Behavior, Environmental Policies and Urban Development Thesis Series, No. 6 (Chapel Hill: University of North Carolina, 1967), p. 11.

The land market is any place where real property rights are exchanged for other rights. Clawson has presented some characteristics of the land market for raw suburban land which corresponds to the area of rural to urban land conversion. First, land is not a homogeneous commodity. Besides location, there are variations in fertility, slope, risk of flood damage, amenities such as views, nearby schools, or open land, and other possibilities. Essentially each tract of land is unique. Each tract of land will have its own rents and values associated with it. Second, there are variable size tracts available for development. Certain land uses may require a certain amount not available from a single owner. Third, the owner often has to sell his entire tract because parcels remaining from a portion sold might be difficult to use or sell. Fourth, society, through government, changes land characteristics thereby changing the value of land. Various improvements, such as transportation, sewerage, water supply, and other utilities are examples. Fifth, land values are affected by government policies, such as taxes, zoning and building codes, as well as the enforcement of such policies. Sixth, there are differences in the modes of transportation available to get to these sites and destinations that can be reached from these sites. Seventh, the demand for land is a derived demand. What people are willing to pay is a result of a stream of

income and costs from the land. Eighth, there are usually a few buyers and sellers at any one time.[1] Barlowe also has some characteristics that are relevant but not necessarily unique to land. First, markets depend upon local conditions. The land is fixed and the market for it depends upon the social and economic conditions that it is related to. Second, credit arrangements are often used in the transactions. Third, brokers are often used.[2] The market for suburban land without structures is hardly the classic purely competitive market and has characteristics that differentiate it from other land markets.

An attempt will now be made to give a more specific discussion of the economic and institutional characteristics that may affect the eventual outcome of the development process which presently takes the form of sprawl. First of all, the characteristics of buyers and sellers, the market structure, will be examined. It appears that collusion is not highly probable in the fringe area.[3] There are large numbers of people involved making

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[1] Clawson, pp. 101-102.

[2] Raleigh Barlowe, Land Resource Economics: The Political Economy of Rural and Urban Land Resource Use (Englewood Cliffs: Prentice Hall, Inc., 1958), p. 202.

[3] A. Allan Schmid, Converting Land from Rural to Urban Uses (Baltimore: John Hopkins Press, 1968), p. 13.

successful collusion difficult. The market is not perfectly competitive, however. Harvey and Clark classify it as monopolistic competition.[1] It would appear that knowledge varies among individuals involved in the market and that the actions of others would have to be considered by individuals.

There are probably variations in preferences among buyers and sellers. They may all be looking for something different in amenities, location, and other characteristics. Another problem is the location of sellers. At any one time, people willing to enter the land market may be scattered in an incoherent pattern not fitting someone's concept of a land development plan. Expectations of future development and credit availability might be particularly important to decisions of speculators. The lack of coordination in terms of preferences, location of available tracts, and individual decision-making may well point toward a chaotic situation.

The location and quality of land may also contribute to a sprawl-like situation. The location of land of proper quality for urban development may produce a pattern that resembles sprawl. There may be undeveloped areas mixed in with developed areas producing a pattern that looks like leap frog or ribbon development. The undeveloped areas may not be economically suitable for development at the present time.

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[1]Harvey and Clark, p. 1.

Institutional factors characteristically influence the land market and affect land use and the location of land use. Indeed, institutional factors such as market rules will affect the structure of the market. The characteristic bundle-of-right in a given area may influence the location and pattern of development. Defective titles, covenants, estate holdings, and trusts on urban land rights may make such land less attractive for development than land with clear title that might be located in the urban-rural fringe. It would seem that the less complex the history of land ownership, the lower would be the probability of clouded title.

Credit and capital markets may have an important influence. Since land markets are characterized by use of credit arrangements, the influence of the capital market should be very great. It is claimed that lenders may lack recognition of economic processes of land acquisition and development and therefore may contribute to conditions that encourage sprawl. There may be a preference for small projects that may be completed in a short time in order to avoid risk. Loans are made on the basis of personal assets rather than on the worth of land being developed. Since an equity of forty to fifty percent is often required, development of small tracts is encouraged due to the shortage of funds. In order to avoid risks,

lenders may attempt to diversify their development loans thereby giving each developer a smaller share.

The incentives and rules created by public policy are very important in the operation of the land market in the urban-rural fringe. There has been a national public policy which has supported the concept of single-family homes and has encouraged such development through guaranteed loans. Decisions to extend provision of public services will affect the value of lands held and encourage their sale for development purposes. Public roads have been an important factor. Highways have contributed to urban congestion and suburban sprawl. The areas of public regulation and taxation are very important. Variations in land use regulations such as zoning and subdivision controls may encourage development in areas of less strict controls which, as likely as not, may be located in fringe areas outside the limits of incorporated places. There is also a problem of fragmentation of governments. Policies and decisions of various governmental units may not be coordinated. Tax laws may encourage behavior on the part of landowners that encourages a sprawl-like configuration of development. Development may take place in small projects over short time periods to avoid paying taxes on so-called paper profits. Coordination through platting might be discouraged if the assessed value of land increases

once land is platted.[1] Assessed value may increase because tax assessors may consider platted land to be more valuable than unplatted land.

Public policy has often favored, or at least has not discouraged, decentralization and sprawl. Much of the present situation of sprawl may be attributed to information and pricing problems. Buyers may lack information and may not purchase housing and land in a particularly rational manner. The buyer may purchase a large lot not being aware of future costs that might result from the purchase. In the future, many improvements might be made in the suburbs that are financed by frontage charge or by lot size. As a result, the purchaser of low density housing may be in a poor situation that he has not contemplated.[2] Zoning may be a tool of public policy that facilitates sprawl and low density development. Communities may employ a tactic called fiscal zoning to decrease costs such as school costs and attempt to increase its tax base. The community may zone for "clean industry" that preserves a high quality neighborhood. Research facilities and data processing operations tend to be low polluters when compared to steel mills and power plants. The community may also zone for minimum-sized lots. In

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[1]This section draws heavily on Clawson, p. 105, and Harvey and Clark, pp. 3-6.

[2]Wilbur R. Thompson, A Preface to Urban Economics (Baltimore: John Hopkins Press, 1965), pp. 323-324.

so doing, the community may attempt to attract high income families who might be assumed by some to have small families. The feeling is that high income people will buy large lots and that they will build large houses thereby increasing the average assessed valuation per person over what might otherwise be expected. If these high income people tend to have small families, which might not be likely, the community's costs might be decreased because fewer educational inputs would have to be provided. By keeping the community at low density, high concentrations of children might be avoided.[1]

Pricing of costs and benefits may be such as to favor decentralization and encourage what some people think is allocation of too much land to urban uses. Lower density populations may not favor the efficient distribution of publicly produced goods such as water supply or electricity. It is claimed that there tends to be increasing returns to scale but decreasing returns to space in the provision of these goods. Each residence needs a delivery capacity to itself all the way from the source of the publicly produced good. Delivery costs tend to increase as distance from the utility increases. Construction costs will increase as more distance is covered as well as transfer costs. For the provision of water, if demand doubles by doubling density, keeping area constant,

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[1]Netzer, pp. 94-96.

capacity is doubled by increasing the diameter of the pipes by the square root of two. However, if demand doubles due to an increase in service area, the pipe mileage must be doubled; the cross-section of the pipe at the base of the old system will have to be doubled and more than doubled in other places; pressure will have to be increased to keep pressure up at the fringe areas; and the pipe joints will have to be upgraded to hold extra pressure. Provision of the same amount of water will be more expensive in the second case.[1] However, a flat rate is usually charged for utilities.[2] In order to cover costs, the average cost per unit must be charged to all customers. Cost, however, varies with distance. There will be some distance from the source of the utility where the average cost per unit equals the price charged per unit. At points that are a shorter distance from the source than the break-even point, the price paid will be greater than cost. Beyond that distance, price paid will be less than cost. The people closer to the utility will subsidize those farther out. The rents that people closer to the source of the utility are willing to pay for land will decrease due to that location. Those people beyond the break-even point will be willing to pay a higher rent.

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[1]Mason Gaffney, "Containment Policies for Urban Sprawl," in Inter-University Seminar on Urbanization in the Missouri River Basin, ed. by Richard L. Stauber, Government Research Series, No. 27 (Lawrence: University of Kansas Publication, 1964), p. 118.

[2]Thompson, p. 327.

This is illustrated in Figure 9. Only the residential and agricultural sectors are illustrated to simplify the diagram. This diagram assumes that the utility source is at distance zero. Distance A is the break-even distance. The distance between B and C shows that the urban-rural fringe will tend to increase with the flat-rate pricing.

Transportation is another possible source of subsidy for people living near the edges of urban areas. Highway planners tend to design highways to accommodate rush-hour traffic. The gasoline tax is the source of revenue. Provision of highway capacity is treated almost as if it was a free good. Payment of highways is spread over all users of highways regardless of when they use the highways. It is often contended that rush-hour motorists pay a charge for use of highways through the gasoline tax that is much less than the cost of providing that capacity to them. Netzer reports that estimates greater than eleven cents per vehicle-mile have been made for the cost of peak-hour highway use. Gasoline taxes seldom exceed one cent per vehicle-mile. It would appear that rush-hour motorists are subsidized heavily by non peak-hour motorists and taxpayers. This subsidy has also contributed to the decline of urban public transit.[1]

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[1]Lyle C. Fitch, et al., Urban Transportation and Public Policy (San Francisco: Chandler Publishing Co., 1964), pp. 122-146, 265-266, cited by Netzer, p. 143.

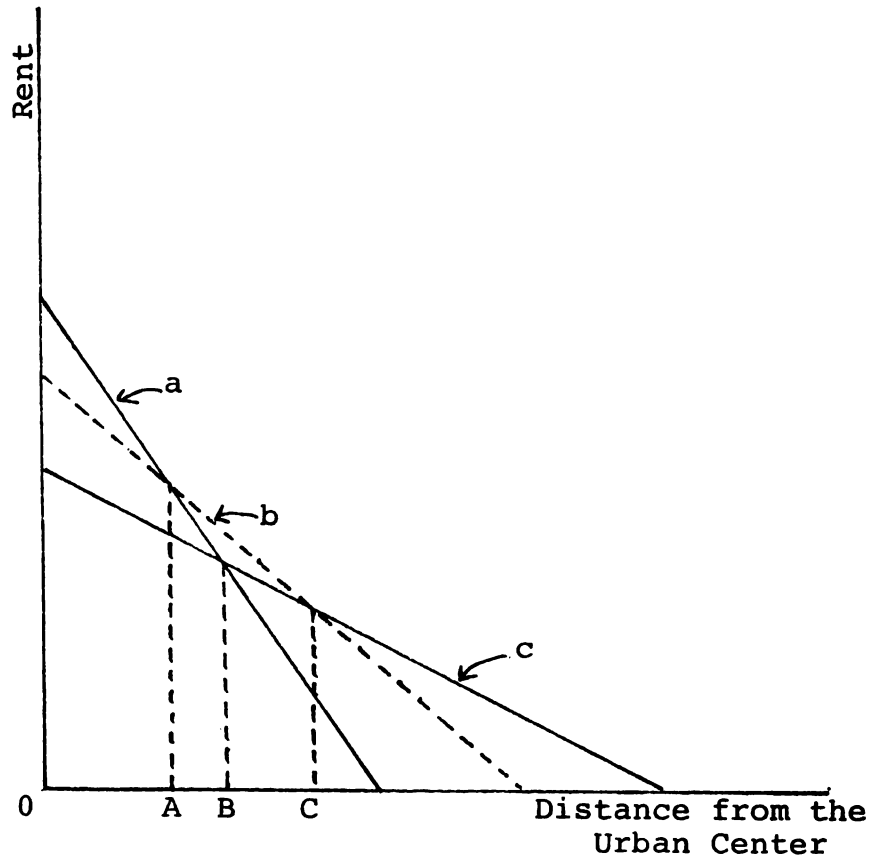

Figure 9.--Rent distortion through utility pricing. Line a is the residential sector rent bid curve without the distortion. Line b is the distorted residential rent bid curve. Line c is the agricultural rent bid curve.

Suburbanites tend to be those motorists who use the highways at rush hours to get to and from work. Thompson contends that the more remote the suburbanite, the more affluent he tends to be, and the more he tends to use subsidized highways.[1]

This situation is illustrated in Figure 10. The subsidy tends to reduce access costs for suburbanites although they incur time costs during traffic jams. As a result, they can afford to pay higher than normal rents farther out. The distance between C and D illustrates that the urban-rural fringe will tend to spread farther out due to transportation subsidies. This diagram suggests that sprawl will tend to occur at a faster rate along expressways and major high-speed highways.

Large lots and suburban sprawl tend to increase travelling costs for people living even farther away from the urban center. Residential areas tend to determine the radius of an urban area. Sprawl tends to increase time and money costs for those people who must pass the residential areas. Costs of providing roads are increased because of the greater distance that must be crossed and more right-of-ways will be needed to complete the road network.

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[1]Thompson, p. 337.

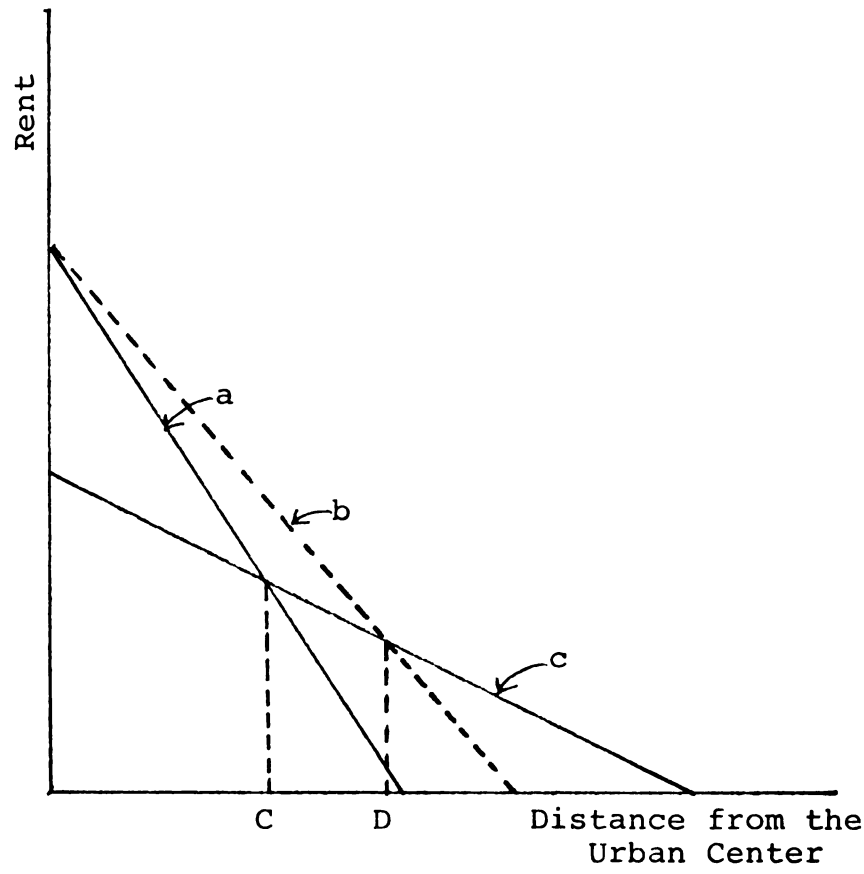

Figure 10.--Rent distortion through transportation pricing. Line a represents the undistorted rent bid curve for the residential sector. Line b is the distorted residential rent bid curve. Line c is the agricultural rent bid curve.

If a land-owner is aware of being able to avoid costs, he is encouraged to locate farther out. Costs may be difficult to identify and allocate to residences. A land-owner may be able to come out ahead by receiving more benefits than his tax share. He may also be able to postpone certain costs and transfer them to a later buyer who is willing to pay them. If improvements are made, they may be paid for out of the general fund. The tax levy is on the value of house and land. The property tax tends to fall more heavily on the owner of a large house with a small lot than on the owner of a small house with a large lot. In this way, people located closer to the urban center may tend to subsidize those living farther away. Sprawl might be encouraged in this way.[1]

There appears to be a tendency for suburban expansion to occur along the lines of least resistance. Housing construction tends to occur where improvements have already been furnished.

This section has attempted to show how decentralization and sprawl have been encouraged beyond what would be expected from population growth and mobility increases. The processes of urban growth and suburban sprawl turns out to be complex; too complex to be dealt with on more than an abstract basis in this thesis.

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[1]Thompson, pp. 324-325.

Value Appreciation and Speculation

A phenomenon that occurs in the urban-rural fringe area is the appreciation of land values above those expected for agricultural use. Marion Clawson states that agriculture can be eliminated as a causative factor of value appreciation in the urban-rural fringe.[1] It is the possible value for urban land use that causes the increase in land values. Land valuation can be characterized by a rent capitalization process. It is also the process of land valuation that prompts exchange of real property rights to take place. Schmid documents a case where the value of suburban lots appreciates 359 percent above agricultural land values.[2] Individuals can be described as determining land values by calculating expected future income on the land and discounting that stream of incomes back to a net present value. Rent is both income and cost, depending on who pays and who receives. The process is characterized by uncertainty and risk which is reflected in each individual's interest rate according to his evaluation of the risk situation.[3]

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[1] Clawson, p. 103.

[2] Schmid, p. 13.

[3] A discussion of the handling of risk is presented in William J. Baumol, Economic Theory and Operations Analysis, 2nd ed. (Englewood Cliffs: Prentice-Hall, Inc., 1965), pp. 453-460.

Following is a list of the variables that might be considered in calculating net present value:

I. Income: present and future
   A. Rents from land use
   B. Expected sales value in a period where a sale is expected
II. Costs: present and future
   A. Holding costs
      1. Property taxes
      2. Interest on value of land if sold
   B. Costs at time of land exchange
      1. Cost of shift of investment
      2. Transaction costs
III. Marginal income tax rate
IV. Discount Rate
   A. Interest on alternative source of investment of funds
   B. Uncertainty factor
      1. Date of future conversion
      2. Illiquidity
V. Time period
VI. Planning Horizon.

Present value is represented by the following equation:

$$V_{y=0} = \sum_{y=0}^{m} \frac{R_y - (1-s)P_y - C_y}{(1+i)^y}$$

$V_{y=0}$ = Net present value at beginning of planning horizon

y = Time period in planning horizon

m = Last time period in planning horizon

R_y = Rent in time period y

P_y = Property tax in time period y

C_y = Holding costs, except property tax, in time period y

s = Marginal income tax rate

i = Discount rate.

The "(1-s)" factor needs further explanation. Property taxes can be deducted from taxable income. The factor "s" is the rate at which an individual pays income tax. The property tax paid in a given period is expressed by $(1-s)P_y$.[1]

Rents accrue to land owners for various reasons. A rent is a return above production costs due to natural limitations. Agricultural and other land uses have income streams that result from those land uses. The value of urban land results from various limitations. Location is one of the most important. As distance from various destinations, such as place of employment, increases, access costs will increase. Those costs, which were discussed earlier, will tend to be capitalized out of the present value of the land tract. Locations that decrease transportation costs should have higher rents over time and therefore higher values. An urban land site may have other valuable amenities such as high quality air, association with neighbors, landscape features, schools, playgrounds, and other public services.[2] Rents are the result of people placing valuations upon land characteristics that are naturally limited.

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[1] Schmid, p. 44.

[2] Schmid, p. 28.

Price appreciation might be the result of several factors. Previously, factors that might increase the demand for land in the urban-rural fringe were discussed. An increase in the demand for land will result in a windfall gain that might be interpreted to be a rent. There is, however, a more dynamic concept in a world of uncertainty and risk: expectations. Expectations of future rent might be capitalized into present value. One possibility is that urban expansion might be expected in the future. As a result, a site with a rent accruing from location might be expected to have a greater rent accruing from that locational advantage due to expected increase in land demand.[1] Also, expectations of continual inflation might result in expected increased land prices that might be capitalized into land values. Non-pecuniary returns and costs might also be capitalized into land values in some way if people can express those so-called non-pecuniary benefits into dollar terms.

A. Allen Schmid also presents a discussion whereby part of the gain of land appreciation is due to non-natural limitations which affect the structure of the land market and could be called profits instead of rents. Rents are returns to natural limitations while profits are returns to entrepreneurs and returns to non-natural limitations. Zoning restrictions can change expectations

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[1]Schmid, p. 29.

of future income and sales value thereby affecting the value of land. Public services supplied at less than cost might be capitalized into the value of land resulting in a windfall gain to the owner of land at that time. Such a situation might occur when charges for public services are not made according to benefits received. The difference between benefits and costs might be capitalized into the present value of the land resulting in a windfall gain or loss depending on whether benefits are greater or less than cost. Schmid claims that such a situation is viewed as rent from the developer's viewpoint but is monopoly profit from the viewpoint of the whole economy since the gain is contrived from a non-natural limitation. Also, there may be private supply restrictions. The rate of sale of land is dependent on price. If the sellers make overly optimistic estimations of the future selling price which are then capitalized into present value, they can make a gain that can be characterized as a profit. If the present price of land is less than some future expected price and if the amount of land sold per time period and the amount of revenue from land sales are considered satisfactory by the seller, the price of land may not increase. In actuality the price of land in some future time period may be less than sellers in the present time period expect the price in that future time period to be. In such a situation, the seller will receive

a net gain on the land sold before it was realized that the actual price in some future time period would be less than the expected price in that time period. Since the high expected future price of land was capitalized into the price at which land was sold, the seller receives a higher price for the land than if the actual future price was capitalized into the price of land. The buyer of the land cannot recover his net loss. Since new land cannot be reproduced except in minor amounts and at great cost, sellers of the land at a lower price may not be able to drive down the price of land once their land is sold. Indeed, their competition may only forestall the time when land is sold at a higher price by other developers. The characteristic of imperfect knowledge and differences of knowledge among buyers and sellers may make the possibility more plausible.[1]

Speculation, then, is an economic activity that results from the expectation of future price increase which is to a certain extent the result of the expectation of future urban land use development. This activity will, in many cases, eventually supply land for that development at that time and rate at which an acceptable gain has been made.

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[1]Schmid, pp. 37-42.

The remaining task in this chapter is to develop behavioral rules to describe when an exchange of property rights will take place. Such rules will be helpful in later discussion and analysis in this thesis. The assumption is made that the people involved maximize satisfaction and that profit-maximizing behavior does not detract from achieving that goal.

The land market, as earlier discussion has shown, is characterized by variations in income, costs, information, and risks and differences in opportunity costs of capital. As a result, people who wish to enter the land market may all have different valuations of a tract of land. The net present value of a tract should represent the maximum a buyer is willing to pay and the minimum that a seller will accept, assuming that there are no transaction costs not capitalized into the net present valuation of the tract of land. If the buyer's valuation is greater than the seller's and neither is certain of the other's valuation, there will be a bargaining process that will set the sales price. The seller would like the sales price to equal the buyer's net present valuation if the buyer's valuation is greater than the seller's since that would be the maximum price that the seller could get and still be able to sell the land. The buyer would like the sales price to equal the seller's net present valuation of the land if the seller's valuation is less than the

buyer's since that is the minimum price the buyer could give and still get the land. The buyer would try to bargain for the lowest price possible and the seller would try to bargain for the highest price possible. If the transaction takes place, the sales price will be somewhere between the buyer's net present valuation and the seller's net present valuation. The actual price that results from the bargaining process will be influenced by each bargainer's knowledge of the situation, experience in bargaining, and urgency to complete the transaction. The behavior rule used here will be:

If $V_a \leq V_b$, then property rights will be transferred from a to b, and

$$V_a \leq P_L \leq V_b$$

V = net present value

a = owner of property rights

b = potential buyer

P_L = price of property rights.

If there are transaction costs incident on either or both of the parties involved in the transaction and the transaction costs are not capitalized into net present value, the behavioral rule becomes:

If $(V_a + K_a) \leq (V_b - K_b)$, then the property rights will be transferred from a to b

and $$(V_a + K_a) \leq P_L \leq (V_b - K_b)$$

K = transaction costs

The minimum that the owner will accept is his net present value plus transaction costs that he must pay. The maximum that a buyer will offer is his net present value minus any transaction costs that he must pay.

The process of speculation could be considered as one in which people foresee incomes from future urban uses and place bids upon owners how engaged in less intensive uses. If the property rights are transferred, the speculator holds the land while the value appreciates to a satisfactory level. Then the lands become available for urban land use development. The net present value of land as calculated by each decision-maker will determine what transactions will take place and will have an impact upon patterns of land use in areas of conversion from rural to urban use.

CHAPTER II

THE PROBLEM OF INEFFICIENT LAND USE PATTERN

Two problems of the present process of suburban land use development are (1) inefficient land use pattern which is defined on page 32 and (2) the ultimate disappearance of open land that some people such as environmentalists consider valuable. Not only is the amount of open space valuable, but its location is as well. Some Americans feel that open space serves a social function and that some urban lands should be preserved in open space. Others feel that the present form of urban land use is a gluttonous and wasteful use of land. The purpose of this chapter is to demonstrate how policies and institutions in urban areas contribute to suboptimal population density in terms of providing a certain quantity of public utilities at minimum total cost and to inefficient land use pattern.

Concept of a Collective Good

An important economic concept is that peculiarity called the public good. It is difficult to define such a good because there is no easily definable dichotomy between

public and private goods. Mancur Olson defines a collective, or public, good as:

> . . . any good such that, if any person X_i, $X_1 \ldots X_i, \ldots X_n$ consumes it, it cannot feasibly be withheld from other groups.[1]

There is a problem concerning what is meant by feasibility. It appears that there are at least two possibilities: (1) resource limitations are such that the good cannot be withheld from other groups even if a group desires to, or (2) the cost of withholding the good is greater than the gain to the withholding group that results from the withholding. The concept of non-excludability of benefits and costs is an important characteristic of some commodities.

Another relevant concept is that of the externality. Technological externalities occur when the output of one firm affects the production function of another firm. Following is a statement in functional notation:

$$Y_1 = f_1(A_1, A_2, \ldots, A_n)$$

and

$$Y_2 = f_2(B_1, B_2, \ldots, B_n, Y_1)$$

Y_1 = output for firm 1

Y_2 = output for firm 2

$A_1, A_2, \ldots, A_n$ are inputs for firm 1

$B_1, B_2, \ldots, B_n$ are inputs for firm 2

f_1 is a rule that assigns values to Y_1 for various combinations of inputs

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[1] Mancur Olson, The Logic of Collective Action: Public Goods and the Theory of Groups (Cambridge, Mass.: Harvard University Press, 1965), p. 14.

f_2 is a rule that assigns values to Y_2 for various combinations of inputs and Y_1

Different names could be assigned to Y_1 and Y_2. Y_2 could become an individual's utility in which case the output of firm 1 would affect that individual's utility. Y_1 could become another individual's utility. In which case the consumption which increases the first individual's utility would affect Y_2. If Y_2 again becomes the output of a firm, the consumption of individual 1 would affect the output of firm 2. An external diseconomy occurs when Y_2 decreases as Y_1 increases. An external economy occurs when Y_2 increases as Y_1 increases.

A pecuniary externality occurs when the output of one firm affects the profits of a second firm. Following is a statement of this in functional notation, given that the above functions hold:

$$D_2 = g_2(Y_2, B_1, B_2, \ldots, B_n, Y_1, P_{Y_2}, P_{Y_2}, P_{Y_1}, P_{B_1}, P_{B_2}, \ldots, P_{B_n})$$

D_2 = profits for firm 1

$P_{Y_2}, P_{Y_1}, P_{B_1}, P_{B_2}, \ldots, P_{B_n}$ are prices of the inputs and outputs.

g_2 is a rule that assigns values to D_2 for various combinations of inputs and outputs.

Some production functions show increasing returns to scale. In these cases marginal cost is less than average cost. If the price is set equal to marginal cost

so that resources will be allocated efficiently, the producer operates at a loss.

Of particular concern since it seems to occur often in the American society is the external diseconomy that is not excluded from others by the producer and cannot be avoided by other firms and individuals except at great cost.

Buchanen and Tullock, in their book The Calculus of Consent, give some definitions and concepts relevant to this discussion. A rational individual who minimizes costs to obtain a given level of satisfaction will compare a certain array of costs. External costs result from individual decision-making and effect other people. An example would be the air pollution from coal burning facilities like electrical generators. Voluntary decision costs arise when people decide to get together to remove an external cost in some way. When people organize to take the firm polluting the air to court to stop them from polluting, certain organizing costs besides the court costs are incurred. Public collective decision costs arise when the mechanism of government is used to eliminate an external cost. Such costs would arise when people organize politically to get a statute passed that regulates the emissions from coal burning facilities. The rational

individual will take that action such that his total costs are minimized at a given level of satisfaction.[1]

An external cost may arise from the removal of an external benefit or the failure to provide an external benefit. External costs may also arise from the provision of some benefit. Buchanan and Tullock predict that the mechanism of government will be used to remove an externality when:

public collective decision costs < voluntary collective decision costs $\leq$ external costs

or

public collective decision costs $\leq$ external costs $\leq$ voluntary decision costs.[2]

Externalities are characteristic of the economies of urban areas. There are internal and external economies of scale which favor the agglomeration of economic activity into small areas. There may also be diseconomies of scale that favor dispersion of economic activity. Perhaps one of the most important of external economies is the transport economy which results from activities being located near each other. Transport and time costs are decreased in this way. The increase in mobility characteristic of the twentieth century has tended to make transport economies less important and therefore favor decentralization.

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[1]James M. Buchanan and Gordon Tullock, The Calculus of Consent: Logical Foundations of Constitutional Democracy (Ann Arbor: University of Michigan Press, 1962), pp. 43-62.

[2]Buchanan and Tullock, pp. 43-62.

Externalities and Inefficiencies of Sprawl

Suburban development can be characterized as a problem of external costs and pricing. Harvey and Clark presented some of the suggested costs of sprawl. Sprawl, or discontinuous development, it is argued, is more costly and less efficient than a more compact area with the population density of previously settled areas. It is the value judgment of some people that suburban development sometimes is not aesthetic or attractive. Lands in areas of development are often left idle. This idleness is considered wasteful since activities less intensive than urban use could be taking place. Land speculation is considered by some people to be unproductive. It is argued that speculation absorbs capital, labor, and entrepreneurial skill without any public gain resulting. Some people would argue that it is inequitable to allow the occupied lands to shoulder such a heavy burden of charges or debt merely for the site costs.[1] It would appear that this last charge might be remedied with smaller lots.

One argument often presented is that the loss of agricultural land to suburban development is wasteful and therefore should be deplored. Gaffney argues that while perhaps it is wasteful, the increased productivity of agriculture and the use of new lands more than compensate

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[1] Harvey and Clark, p. 107.

for this loss. He considers the locational aspect to be more important. However, the effect on urban land is considered to be even more important. Gaffney states that urban land is one of the most valuable of natural resources. Sprawl does not protect the quality of that resource. Efficiency is defined by him to be the maximization of net human satisfaction given the resources available. The efficient city maximizes ease of contact among individuals giving people, both as consumers and producers, the widest choice of alternative contacts with the least difficulty. Gaffney then argues that cities experience increasing returns to population density. Such goods as public utilities and transportation can provide the same level of satisfaction at lower costs as population densities increase. It is the problem of pricing that introduces the problem of inefficiency of urban land use. Land rents are distorted by pricing practices of urban utilities and transportation systems so that they do not equal the marginal value product of that land. The result is that land values in the urban center decrease while land values in the fringe area increase. The effect of the pricing techniques discussed in the previous chapter is to create pecuniary externalities. The production functions of land are not altered, but the rents that can be obtained by an owner of a tract of land are affected. It might be argued that these pricing policies tend to redistribute

land rents from lands near the central business district to lands in the urban-rural fringe area. By subsidizing land use in the urban-rural fringe with these pricing policies, the demand for lands in the urban center will tend to decrease. As a result, the renewal frequency of urban land might be slowed resulting in deterioration of improvements on the land, the so-called grey-areas and slum districts. The decrease in the value of land tends to discourage land-owners from making improvements, since the rents received by doing so will be decreased.[1]

The problem of suburban sprawl becomes a problem of optimum poulation density and efficient land use pattern. The problem of optimum population density can be illustrated in population versus dollar space. Various services in urban areas show economies of population density, as cited by Gaffney and presented earlier in this thesis, such as utility provision and transportation. A given level of service can be provided more cheaply with higher population density. The costs of providing these services and the value of these services can be summed as shown in Figure 11 (curve d). Given a level of services in an urban area, the aggregate cost of providing them will decrease as density of population increases. However, diseconomies of increasing population density are also

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[1]Gaffney, pp. 117-119.

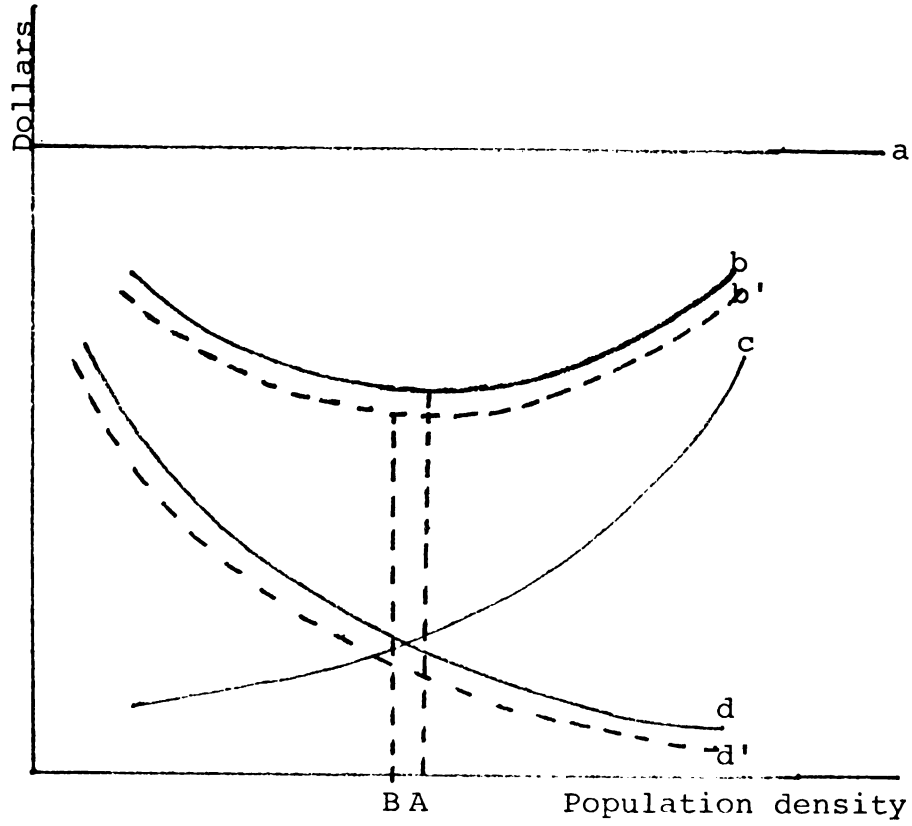

Figure 11.--Optimum population density. Line a is the value of the given level of service. Line b is the total cost curve without a subsidy. Line b' is the total cost curve with the subsidy. Line c is the curve of increasing costs to density. Line d is the curve of decreasing costs to density. Line d' is the curve of decreasing costs to density with the subsidy.

likely. Certain amenities may be given up as population density increases. There may be a greater probability of personal conflicts. Law enforcement costs may increase if increased population density increases crime and personal conflicts. Space may become a barrier to increasing population density. A curve plotting these costs will increase with density (curve c). These costs can be summed with the costs of providing services to provide a schedule of total costs. The objective is to provide a level of aggregate public services at minimum cost. The optimum density is density A in Figure 11.

A unit of delivered-utility-service consists of (1) a unit of the utility-service, such as electricity or water, that is produced by the supplier and (2) the distribution of that unit of the utility-service to the consumer. The price of the delivered utility-service is equal to the sum of (1) the price of the utility-service produced by the supplier plus (2) the price of the distribution of the utility-service to the consumer. When the suppliers put a price on the delivered-utility-service that is uniform for all consumers regardless of their distance from the site of utility-service production, consumers are not subject to the same price of the utility-service before it is distributed. This effect occurs because distribution costs of the utility-service increases as distance increases from the source of the utility-service

if delivery costs per unit of distance per unit of delivery service are constant. If price per unit of utility-service is constant, distribution costs per unit of distance per unit of utility-service is constant, and each consumer just covers the cost of a unit of utility-service, prices per unit of delivered utility-service should increase as distance from the source of the utility-service increases. With uniform pricing of delivered utility-service and constant distribution costs per unit of distance per unit of utility-service, the price of a unit of utility-service, that is, the price of the delivered utility-service minus the distribution costs, will decrease as the distance from the source of the utility-service increases. Some people will receive the service at less than marginal cost. These people will be those who are at a greater distance from the source of the utility-service. In essence, the people closer to the source of the utility-service subsidize those farther away.

Given uniform pricing of utilities, the cost curve of utility-service provision for those farther away from the source of the utility will shift down because those closer to the utility are covering part of the distribution cost. If the diseconomies of increasing population density do not change (curve c does not shift), the total cost curve will decrease because of the cost shifts from curve d to curve d'. The minimum point of the total cost curve

will tend to shift to a lower population density, therefore the least cost density decreases to density B in Figure 11. This shift occurs because the subsidy could be considered a rent on land. Because of the decrease in cost, people can afford to buy more land per lot thereby decreasing the population density. This density is termed sub-optimal since the price of utility-services is less than the cost of providing the utility services. Society bears a cost in this lower population density since the costs are distributed to those areas not receiving the subsidy. To the extent that the sources of these utilities tend to be near the urban center, it can be said that people living near the urban center subsidize those living in the urban-rural fringe by paying some of the cost of providing utility services to those people living in the urban-rural fringe.

Uniform pricing of utilities may also result in a sub-optimal allocation of resources and goods. In order for an optimal situation to exist in a Paretian sense, several conditions must exist. One is that the marginal rate of substitution between all goods must be equal for all individuals. A utility-maximizing individual will set his marginal rate of substitution of goods equal to the ratio of prices of those two goods. The condition becomes:

$$MRS_{xy}^{1} = MRS_{xy}^{2} = \ldots = MRS_{xy}^{n} = P_y/P_x$$

where

MRS = marginal rate of substitution, where the superscript is the individual and the subscript relates to the goods

P_i = price of good i

x,y are goods

1,2,...,n are individuals.[1]

In order for this condition to be satisfied, all consumers must face the same price per unit. Given the variation of price per unit of utility over space that results from uniform pricing of delivered-utility-services, the marginal rates of substitution of all individuals in the market area will not be equal. This situation is not optimal in the Paretian sense because the distribution of goods could be altered in some way, improving at least one individual's utility without decreasing someone else's. The utilities will be overconsumed in areas where the price is less than cost. Because of this over-consumption, there will be a mis-allocation of resources to the distribution of utilities.

Pricing techniques that redistribute rents such as the pricing of utilities and transportation will distort

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[1] $MRS_{xy} = MU_y/MU_x$, where MU is marginal utility so that $MU_y/MU_x = P_y/P_x$. Setting marginal rate of substitution equal to the ratio of prices is consistent with utility-maximizing which is assumed.

rent bid functions in the manner shown earlier in this thesis. Rent as perceived by the individual will not likely be equal to the social value of marginal product which is the value to society of land in a given use. Other externalities may exist which distort these rents. When the rents at given locations as expressed by the rent bid functions do not equal the value of marginal product at those locations, the land use that results is inefficient according to the definition of efficient land use pattern in Chapter I, page 32. Sprawl hence is an an example of an inefficient land use pattern and results in sub-optimal population density.

Values and Benefits of Greenspace

Certain groups, such as the Audubon Society, contend that there are values of open land and that some of the values are not recognized by the land market. Shomans feels that more should recognize the value of urban greenspace.[1] That is not the point of this discussion. Rather, the values that are suggested for open land put it in the category of a collective good. The benefits are often very intangible and it is difficult to exclude users.

Ecological value has been cited. The concept of the city as part of ecological systems is argued.

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[1]Shomans, pp. 24-40.

Vegetation which would be preserved by greenspace would be part of large ecological cycles such as the carbon and hydrological cycles. Photosynthetic activity makes organic materials using carbon dioxide as an input. In such a way, plants in greenspace or open land might contribute to carbon dioxide equilibrium. It is possible that the carbon dioxide equilibrium will not be affected much by plants preserved in urban areas. Also, the process of evapotranspiration in plants makes them an integral part of the hydrological cycle.

A test has been made showing that open land can be an important factor in helping to remove air pollutants, basically due to the fact that the assimilative capacity of the air in these areas for pollutants is not being used. Ben Davidson, a faculty member of New York University, measured sulfur dioxide concentrations along Seventy-ninth Street going down wind from the Hudson River on Manhattan Island in New York City. Over Central Park, there was a forty percent dilution of the amount of sulfur dioxide in the air. It would be difficult to exclude non-payers from consuming this cleansing activity.

There are also physical values of open land. Vegetation apparently affects micro-climate. It is claimed that trees regulate temperature, humidity, and airflow.

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[1]Shomans, pp. 24-40.

Concrete, in the form of streets and buildings, stores heat on summer days and releases it at night. Evapotranspiration, it is claimed, helps to cool the air. Trees help to reduce the amount of dust in the air by influencing the movement of air, filtering out dust, airborn ash and pollen. Trees and park areas help to diffuse the wind, contributing to human comfort.

Noise is a characteristic of modern American society. Many activities produce enough noise to cause damage to the hearing mechanism. Lower levels of noise may interrupt work, sleep, and conversation and also interfere with desirable soundwaves. Trees tend to cushion noise and deflect soundwaves. This effect would appear to be caused by the trees' effects on air movements, through which sound is transmitted.

Economic values are also claimed, even though all benefits are economic if people are willing to attach values to them. Values of properties adjacent to tracts of open land may increase. The value of land for outdoor recreational activities is becoming more important since opportunities in urban areas are becoming scarcer. Other values include aesthetic appreciation and educational value.[1]

It appears, then, that many of the values claimed for open lands affect other people besides landowners or

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[1]Shomans, pp. 24-40.

occupiers. Open space can be considered to be collective good due to the externalities involved. These externalities could cause an inefficient land use pattern.

It appears that if benefits accrue to people due to the presence of open space, a decision to remove the open space through some land development would result in an external cost equal to the net present value of those benefits being captured by those not involved in the decision. A large part of that cost can contribute to a loss of land values. To the extent that benefits of open space accrue to landowners due to proximity of open space, a decrease of rents on land near open areas will occur when open space is removed. Such costs might result from the loss of amenities that are desired or from the increase in time and travel costs necessary to reach alternative open space opportunities.

Such benefits are difficult to price. As a result, the price received by a supplier of possible open space opportunities may not be equal to marginal social benefit of an open space opportunity. As a result, price multiplied by marginal physical product will not be equal to social value of marginal product. The land use pattern will be inefficient. If the price is greater than social marginal benefit, there will be a mis-allocation of land to open space. If price is less than social marginal benefit, there will be a mis-allocation of land to

non-open space uses. It is the opinion of many that not enough land is allocated to open space in urban areas. The formulation of efficient land use in this thesis shows that the location of open space is also important.

The Problem of Transactions Costs and Resource Allocation: The Coase Rule

The essential statement of the Coase Rule is that given perfect competition, the definition of who pays in externality situations does not affect resource allocation, which will be optimal, but only income distribution, assuming that there are no costs in making transactions.[1] Externalities are important aspects of the urban-rural fringe problem. If there is to be an efficient land use pattern, the rent bid must express the social value of marginal product and land must be allocated to that use which expresses the highest rent. Externalities are a source of rent bid function distortion. Prohibition of development in open space areas will result in external costs being incident upon possible developers and people desiring development. Complete development of an open space area will result in an external cost incident on people desiring open space. A similar situation exists for complete allocation of

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[1] Ronald Coase, "The Problem of Social Cost," in Readings in Microeconomics, ed. by William Breit and Harold Hochman (2nd ed.; Chicago: Holt, Rinehart and Winston, Inc., 1971), p. 490.

resources to construction of housing in the urban-rural fringe. The Coase Rule points out three important problems: (1) the definition of property rights; that is, who pays and who benefits, (2) transactions costs, and (3) market structure. A special section of this chapter will discuss the effects of market structure.

One of the basic problems is definition of property rights which define what market transactions may take place. Ownership of various rights is defined through statutory or common law. Rights are defined concerning who bears the costs of urban-rural fringe development on urban core redevelopment, who is to control development, and who bears the cost of development in the urban-rural fringe. With the open land situation, development of all open land for housing results in an external cost being placed upon those who value open space. If development is prohibited, an external cost is borne by those who desire development in the area. Property rights define the distribution of external costs and the decision structure which allocates land to different uses. According to Coase, there will be an optimum allocation of resources in the Paretian sense regardless of who bears the costs, provided that there are no transactions costs, that perfect competition exists, and income effects are negligible.

Development of land for residential purposes and the use of land to produce open space opportunities will

be discussed in terms of the Coase Rule. With perfect competition, the price of the good produced will equal marginal social benefit. Price is set in the market place. The rent bid made by any firm under conditions of perfect competition is equal to the social value of marginal product.

A housing opportunity is the provision of a dwelling place. When the rate of construction of new dwelling units is zero, the rate of provision of housing opportunities is constant. The value of housing opportunities may increase when open space opportunities are produced. A rent could accrue to residential land due to its proximity to open space opportunities. However, production of open space opportunities may increase the cost of providing more housing thereby reducing the net value of new housing to the producer of new housing opportunities and may change the method of producing new housing units. It would seem that pecuniary and technological externalities exist between a firm that produces open space opportunities and one that produces housing opportunities. Up to a certain level of provision of housing opportunities, provision of open space opportunities may provide an external benefit to the firm providing housing opportunities. Beyond that critical level of housing opportunity provision, production of open space opportunities may provide an external cost to the production of housing opportunities.

The production of housing opportunities may decrease the value of some open space opportunities and may physically interfere with or prevent the production of certain open space opportunities. A pecuniary external cost exists between provision of housing opportunities and provision of open space opportunities. The production of housing may decrease the values of aesthetic views and of the feeling of solitude that might be associated with a location. Provision of housing opportunities might physically interfere with the provision of open space opportunities by not allowing adequate space for an activity to take place. Baseball and football fields need a relatively large amount of space and the amount of space after housing opportunities are provided may not be adequate. So a technological externality may also exist.

Housing opportunities will be provided by one firm and open space opportunities provided by a second firm. In functional notation, the situation could be illustrated in the following manner:

$$D_1 = g_1(Y_1, A_1, A_2, \ldots, A_n, Y_2, P_{Y_1}, P_{Y_2}, P_{A_1}, P_{A_2}, \ldots, P_{A_n})$$

$$D_2 = g_2(Y_2, B_1, B_2, \ldots, B_n, Y_1, P_{Y_1}, P_{Y_2}, P_{B_1}, P_{B_2}, \ldots, P_{B_n})$$

D_1 = profits of firm 1; firm 1 provides housing opportunities

D_2 = profits of firm 2; firm 2 provides open space opportunities

Y_1 = housing opportunities

Y_2 = open space opportunities

$A_1, A_2, \ldots, A_n$ are inputs for firm 1's production process

$B_1, B_2, \ldots, B_n$ are inputs for firm 2's production process

g_1 is a rule that assigns values to D_1 for various combinations of inputs, outputs, and prices

g_2 is a rule that assigns values to D_2 for various combinations of inputs, outputs, and prices

Given that other values are equal, D_1 will increase as Y_2 increases when Y_1 is less than a critical value Y_1', D_1 decreases as Y_2 increases. Given that other values are equal, D_2 will decrease as Y_1 increases.

In further discussion, it will be assumed that Y_1 is greater than Y_1', so that production of open space opportunities results in an external cost being captured by firm 1.

In Figure 12, production of housing increases going to the right along the horizontal axis. Dollars for the cost of producing housing and open space opportunities increase going up the vertical axis. Provision of open space opportunities increases as provision of housing opportunities decrease in a given area of land. The value of external costs incident on the firm producing open space opportunities will be assumed to increase as the amount of housing opportunities provided increases. The value of the external cost incident on the firm providing housing opportunities increases as the amount of open space

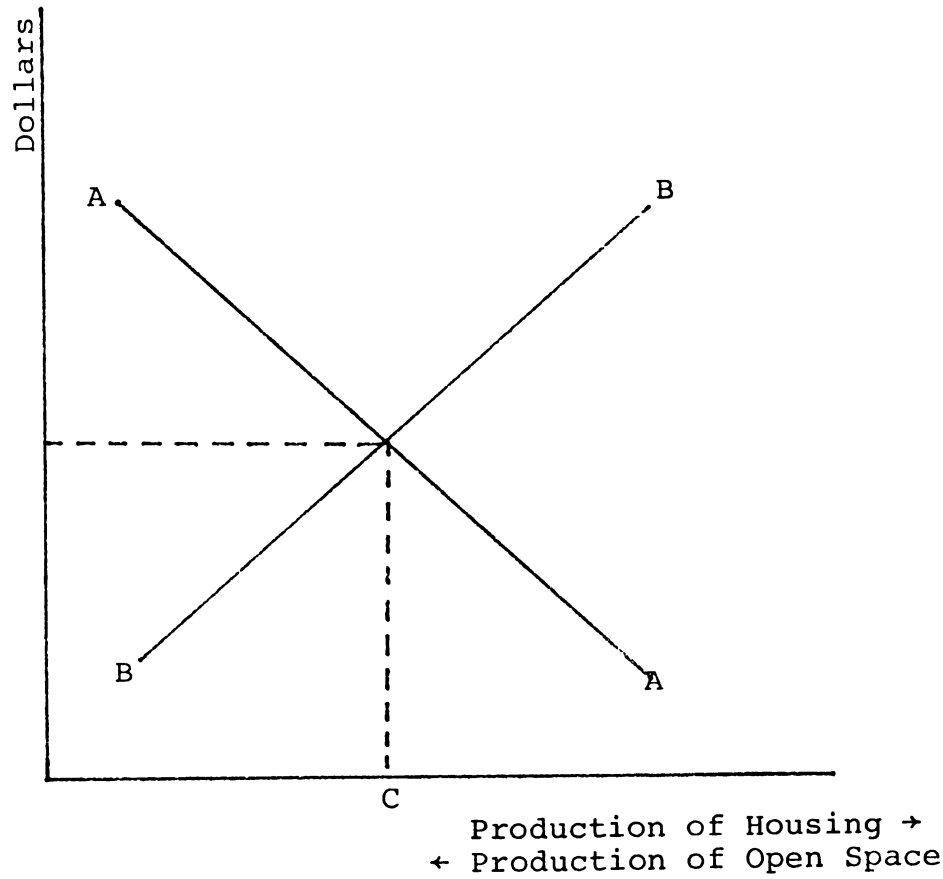

Figure 12.--Demonstration of the Coase Rule.

opportunities and the land devoted to open space opportunities increases. When the firm providing open space opportunities is liable to cover the damages inflicted upon the firm providing housing opportunities, that is, firm 1 has the right to decide how land is to be developed, AA in Figure 12 becomes the marginal benefit curve for firm 1. To simplify matters:

MBA = marginal benefit for firm 1.

Curve BB becomes the marginal cost curve for firm 2, the firm providing open space opportunities. Again, to simplify matters:

MCB = marginal cost for firm 2.

Curve AA defines the minimum that firm 1 will accept to stop increasing the amount of housing opportunities. Curve BB defines the maximum that firm 2 will pay to stop an increase in the amount of housing opportunities. Provision of housing opportunities and provision of open land opportunities will occur at rates such that MBA = MCB; point C in Figure 12. These rates of production will be optimal in the Pareto sense if all individuals affected by the problem are organized into the two firms since the value of the last unit of housing opportunity is equal to the value of the last unit of open space opportunity. If firm 1 is liable to pay firm 2 for the cost captured by firm 2, BB becomes the marginal benefit curve for firm 2, the firm providing open space opportunities. To simplify matters:

MBB = marginal benefit for firm 2.

Curve AA becomes the marginal cost curve for firm 1, the firm providing open space opportunities. Again to simplify matters:

MCA = marginal cost for firm 1.

Provision of housing opportunities and provision of open space opportunities will be the rates such that MBB = MCA, again point C in Figure 12. The definition of who benefits and who pays affects only income distribution and not resource allocation, providing that perfect competition exists, there are no transactions costs, and there are only negligible income effects, three big assumptions. Definition of property rights and trading will remove Pareto relevant externalities.

In this case there is the additional problem of transactions costs, so that the definition of property rights and therefore income distribution will affect allocation of resources. Transaction costs result from finding out:

> . . . whom one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain, to draw up a contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on.[1]

When more than two firms or individuals are involved in a transaction, the problems of collective decision-making

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[1]Coase, p. 495.

costs discussed by Buchanen and interdependencies' costs discussed by Mancur Olson enter. These people have to be identified and organized. People may be difficult to organize because they are apathetic or dislike organizations. Costs may also arise in trying to exclude benefits from people who do not desire to participate in a transaction. These costs may prevent a transaction from taking place or a sub-optimal allocation of resources and inefficient land use pattern might result. External costs that were Pareto-relevant previously might still remain after transactions had taken place.

This situation is demonstrated in Figure 13. Curves AA and BB are the same as in Figure 12. Point C is the same. If firm 1, the firm which provides housing opportunities, has the right to develop land, the minimum bid that it will accept to stop providing more opportunities is its marginal benefit at a given rate of production of housing opportunities, MBA, plus all transaction and collective-decision-making costs incident on it. Curve A_1A_1 shows the minimum bid that firm 1 will accept to stop increasing the number of housing opportunities. The maximum that firm 2 will pay to stop increases in production is MCB minus all transaction and collective decision-making costs incident on it. Curve B_1B_1 shows the maximum bid that firm 2 will offer. The result is a sub-optimal allocation of resources at point D since the value of the last unit

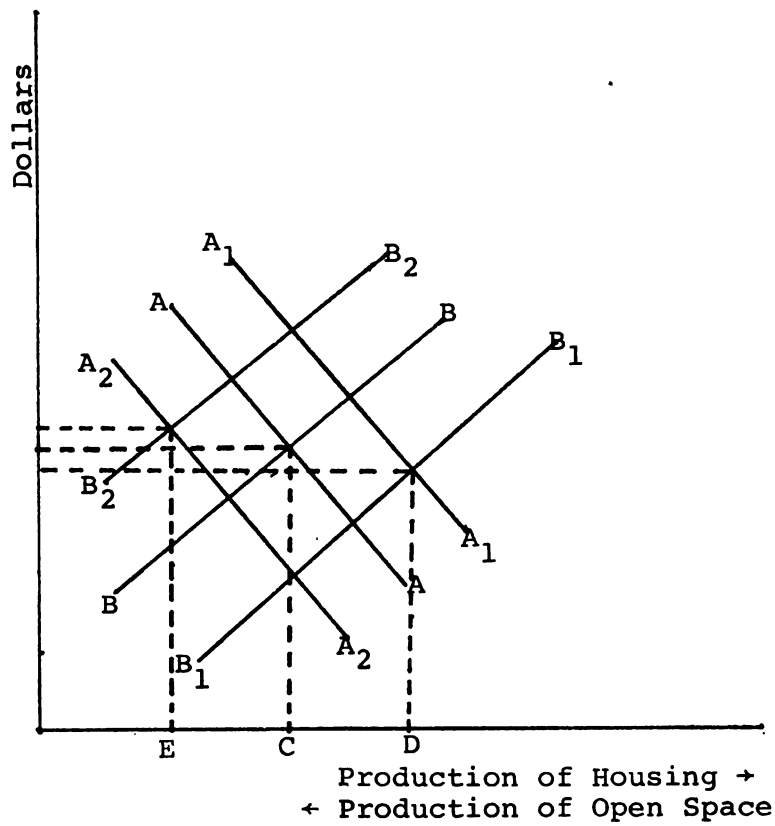

Figure 13.--Demonstration of Coase Rule with transactions costs.

of housing opportunity produced is less than the value of the open space opportunities being forgone. Therefore there is a welfare loss.

If firm 2, the firm that provides open space opportunities has the right to develop land, a different allocation of resources will take place. The minimum that firm 2 will accept to stop provision of open space opportunities is its marginal benefit, MBB, plus all transaction and collective decision-making costs incident on it. Curve B_2B_2 shows the minimum bid that firm 2 will accept at various rates of production. The maximum that firm 1 will pay is its marginal cost, MCA, minus all transaction and collective decision-making costs incident on it. The transaction results in the provision of housing and open space opportunities at point E. Neither D nor E is optimal since there is a welfare loss from point C. At point E, producers of housing bear the loss of welfare, while at point D, those desiring open space bear the welfare loss. Once the rates of provision and open space are set, land will be allocated to the various uses according to the bids made by each firm. The transaction will remove rent distortions due to Pareto-relevant externalities when there are no transaction or collective decision-making costs. When there are transaction and collective decision-making costs, Pareto-relevant externalities may not be removed. The distribution of income which results from property right definition will affect production

occurring on urban-rural fringe land, when there are transaction and collective decision-making costs. When income effects are not negligible, the maximum that the firm without the property right will offer will decrease if income is shifted away from it. The value of production to the firm with the property right will increase thus increasing the minimum it will accept to stop production.

The external, transaction, and collective decision-making costs could make it logical for collective action to take place. As stated previously in this chapter, a rational individual will try to minimize costs at a given level of satisfaction. It is likely that in a situation similar to the example just discussed that there would be several firms involved in providing housing opportunities. Open space opportunities could be provided by a large variety of firms. Government can provide some opportunities through parks and playgrounds. Private individuals and firms could also provide open space opportunities. Farmers might provide small ponds with picnic areas. Farmers might also provide open space opportunities without ever permitting public access to their lands. The view of farmland might be valuable to some people. Open space opportunities come in a wide variety of forms and could be provided by a wide variety of firms. A large number of people outside of the firms providing housing or open space might attempt to become part of the decision-making process because they

feel that their self-interest is involved. It is not uncommon for private citizens to try to save an area of open space in the path of urban development. Public and voluntary collective decision-making costs are very important in such situations.

One method of trying to solve the problem would be to combine firm 1 and firm 2 and make the decision of how to allocate land resources between residential land and open space uses administratively. Market imperfections discussed in the next section will show that the resulting land use pattern may still be inefficient. Transaction costs could be decreased by making the decision within the administrative structure of a single firm or unit of government. However, since one firm might be a unit of government and the other a private firm, this type of solution may not always be politically feasible in this country.

Many people concerned might feel that the best answer is to have government units intervene in this market situation. Attempts might be made to protect open land through applications of the police power, such as zoning. There might also be attempts to use the power of eminent domain to keep land in open space uses. These methods might not necessarily solve the problems of inefficient land use pattern and sub-optimal population density

because the rent bids on land may not equal social value of marginal product.

At the present time, it does not appear that many transactions between groups that cause and bear the costs of externalities that concern an efficient land use pattern are taking place. As described in Chapter I, the institutional characteristics discourage the organization of larger firms to develop land and eliminate external costs by use of administrative decisions. One of the proposed tools of land use planning in many states is preferential tax assessment.

Market Imperfections and Inefficient Land Use Pattern

The market for housing is not perfectly competitive. Three imperfections are: (1) differentiation of product, (2) imperfect knowledge and variations in knowledge among buyers and sellers, and (3) barriers to entry by producers through credit and capital arrangements. As a result, there is a tendency for marginal revenue for the firm to be less than the price of housing. This occurs because:

$$MR = P(1+1/e)$$

MR = marginal revenue of housing firm

P = price of housing

e = price elasticity of demand for housing,

where

$$e = \frac{P}{Q} \cdot \frac{dQ}{dP}$$

Q = quantity of housing.

Price elasticity of demand has a negative value. It is equal to infinity only under conditions of perfect competition. Therefore, marginal revenue is less than price except under conditions of perfect competition.[1] Under conditions of monopolistic competition, a market structure which might describe the housing market, price elasticity of demand is not infinite, because the firm has some discretion in setting price since products are not homogeneous. The rent the firm will bid is equal to marginal revenue multiplied by marginal physical product which is marginal revenue product. Marginal revenue product is less than value of marginal product because price is greater than marginal revenue and marginal physical product is the same for both cases. Value of marginal product is price of output times marginal physical product. A profit-maximizing firm under these market conditions will tend to restrict output, and society will suffer a welfare loss. Less land will be allocated to housing. However, it cannot be said whether lot size will increase, decrease, or stay the same. An efficient land use pattern will not result because the rent bid is not equal to value of marginal product.

The subsidies that result from pricing of utilities and transportation, however, will still encourage housing

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[1]Braff, pp. 174-179, 210-213.

construction in the urban-rural fringe. Rents will still accrue to lands in the urban-rural fringe from those subsidies. It might still be possible that bids in the urban-rural fringe are greater than the social value of marginal product because of the rents accruing from pricing of utilities and transportation. However, housing construction near the urban center may decrease enough to result in a decrease of housing production in the entire urban area. The subsidy resulting from utility and transportation pricing may still continue to encourage a sub-optimal population density.

The effect of the flow of information on market performance does not seem to be discussed much in the economic literature. It would seem, however, that people might desire large lots but would not be aware of all the costs associated with them. As a result, some people might pay more than they really should for a house and lot. If this effect occurred, there would be a tendency for the residential rent bid to be greater than social value of marginal product.

The non-excludability feature of public goods affects the rent bids made and the resulting land use pattern. Open space was classified earlier as a public good. When open space is provided, many people who do not want to pay for its benefits can not be excluded from consuming the benefits of open space. As a result, the price received by a firm will not equal the marginal social

benefit. The rent bid made by the firm will not be social value of marginal product. Allocation of land to large lots and the disappearance of open space will be encouraged. As the section on the Coase Rule shows, the definition of who benefits and who pays in this situation will affect the allocation of land resources when there are transaction and collective decision-making costs.

Summary Statement of the Problem of Sprawl

It appears that sprawl consists of two basic problems: (1) inefficient land use pattern and (2) sub-optimal population density. In Chapter I, tools of analysis, the definition of efficient land use pattern, and information about the process of sprawl were discussed. In Chapter II, sprawl was discussed in economic terms. Government policy, institutional characteristics, market structure, and externalities contributing to the problem of sprawl. It was shown how uniform pricing of utilities might contribute to the problem of sub-optimal population density. Rent bid distortions through utility and transportation pricing, market structure, and externalities and non-excludability of benefits and costs contribute to an inefficient land use pattern. The lack of formal definition of property rights and the presence of transaction and collective decision-making costs are barriers to the clearing of Pareto-relevant externalities.

CHAPTER III

PREFERENTIAL TAX ASSESSMENT IN MICHIGAN

Preferential, or use-value, tax assessment has been suggested as a means to preserve open space, to channel urban growth, and to inhibit urban sprawl. This type of legislation has been passed in many states. Michigan is currently contemplating such legislation. House Bill No. 4100 was introduced in the Michigan House of Representatives on February 3, 1971. House Bill No. 6229 was introduced on May 17, 1972. Both were referred to the House Committee on Taxation. The objective of this chapter is to give a brief discussion on property taxation, its supposed effects on agriculture, and its contribution to sprawl. Then a discussion of the various types of preferential tax assessment and their supposed objectives will be presented. Following that, specific features of H.4100 and H.6229 will be presented and compared.

Taxation

Property taxation is an important institution in the urban-rural fringe. The so-called ad valorem tax is said to be an important element in producing the sprawl

pattern of suburban land use development. The ad valorem, or general, property tax originated in a rural American society and is based on the concept that there is a direct relationship between land ownership and wealth. This relationship may have been true in the nineteenth century, but other forms of wealth are now available and cloud that relationship. Basically, the general property tax is, ideally, a tax on all wealth that has exchange value, whether it is tangible or intangible, movable or immovable. In each taxing jurisdiction, it is to be valued uniformly and taxed at a uniform rate.

Property is defined according to different categories. There is personal property which is movable. This category consists of tangible or intangible property, such as contractual rights. The other category is real property which consists of land and improvements.[1] The tax on real property is the primary concern of this paper.

Barlowe states that the property tax was accepted by the rural society in which it was developed. Tax levies were low since government expenditures were low. Most taxes were used for local government services and improvements so that taxpayers could relate the taxes to benefits received.

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[1]James Gilmore Ahl, "Use-Value Assessment in Macomb County, Michigan: Simulated Effects on Township Finances in Five Townships in the Rural-Urban Fringe, 1960-1969" (an unpublished Ph.D. dissertation, 1971), pp. 8-11.

Land ownership was closely correlated to individual wealth and taxpaying ability.[1]

Land is supposedly assessed for taxation at a certain proportion of its market price at its highest-and-best use. In the urban-rural fringe, there may be more opportunities for development than there is demand for such developed land. However, much farmland in the fringe area is assessed as if it were developed property since that could be considered its highest-and-best use. Given a rate of taxation, the tax bill on undeveloped land will increase as the assessed valuation increases. Value appreciation is a phenomenon anticipated in the urban-rural fringe areas. In developed areas, the demand for public services often increases. In order to cover these cost increases, tax rates increase. The rural landowner is in the position of seeing his holding costs increasing without his ability to pay increasing as long as the land remains in its less intensive use.[2]

These tax increases put the rural landowner in a squeeze. He is often confronted with the decision to try to continue the land's current use or to sell his land to a speculator, developer, corporation, or government for the purpose of urban land use development. The property tax is a fixed cost which does not vary with the output of the

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[1]Barlowe, "Taxation and Agriculture," p. 83.

[2]Ahl, p. 20.

land. In the economic long-run, the decision to continue or shut down has to be made. It is theorized that the tax on the land is borne by the owner of the land at the time that it is levied. Any difference between tax and benefits from the tax will be capitalized into the value of the land. If the tax is greater than the value of benefits received, the land-owner takes a capital loss. It seems likely that owners of large tracts of land in the urban-rural fringe may pay high taxes and receive few benefits. Also taxes on residential property tend to be borne by the occupant, whether landowner or tenant.[1] So the farmer who lives on his own farm may find himself saddled with a large tax burden that cannot be shifted to someone else. The farmer also has little market power in the sale of the product harvested from the land. The price of agricultural goods tends to be set by the market. The incidence of the tax may not be shifted to the consumer in the form of higher food prices. Essentially, the rent on this property has been reduced. Increasing property tax plus other factors may make the sale of land for the development of urban uses more attractive.

It is stated that results of the ad valorem system include: (1) an excessive burden on so-called bona-fide farmers, (2) a contribution to the sprawl pattern of urban

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[1]Dick Netzer, Economics of the Property Tax (3d ed.; Washington, D.C.: The Brookings Institution, 1970), pp. 33-34, 45.

development, and (3) encouragement to the disappearance of open space in the urban-rural fringe.[1]

Raleigh Barlowe suggests that the following improvements are needed in the area of tax policy as it concerns land use policy: (1) continuing efforts should be made to secure better administration of the property tax; (2) property tax levies should be controlled so as to reflect the paying abilities of the property owners; and (3) policies to safeguard agricultural land are needed in areas of suburban and urban expansion.[2]

Preferential Tax Assessment

Preferential tax assessment is a policy whereby land is assessed for property taxation according to its value in an existing use rather than in a potential, more-intensive, highest-and-best use. The land would be assessed at less than market price or a prescribed proportion of that market price. It is thought that in this manner, holding costs of agricultural and other open space uses would be held down allowing that open space use to continue. There appear to be several motives for attempting to have such an assessment policy made into law. First, there are desires among some people to keep high-grade agricultural land in agricultural use. Second, there is a desire to keep

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[1] Ahl, p. 21.

[2] Barlowe, "Taxation and Agriculture," pp. 97-98.

agricultural, forest, and other less intensively used lands around cities as open space for aesthetic reasons. Third, it is hoped that efficient and orderly land use development of urban-rural fringe lands may take place according to the most socially desirable uses.

There are four basic categories of preferential tax assessment. The first is simple use-value assessment. Lands that qualify for assessment are defined under law. The landowners can apply for preferential treatment and if they qualify, their land is assessed according to its value for open space use. All other factors are to be ignored. The second category is deferred, or roll-back, taxation. With this method, two assessed values are recorded. The assessment at use-value is on the tax rolls while the assessment at highest-and-best use is also recorded. If land use is changed to some use that does not qualify under the law, all or part of the difference in taxes between the two assessments becomes due. Sometimes there is an interest charge. Either of the two previous categories can be combined with zoning. Land that qualifies for the preferential treatment may have to be zoned for some open space use by a unit of government with the power to do so. Planning is involved in this way. The fourth category is the use of preferential tax assessment with the acquisition of development rights. The governmental unit contracts with the landowner who surrenders his rights to develop the land into a

more intensive land use than the specified open space use. In return, the landowner may receive compensation in the form of preferential tax assessment. Various penalties may be used if the contract is broken by the landowner.

Michigan Legislation

In recent years, preferential tax assessment legislation has been introduced in Michigan. At the time of this writing, no bill has been passed. As noted above, presently there are two bills before the House Committee on Taxation: H.4100 and H.6229. Both fit into the deferred taxation combined with zoning category. The basic features of these bills are as follows:

H.4100

Eligibility for preferential tax assessment:

> Farmland that is zoned exclusively for agriculture or horticulture, or land devoted to agriculture or horticulture for three previous years and from which the owner derives at least one-third of his total income is eligible for preferential tax assessment. Definition of agriculture or horticulture is not presented in H.4100 or Public Act 206 of 1893, The General Property Tax Act.

Assessment procedure:

> The State Tax Commission publishes a range of property values based upon productivity and net earning capacity. A capitalization rate will be selected that reflects a fair rate of return on investment, risk, and property taxes. Criteria based upon productivity or net earning capacity will be capitalized at the rate selected.

Roll-back procedure:

The difference between taxes paid or payable under preferential assessment and the assessment based on its new use for the current and the two previous years must be paid when the land is sold or used for other than agricultural or horticultural purposes.

H.6229

Eligibility for preferential tax assessment:

Agricultural or horticultural land which is defined to be a tract of land of 100 or more acres under single ownership and devoted to agriculture for three of the five previous years to application is eligible for preferential tax assessment. A tract of land from 5 to 100 acres devoted to agricultural or horticultural use making a minimum of 100 dollars per acre for three of the five previous years to application is also eligible for preferential tax assessment.

Open land is also eligible. Open land is any tract of land of 100 or more acres designated as open land in an official comprehensive land use plan adopted by a regional planning and development district, council of governments, county, city, village, or township. The land must be zoned as open land based on one or more of the following criteria: conservation and enhancement of natural or scenic resources; conservation of soils, wetlands, beaches, or marshes; enhancement of the value to the public of adjoining parks, forests, wildlife preserves, nature reservations, sanctuaries or other open land; protection of streams or water supply; preservation of historical sites; or enhancement of recreational opportunities. A tract of land 5 to 100 acres situated in an urban area and open to public use subject to special conditions of the legislature and retained in a natural state is also considered open space.

Assessment procedure:

Land and improvements are assessed at highest and best use, but only the improvements are taxed at the ad valorem rate. Land subject to the specific tax in H.6229 is classified by the assessor and taxed according to rates defined in the legislation. Each land classification which is based on a soil classification has a tax rate per acre assigned to it.

Roll-back procedure:

> When a landowner wishes to withdraw land from a given classification, he applies for withdrawal and the land is withdrawn on the third tax day after application. When a change in land use that conflicts with the classification is made, a penalty of six percent of assessed value or sales price, whichever is higher, is levied. Upon withdrawal from the classification, the difference between the specific and ad valorem tax for no more than five previous years at six percent compound annual interest must be paid.

There are some fundamental differences between the two bills. H.6229 has a broader classification of eligible lands including open lands for conservation and environmental values, while H.4100 is concerned mostly with agriculture. H.6229 also states that comprehensive land use plans must include a tract of land in the open land category to be eligible. It appears that an attempt has been made, perhaps, to broaden the base of support from farmers to include environmentalists. Explicit reference is made to environmental and urban values in H.6229. Both bills give the agricultural landowner who qualifies a relatively free hand in deciding whether or not to bring his land under preferential tax assessment. While there is a provision for zoning in H.4100, the alternate eligibility requirements appear more lenient than in H.6229.

There is also a major difference in the assessing procedures. Two assessments are specifically stated in H.6229. The state tax commission is to establish values if the provisions of H.4100 became law, while the tax rate per acre for a given soil classification is defined in H.6229.

The provisions of H.6229 would seem to remove flexibility in the operation of the taxing procedure. It appears that any change in tax rates would have to be made by the legislature.

Penalties for changing land use from a classified use are stricter under H.6229 than H.4100. Six percent of the appraised value or sales price, whichever is higher, must be paid when land use is changed without changing the classification. The roll-back provision in H.6229 is five years while it is three years in H.4100. The deferred taxes are subject to six percent interest in H.6229. Landowners must apply for land classification change under H.6229 but not under H.4100. The landowner has a freer hand in decision-making under H.4100.

CHAPTER IV

EVALUATION OF H.4100 AND H.6229

Little is known about the effects of preferential tax assessments. There has not been much empirical observation. In general, the problem has been too complex and time has been too short to really draw conclusions on the effectiveness of these assessment procedures. Most statements on the subject are, in essence, conjecture. Also, the set of variables affecting the urban-rural fringe has been too complex. There is the problem of the lack of knowledge as to what influences the pace of development and the specific kinds of lands involved. Before applying preferential assessments, there are several questions to be answered: What is the function of open space to be? What uses are to be protected and what lands are consistent with that use? Who shall pay? What are the objections to preferential tax assessment as a land use policy? How effective is preferential tax assessment as a land use policy? The last two questions will be emphasized in this chapter. Due to the eomplexity and size of the problem of preferential tax assessment as a land use policy, the evaluation of H.4100 and H.6229 presented in this chapter cannot hope to be the final word.

Discussion of Preferential Tax Assessment in General

Hady indicates that one objection raised to preferential tax assessments is that landowners are given a substantial tax advantage with little being required of them. Tax deferrals and withdrawal penalties remove financial incentives for short term speculation. It would seem that H.6229 defines greater obligations for landowners than H.4100. Neither provides penalties as stiff as those found in Californian or Hawaiian legislation. Speculators might be successful in getting their land classified under the provisions of the tax assessment law.[1] It would seem that as more land uses become eligible, it would be easier for speculators to get their land into an eligible category. Also, as the definition of eligibility requirements becomes less specific, it would be harder to exclude tracts of land that might be owned by speculators. More land uses are eligible under H.6229 than under H.4100. However, the definition of land use that is eligible in each land use category in H.6229 is more specific than the definition of eligible land in H.4100. In both bills, agricultural land uses have loopholes to escape the zoning requirement for eligibility.

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[1]Thomas F. Hady, "An Overview of the Taxation of Open Land," in the Proceedings of the Seminar on Taxation of Agricultural and Other Open Land, No. 1-P5:71-2M-ST (East Lansing: Cooperative Extension Service, Michigan State University, 1971), pp. 5-6, 8.

Ishee also presents some suggested objections. Some people apparently feel that the objectives sought by preferential tax assessments are wrong, that the tax procedures cannot be used effectively to influence land use patterns, and that the costs are not borne by the people who benefit by retaining land in open space. This objection raises the question of "Who pays?" It is argued that the change in local government spending patterns comes at the expense of currently provided government services. The problem of government fragmentation enters. The loss is often retained in areas where tax bases are already low. The benefit of open space goes, to a large extent, to the metropolitan people who are not in that taxation district. This situation might be construed as the distribution of benefits from rural governments to metropolitan people. Also, retaining land in open space does not provide public access to open space. Preferential tax assessment leaves the decision to develop to the landowner, it is argued, and only delays sprawl.[1] Both H.4100 and H.6229 are vulnerable to criticism concerning the distribution of costs and benefits. No attempts are made to handle the problems of government fragmentation or local government finance problems caused by preferential

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[1]Sidney Ishee, "The Maryland Farmland Use-Value Assessment Law," in the Proceedings of the Seminar on Taxation of Agricultural and Other Open Land, No. 1-P5: 71-2M-ST (East Lansing: Cooperative Extension Service, Michigan State University, 1971), p. 33.

tax assessment. The deferred tax and withdrawal penalties attempt to prevent landowners from removing their land from open space uses.

Clawson feels the statement that taxation removes land from less intensive uses is not very sound. Taxes, he claims, affect the demand for land very little. It seems, however, that rents and values would be affected by preferential tax assessment. The question is: how much? It is also felt by Clawson that many administrative problems may result when trying to limit benefits. The message seems to be that it may be easier to let people qualify rather than exclude them, perhaps with undesirable land use patterns resulting. Clawson also feels that landowners should have less discretion in the matter of whether or not land is to remain in open space use.[1] Both H.6229 and H.4100 leave the discretion to apply and withdraw up to the landowner.

James Ahl studied H.4100 in a doctoral dissertation and had several criticisms. There is a shortage of data to implement the legislation. Primarily, it is difficult to assign a use-value assessment to a tract of land. Soil productivity is used. Ahl considers it a poor indicator. This criticism detracts from H.6229 and

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[1]Marion Clawson, "Comments on Taxation of Agricultural Land," in the Proceedings of the Seminar on Taxation of Agricultural and Other Open Land, No. 1-P5:71-2M-ST (East Lansing: Cooperative Extension Service, Michigan State University, 1971), pp. 86-87.

points to a basic weakeness in H.4100. Taxes tend to be redistributed from the participating farmer to the urban property taxpayer and non-participating farm taxpayer. This redistribution depends upon the size of the eligible tract, prior use requirements, and productivity requirements. The greater the amount of participating farmland, the greater the amount of tax that is redistributed. As a result, Ahl feels that alternative sources of revenue will have to be found for rural areas. Cost of use-value administration will be much greater than costs under the general property tax. Administration costs will increase in order to maintain two tax rolls. There will also be costs in defining and maintaining requirements concerning eligibility, equity, and enforcement. There will also be other problems caused by the deferred payments: revenue will not be consistent over time and there will be problems of efficient handling of the deferred funds.[1] The question really appears to be whether or not the costs of this legislation will be justified by the effectiveness of the legislation as a land use policy.

Barlowe implies that preferential tax assessment may work toward a goal of distributive justice. He feels that it is not just for lands socially best suited to their present uses to be assessed at a more intensive use as long as owners are dedicated to the perpetuation of

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[1]Ahl, pp. 178-84.

their present use. Preferential tax assessment could be considered as a means for rewarding owners of land who use their land in what policy-makers might determine to be a socially desirable way such as preserving open space. He also feels that roll-back provisions in preferential tax legislation increase the incentive to keep land in an open space use.[1]

During the 1960's, Ishee reports that farm land in Maryland was converted to non-farm uses at a slower rate than in the 1950's. Preferential tax legislation was enacted in the late 1950's and was in effect throughout the 1960's. Some proponents of preferential tax legislation claim that preferential tax assessment contributed to this lower rate of conversion to non-farm uses. Ishee states that it is not possible to say whether or not preferential tax assessment contributed to the lower rate of conversion. However, it does remain a possibility.[2]

In New Jersey, Garrison reports that the rate of withdrawal of lands from farms slowed considerably from 1967 to 1972 and that the rate of decline of the number of farms has decreased. New Jersey has preferential tax assessment with roll-back provisions. Garrison cites a

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[1]Raleigh Barlowe, "The Effects of Taxes on Land Use with Special Reference to Michigan," in the Proceedings of the Seminar on Taxation of Agricultural and Other Open Land, No. 1-P5:71-2M-ST (East Lansing: Cooperative Extension Service, Michigan State University, 1971), pp. 20-21.

[2]Ishee, pp. 32-33.

study by Rutgers College of Agriculture and Environmental Science in which it was found that 40 percent of all farmers sampled in the study claimed that the Farmland Assessment Act, New Jersey's preferential tax law, was a positive force enabling them to remain in farming. The same study reported that 25 percent of the farmers sampled felt that the law substantially influenced decisions related to added investments. Garrison feels that the New Jersey Farmland Assessment Act contributed substantially to the retention of land in agricultural use in the short run.[1]

The effectiveness of preferential tax assessment is rather controversial. Some people say that it works well; others say that it does not. No one really says what working well or poorly means. There does seem to be a consensus that the promise of a large capital gain can persuade an owner of land under preferential tax assessment to sell the land and change land use. It really seems that the controversy is over whether the preferential tax assessment works a little or not at all. Some people may think that preferential tax assessment may slow the rate of land use conversion and buy time in which to devise better programs. Preferential tax is proposed as a

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[1]Samuel Garrison, "Problems and Impact of the New Jersey Farmland Assessment Act of 1964," in the Proceedings of the Seminar on Taxation of Agricultural and Other Open Land, No. 1-P5:71-2M-ST (East Lansing: Cooperative Extension Service, Michigan State University, 1971), pp. 45-47.

short-run tool which cannot succeed alone but which can be a stop-gap measure as more effective tools are devised, legislated, and implemented. An effective land use policy would change the factors that actually cause sprawl. An effective land use policy would include government planning of the location of improvements such as new roads, utilities, and sewerage so as to encourage a socially desirable land use pattern. Utilities and transportation should be priced in such a way as to prevent the redistribution of rents that favor urban sprawl. Alternative forms of transportation such as mass transit could be included. The distribution of property rights will play an important role in the manner in which land is used. In particular, the acquisition of development rights by public agencies and taxation of capital gains to remove the incentives to change land use could be land use policy tools that are more effective in regulating urban sprawl than preferential tax assessment. There does seem to be a basis for a longer range plan of attack in the form of the Governor's Special Commission on Land Use Report. Also, there is the problem of political feasibility. A land use policy more effective than preferential tax assessment might not be acceptable to the legislature and to the electorate.

Hady feels that preferential tax treatment should be limited to those areas where open space is desired by

policy-makers; that is, there should be some planning involved in the allocation of preferential tax assessment. When this does not occur, the availability of land may be restricted and further leap-frog development may be encouraged. As a result, the costs of providing services to the growing population may increase. Orderly development and planning activities may be hampered by not controlling the way these preferential tax assessments are allocated. Also, the laws may encourage the holding of land for value appreciation if benefits are made available to land which is in the probable path of urban expansion, if preferential tax assessment is not effective in holding land for open space use, and if requirements for obtaining the differential assessment are easy to meet and restrictions on future land use are few.[1] Collin states that the effectiveness of the California law is aided by some government control over withdrawal and entrance procedures. California has an easement arrangement whereby government authorities approve land entering and withdrawing from the program.[2] These statements point to weaknesses in H.4100 and H.6229. Entrance and withdrawal is left to the discretion of the landowner.

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[1]Hady, pp. 8-9.

[2]Don V. Collin, "The California Land Conservation Act: The Easement and Contract Approach to Open Land Planning," in the Proceedings of the Seminar on Taxation of Agricultural and Other Open Land, No. 1-P5:71-2M-ST (East Lansing: Cooperative Extension Service, Michigan State University, 1971), p. 57.

Epp presents the opinion that preferential tax assessments can be an important part of overall land use policy, especially in the influence of short-run decisions. He feels that farming operations can be allowed to continue until land is ready for urban development. Neither H.4100 nor H.6229 provides for a coordinated land use policy. However, the call for one has been made by the Governor's Special Commission on Land Use. Epp feels that alternative policies would be to shift certain local services to the national or state level so that part of the local finance problem could be relieved, user charges could be used whenever possible, and greater reliance could be made upon taxes other than the property tax (such as income or capital gains taxes) for raising revenues. Zoning and public purchases of lands and rights could also be used.[1]

Effectiveness of H.4100 and H.6229

An attempt will be made to discuss the probable effectiveness of these bills in terms of the concepts presented previously in this thesis. It appears that the proposed legislation has little or no effect upon many of the factors involved in the process of urban expansion

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[1]Donald J. Epp, "Taxation of Agricultural and Other Open Land," in the Proceedings of the Seminar on Taxation of Agricultural and Other Open Land, No. 1-P5: 71-2M-ST (East Lansing: Cooperative Extension Service, Michigan State University, 1971), pp. 83-86.

and urban sprawl. Indeed, it appears that the legislation will have little effect upon the rent bid functions of urban land unless there are indirect feedback effects that are not immediately noticeable. The implementation of these bills should have no effect upon net population growth in urban areas, the determinants of which are natural increase and migration. It does not appear that the legislation considered the impact of population growth upon urban growth and land use patterns. Population growth is a major factor in urban expansion and sprawl. Nor does the legislation have any impact upon another major factor, transportation technology, particularly upon which types of technology should be affected. Also, little is being done to influence consumer preferences or income elasticities of demand for space or environmental quality.

Other factors which may be more easily affected are also neglected. There is no attempt to change pricing of public services to a user-charge system. No mention is made of transportation costs and capital markets for various modes of transportation. The pricing methods of such utilities as electricity and water are also neglected. The tendency for rents to be redistributed due to these pricing methods is not dealt with. While H.6229 and and H.4100 provide tools for planning, no attempt has been made to influence planning decisions on the local level

that affect rent bid functions or the fragmentation of government that can permit fiscal zoning and incompatible plans.

The proposed legislation does little to affect the institutional structure of the suburban land market. In particular, differences of information among various buyers and sellers have not been attacked by this bill. The credit markets for raw suburban land have not been affected. Risk from holding land in the urban-rural fringe does not appear to have decreased, permitting longer term loans which may enable larger firms to make development plans and take on larger, better coordinated projects. Equity requirements have not been changed. Finally, the legislation has not taken into consideration the concept of the collective good. There has been no attempt to define benefits and costs that result from open land and various land use patterns. Nor has there been any attempt to define rights; that is, who benefits and who pays. In particular, there has been no attempt to define development rights and methods for the state, corporations, and other organizations to deal with development rights. As a result, the legislature has made no explicit attempt to deal with the problems of sub-optimal population density and inefficient land use pattern. The transactions costs which can distort market solutions have not been dealt with. It would seem that the failure to deal with some

causes of urban sprawl which are perceived to be important would raise questions as to the effectiveness of H.4100 and H.6229 as land use policies.

Use-value legislation may affect the valuation placed upon eligible land. The tax deferred per year may be considered a rent which can be capitalized into the land value. Use-value assessment will affect expectations of future income on eligible land. In this way, the rate of rural to urban land use conversion might be affected by the effect upon supply of land for more intensive uses. Use-value assessment will affect the rent bid functions of lands which are eligible. There might also be some external effects that cause the value of land near preserved open space to increase. Also, rent bids for urban land might increase due to the decrease in supply of land for urban uses. The question is: How important are these effects of use-value assessment and will these effects make use-value assessment an effective policy tool? An effective land use policy tool will be one that brings about an efficient land use pattern where the rent bids are equal to social value of marginal product. If that cannot be achieved by use-value assessment, the effectiveness of use-value assessment will have to be evaluated in terms of decreasing the rate in acres per year at which land is converted from rural to urban use. For preferential tax assessment to be considered effective

when it does not bring about an efficient land use pattern, the rate of rural to urban land use conversion would have to be decreased to a level low enough to give policy-makers enough time to devise more effective policy tools that will keep certain non-urban lands in their present uses. Some possible more effective policy tools were discussed in a previous section of this chapter.

Geometric Analysis

More specific discussion of these bills (H.4100 and H.6229) will now be presented. A spectrum of urban growth from stagnation to rapid growth will be covered. In this geometric analysis, three stages, (1) stagnation, (2) moderate growth, and (3) rapid growth, will be discussed. Initially, a simple preferential tax assessment will be discussed. H.4100 and H.6229 will be presented in a later section.

Use-value assessment will have an effect upon the rent bid functions. The difference between the ad valorem tax and preferential tax payments multiplied by one minus the marginal income tax rate will be considered to be a rent on eligible land. Property taxes are deductible from taxable income. The decrease in the tax payment increases the net income on the fixed factor, land. The assumption is made that owners of eligible land will exercise the option to have land assessed under preferential tax assessment. It is also assumed that

property tax assessors assess land for ad valorem taxes at the market value of land in its market highest and best use or at some constant fraction of that market value. Highest and best use is that use which will produce the highest rent on land given a market structure. The income capitalization approach should produce an assessed value equal to the market value of land in its highest and best use. At some distance from the urban center, use value assessment may be equal to ad valorem assessment since non-urban uses will produce the highest market value in some areas. It will also be assumed that land in the urban-rural fringe will have a use-value assessment less than ad valorem assessment. In working with rent bid functions, only the agricultural rent bid function and the outermost urban rent bid function will appear in the diagrams because the problem of sprawl occurs in the peripheries of urban areas.

Before discussing these cases, however, the problem of an efficient land use pattern will be discussed. Land use pattern is efficient when all rent bid curves express social values of marginal product in each use over space. It will be shown that there is no reason to expect an efficient land use pattern to occur when use-value assessment is enacted. In Figure 14, line U' is the rent bid function of the outermost urban land use. It does not express the social value of marginal product for

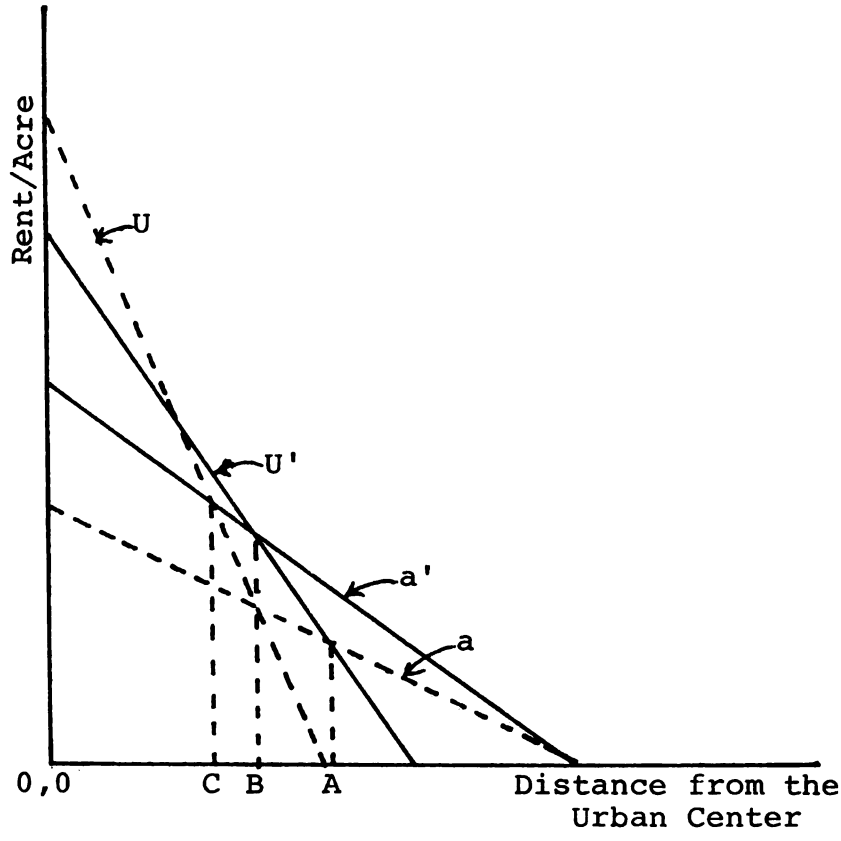

Figure 14.--Land use patterns and efficient land use pattern.

U = Urban VMP
U' = Distorted urban rent bid function
a = agricultural rent bid function prior to use value assessment
a' = agricultural rent bid function after use value assessment.

Point C describes efficient land use pattern; A, the pattern without use value assessment; B, the pattern with use value assessment.

reasons discussed in Chapters I and II. Line U describes social value of marginal product. Line "a" is the agricultural rent bid function prior to use-value assessment. Line "a'" is the agricultural rent bid curve after use-value assessment. It will be assumed that use-value assessment is obtained by capitalizing the income from the present use into a net present value or some constant fraction of that value. The margin between urban highest and best use will occur at point A with ad valorem tax and at point B with use-value assessment. Neither of the land use patterns that result can be considered to be efficient since U' does not equal social value of marginal product. If it is assumed that the agricultural rent bid function "a'" is equal to the social value of marginal product for agriculture, the margin occurring at point C would define an efficient land use pattern. Line "a'" is considered to be the social value of marginal product because this is the rent bid that will occur after a policy decision is made to enact use-value assessment. Use-value assessment is enacted because the rent bid under ad valorem assessment did not produce the desired land use pattern. The land use pattern resulting from "a'" and the urban rent bid function U', point B, might be considered to be a better land use pattern than the pattern that results from ad valorem taxation. By coincidence, if the rent bid functions had the correct configuration, an efficient land

use pattern might be forthcoming from preferential tax assessment.

The phenomenon of growth will now be dealt with. The state of transportation technology and the pricing mechanism of transportation will be held constant for the time being. The result of urban growth through population growth, income growth, or both will be an outward shift of the urban rent bid curve. Urban growth may result from an increase in population, an increase in aggregate income, or both. As a result of urban growth, the demand function for land for urban uses will shift upward and outward causing the price of such land to increase and the urban rent bid curve to shift upward and outward at all locations. An area of economic stagnation will not have its urban rent bid curves shift out. The faster the rate of population or income increase, the faster will be the rate of outward urban rent bid curve shift. Stated in a different manner, after a given time period, the rent bid curve of a stagnant area will not have shifted outward, the rent bid curve of a moderately growing area will have shifted outward, and the rent bid curve of a rapidly growing area will have shifted out farther. In Figure 15, line A is the rent bid curve for all three cases at the initial point in time, t_0. It will also be the rent bid curve of the stagnation case at the final point in time, t_1. Line T_1 is the rent bid curve

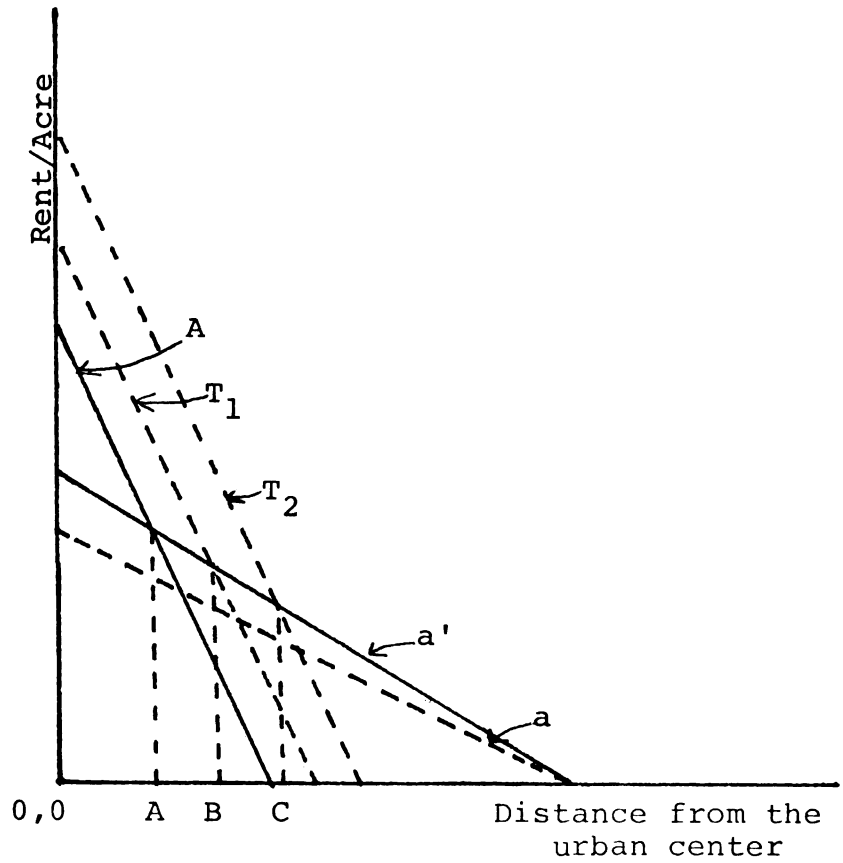

Figure 15.--Various rates of rent bid function shift over time period t_1-t_0. A is the position of all cases at t_0. At t_1, A is the rent bid curve for the stagnation case, T_1 the rent bid curve for the moderate growth case, and T_2 the rent bid curve for the rapid growth case.

of the moderate growth case at t_1, and line T_2 is the rent bid curve for the rapid growth case at t_1. Figure 15 shows that the margin between urban and rural highest and best use is farther from the urban center at t_1 with the moderage growth case (point B) than the stagnation case (point A) when there is preferential tax assessment. At t_1 with the rapid growth case, the margin with preferential tax assessment (point C) is farther from the urban center than the margin for the moderate growth case with preferential tax assessment (point B). Two things can be said: (1) An efficient land use pattern will occur by coincidence in these three cases. (2) Sprawl may have been contained in these three cases, so the situation might be considered by some individuals to be better than if there was no preferential tax assessment. These conclusions were deduced from Figure 14. Lines "a" and "a'" are the same in Figure 15 as in Figure 14, so that the same conclusions apply to the land use patterns in Figure 15 as the land use pattern shown by point B in Figure 14. In the stagnation case, the urban area might actually decrease with preferential tax assessment. It seems possible that the lands previously developed might not revert to less intensive uses immediately. In areas where the margin is shifting out, actual development may not be keeping up. The faster the rate of urban growth, the farther out the margin between urban and rural land use will shift during

the given time period, regardless of whether there is a preferential tax assessment or not. Sprawl is favored in the more rapidly growing areas.

The writers cited earlier in this chapter seem to agree that preferential tax assessment is not "the answer" to urban sprawl, rather it is a short-run tool that may buy time for better programs to be developed. The effectiveness of preferential tax assessment should be analyzed in the context of slowing urban sprawl. A different application of the basic diagram presented in this chapter will be examined. In Figure 16, point B is the margin between agricultural and urban land use without preferential tax assessment. Point A is the margin with preferential tax assessment. A measure of the effectiveness of preferential tax assessment in each case would be the amount of time it takes for the margin to shift from A to B as urban curves shift outward with growth. With no population or income increases, assuming that transportation technology and pricing do not change, the time required for the margin to shift from A to B would be very large. This case is one of stagnation; the rate of movement of any given point on a rent bid curve in a horizontal path to the right will approach zero units per unit of time. As a result, t_1-t_0, the time required for the margin to shift from A to B, will approach infinity. The larger the value of t_1-t_0, the greater will be the effectiveness of preferential tax

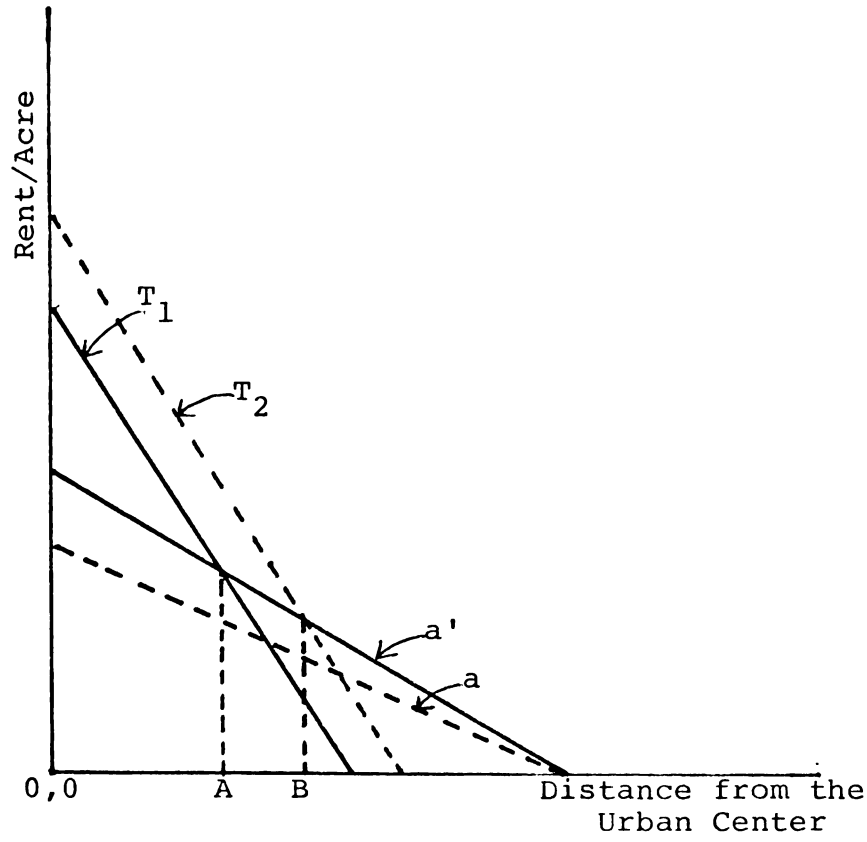

Figure 16.--Shifting out of urban rent bid curves. Line a is the agricultural rent bid curve with ad valorem taxation. Line a' is the agricultural rent bid curve with preferential tax assessment. Line T_1 is the urban rent bid curve at time t_0. Line T_2 is the urban rent bid curve at time t_1. Point B is the margin at t_0 when there is ad valorem taxation. Point A is the margin at t_0 when there is preferential taxation. Point B is again the margin at t_1 when the urban rent bid curve shifts to T_2 and there is still preferential taxation. Time period t_1-t_0 is the amount of time it takes for the margin to shift from A to B when there is preferential taxation.

assessment. When the urban growth rate is very fast, urban rent bid curves shift to the right faster (Figure 16) and t_1-t_0 approaches zero, indicating that the effectiveness is relatively low. The effectiveness in each of these cases depends upon the differences between ad valorem and preferential taxes and the rate of growth. The rate of growth of an urban area increases as the rate of population growth increases, the rate of income growth increases, or both increase. Given a difference between the taxes, the preferential tax assessment becomes less effective as the rate of growth of an urban area increases.

If transportation technology or pricing is allowed to change in such a way as to favor landowners in the urban-rural fringe, preferential tax assessment becomes less effective. If present pricing techniques continue, highway construction in the urban area that reduces time costs in moving from the fringe to the urban center will decrease the time period needed to move from A to B in Figure 16. In Figure 17, this effect is demonstrated. With the stagnation case, t_1-t_0 would decrease as the urban rent bid curve shifts from T_1 to T_2. The line T_2 is the urban rent bid curve after transportation time costs have decreased for land owners in the fringe area. It does not seem implausible that areas growing in terms of population and income would have more roads built,

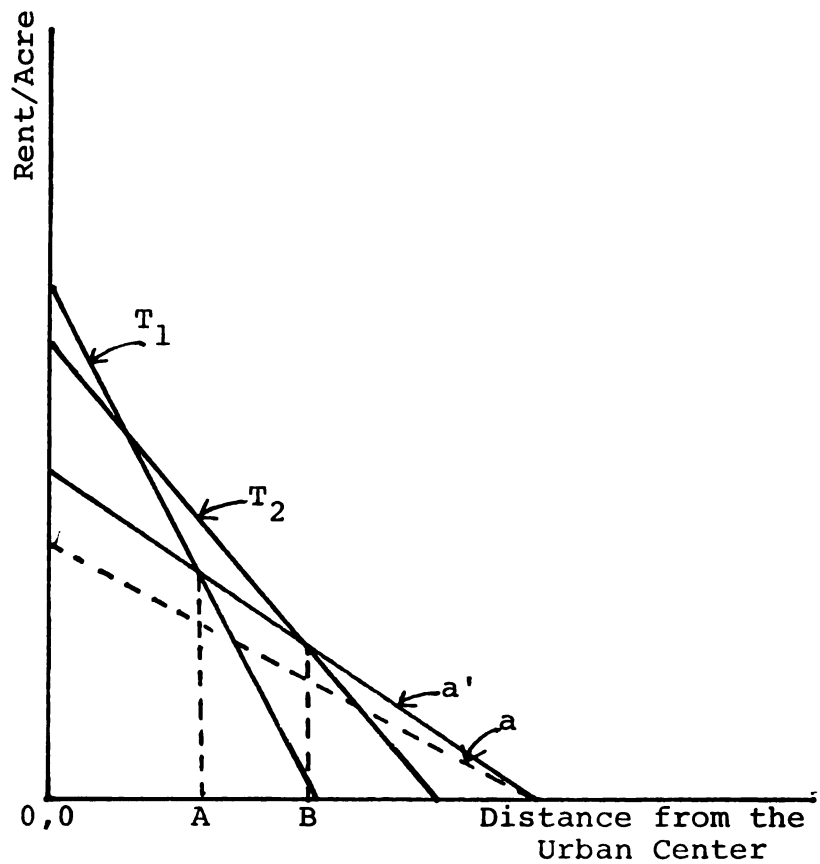

Figure 17.--Change in the urban rent bid function. T_1 is an urban rent bid curve such that the bid is not a social value of marginal product. A is the margin between urban and rural use for T_1. T_2 is a second urban rent bid function that results from changing transportation pricing or technology. The bids are not a social value of marginal product. B is the margin between urban and rural use for T_2.

particularly expressways. Preferential tax assessments in this case will be less effective than any of the cases discussed previously. Given a rate of urban growth, the value of t_1-t_0 will be less when time costs for landowners in the fringe area decrease than when they remain constant.

Mathematical Analysis

Preferential tax assessment will now be explored in mathematical terms. First, simple preferential tax assessment will be explored. Decision rules presented in Chapter I will be used. If $V_a < V_b$, property rights will be transferred from a to b, provided that individual "a" holds the property rights originally. Net present value is represented by the following equation:

$$V_z = \sum_{y=0}^{m} \frac{R_y - (1-s)P_y - C_y}{(1+i)^y}$$

V_z = net present value calculated by individual z

z = a or b

y = time period in individual z's planning period

m = last time period in individual z's planning period

R_y = gross rent in time period y

P_y = property tax in time period y

C_y = other costs in time period y

s = marginal income tax rate

i = interest rate, which is an alternative rate of return plus a factor for risk.

The agricultural land owner will be a, while b is a potential buyer for more intensive land use. (See Appendix A for a complete listing of variable names.)

Two hypothetical urban areas will be presented. They are A and B. For the time being only one time period will be used. Later, more time periods will be used. The equation of the outermost urban rent bid curve of case A at the initial point in time is:

$$R_{u,0} = 105 - 50x$$

$R_{u,0}$ = gross urban rent at the initial point in time, t_0

x = distance from the urban center in miles.

The agricultural rent bid curve at the initial point in time for case A is the following equation:

$$R_{f,0} = 60 - 9.1x$$

$R_{f,0}$ = gross agricultural rent bid at the initial point in time, t_0

x = distance from the urban center in miles.

The outermost urban rent bid function of case B at the initial point in time is described by the following equation:

$$R_{u,0} = 1000 - 80x.$$

The agricultural rent bid curve of case B at the initial point in time is described by the following equation:

$$R_{f,0} = 200 - 10x.$$

The margin between urban highest and best use and agricultural highest and best use at t_0 is defined by

$R_{u,0} = R_{f,0}$ assuming that holding costs for both the urban and agricultural uses are equal. The margin between urban and rural highest and best uses at t_0 before preferential tax assessment is 1.10 miles from the urban center in case A and 11.42 miles from the urban center for case B.

Preferential tax assessment results in rent accruing to the owners of agricultural land. The rent is defined by the following equation:

$$p = (1-s)(P_y - P'_y)$$

p = rent per acre

P_y = ad valorem property tax

P'_y = preferential tax assessment.

It will be assumed in this discussion that p = \$5.00. It is also assumed that there is a parallel shift in the agricultural rent bid curve equal to p. For case A, the gross agricultural rent bid becomes:

$$R'_{f,0} = 65 - 9.1x = 60 - 9.1x + 5 = R_{f,0} + p$$

$R'_{f,0}$ = agricultural rent bid with preferential tax assessment at the initial point in time, t_0.

After such a preferential tax assessment, the margin between urban and agricultural highest and best use is defined by $R_{u,0} = R'_{f,0}$. The margin in case A shifts to 0.98 miles from the urban center. It will be assumed in this paper that there are no other causes of agricultural rent bid shifts other than preferential tax assessment so that

$$R_{f,0} = R_{f,1}$$

and

$R'_{f,0} = R'_{f,1}$

$R_{f,1}$ = agricultural rent bid at the final point in time, t_1, when there is no preferential tax assessment

$R'_{f,1}$ = agricultural rent bid at t_1 with preferential tax assessment.

Over a period of time, if there is growth in the urban area as discussed in the geometric analysis section, the urban rent bid curve will shift out so that it is described by:

$R_{u,1} = 110 - 50x = R_{u,0} + p$

$R_{u,1}$ = urban rent bid at time t_1.

This rent bid curve will have experienced an upward shift of $5.00. The margin between urban and agricultural highest and best use described by $R_{u,1} = R'_{f,0}$ occurs 1.10 miles from the urban center. During that time, 503 acres would have been converted from agricultural to urban highest and best use. If preferential tax assessment was not applied in this case, the margin between urban and agricultural highest and best use would be defined by $R_{u,1} = R_{f,1}$ and would occur 1.22 miles from the urban center rather than at 1.10 miles. During this time period, 563 acres would be converted from agricultural to urban highest and best use without preferential tax assessment. The rate of growth will be varied by varying the length in years of the time period t_1-t_0. The shorter the length of time, the faster will be the rate of urban growth caused by population or income increase. During

the time period t_1-t_0, 503 acres will be converted from rural to urban highest and best use when there is preferential tax assessment and 563 acres will be converted when there is no preferential tax assessment. The shorter the time period in years of t_1-t_0, the greater will be the yearly rate of conversion of land from rural to urban use in acres per year. Below are given various lengths of time in years for the time period t_1-t_0. Table 1 shows the rate of rural to urban land use conversion per year for the different values of t_1-t_0. During the time period t_1-t_0, the outermost urban rent bid function shifts from:

$$R_{u,0} = 105 - 50x$$

to

$$R_{u,1} = 110 - 50x.$$

Table 1.--Rate of land use conversion for two different tax policies in case A.

Time period t_1-t_0 (years)	Rate of land use conversion for preferential tax (acres per year)	Rate of land use conversion for ad valorem tax (acres per year)
10	50.3	56.3
5	101.0	112.6
2	251.0	281.5
1	503.0	563.0
1/2	1006.0	1126.0

Table 2 presents the ratio of the rates of land use conversion for ad valorem to preferential taxes. The preferential tax assessment results in a lower rate of conversion of land from agricultural highest and best use than the ad valorem assessment. The ratio between the rates of land use conversion is equal to the ratio of the total amount of acreage converted under ad valorem assessment and the total amount of acreage converted under preferential tax assessment. Since the urban area is assumed to be circular, this ratio is equal to the ratio:

$$(1.22^2 - 1.10^2)/(1.10^2 - 0.98^2) = 1.12.$$

It will be shown after case B is presented that the different tax assessments do little to affect the rate of land use conversion.

In case B, if p = \$5.00, the margin between urban and agricultural highest and best use shifts from 11.42 miles from the urban center to 11.35 miles when preferential

Table 2.--The ratio of land use conversion rates for ad valorem tax to preferential tax in case A.

Time period t_1-t_0 (years)	Ratio ad valorem tax to preferential tax
10	1.12 = 56.3/50.3
5	1.12
2	1.12
1	1.12
1/2	1.12

tax assessment is applied. The agricultural rent bid curve will have become:

$$R'_{f,0} = R'_{f,1} = 205 - 10x = 200 - 10x + 5 = R_{f,0} + p.$$

After a period of time, the urban rent bid function will have shifted up to:

$$R_{u,1} = 1005 - 80x = 1000 - 80x + 5 = R_{u,0} + p.$$

The margin at time t_1 will be 11.42 miles from the urban center when preferential tax assessment is used. A total of 3,220 acres will have been converted from rural to urban highest and best use when preferential tax assessment is used. If there is no preferential tax assessment, the margin will occur at 11.50 miles from the urban center. A total of 3,680 acres would have been converted from rural to urban highest and best use with ad valorem taxation. Presented in Table 3 are some lengths of time that indicate rates of shifting out of urban rent bid

Table 3.--Rate of land use conversion for two different tax policies in Case B.

Time period t_1-t_0 (years)	Rate of land use conversion for preferential tax (acres per year)	Rate of land use conversion for ad valorem tax (acres per year)
10	322	368
5	644	736
2	1610	1840
1	3220	3680
1/2	6440	7360

curves and corresponding rates of land use conversion for preferential and ad valorem tax assessments.

Table 4 presents the ratio of the rates of land use conversion for ad valorem to preferential taxes.

In case B, the ratio of the rates of land use conversion is equal to the ratio:

$$(11.50^2-11.42^2)/(11.42^2-11.35^2) = 1.14.$$

Given a circular city, assuming that preferential tax assessment causes a parallel shift of the agricultural rent bid curve in the area of concern and that other costs on the land remain constant, it is not difficult to prove that the results of cases A and B should occur. The area of land use conversion in acres is:

$$640\pi x_1^2 - 640\pi x_0^2 = 640\pi(x_1^2 - x_0^2)$$

x_1 = radius of urban area at point in time t_1

x_0 = radius of urban area at point in time t_0.

Table 4.--The ratio of land use conversion rates for ad valorem to preferential tax in case B.

Time period t_1-t_0 (years)	Ratio ad valorem tax to preferential tax
10	1.14 = 368/322
5	1.14
2	1.14
1	1.14
1/2	1.14

The ratio of rates of land use conversion is:

$$640\pi(v_1^2 - v_0^2)/640\pi(w_1^2 - w_0^2) = (v_1^2 - v_0^2)/(w_1^2 - w_2^2)$$

v_t = radius of urban area with ad valorem tax assessment at time t

w_t = radius of urban area with preferential tax assessment at time t

t = 1 or 0, for points in time t_1 or t_0.

It appears then that preferential tax assessment has little effect upon the rate of land use conversion. The rate of land use conversion is the number of acres per year converted from rural use to urban use. The difference in the rates of land use conversion for preferential tax assessment and ad valorem tax assessment is due to the fact that land converted from rural to urban use under ad valorem assessment is farther from the urban center than the land converted under preferential tax assessment. The difference in land use conversion depends upon the qualities of a circle rather than upon preferential tax assessment. If $v_1 = w_1$ and $v_0 = w_0$, the rates of land use conversion will be equal for preferential tax assessment and ad valorem assessment. The rate of land use conversion is determined by the shifting out of urban rent bid curves.

The basic accomplishment of preferential tax assessment at this stage of the analysis is that at time t_1 the margin is at 1.10 miles from the urban center rather than 1.22 miles in case A and at 11.42 miles rather

than 11.50 miles from the urban center in case B. Preferential tax assessment affects the location of the margin between urban and rural highest and best use. It has an effect upon which area of the circular city is converted from rural to urban land use. Preferential taxation does not directly affect the rate of conversion by controlling the shifting out of the urban rent bid curves. However, since preferential does move the margin closer to the urban center, the decrease in the rate of land use conversion can be attributed to the enactment of preferential tax assessment. Preferential tax assessment could be considered to be buying time to formulate other land use policies. The faster the rate of growth of the urban area, the less will be the time bought by preferential tax assessment.

The situation becomes more complex when expectations and interest rates are dealt with. It will be assumed that all urban land users are identical and that agricultural land users are identical. The margin between urban and rural highest and best use occurs where

$$V_a = V_b$$

V_a = net present value calculated by agricultural land users

V_b = net present value calculated by urban land users.

When $V_a < V_b$, the highest and best use will be urban. When $V_a > V_b$, the highest and best use will be agricultural.

If the numerator of the expression for V_z given at the beginning of this mathematical analysis section is constant, as m approaches infinity:

$$V_z = \frac{R_y - (1-s)P_y - C_y}{i^y} .$$

If $(1-s)P_y$, C_y, and i are equal for both urban and agricultural land owners and R_y is not expected to change in the future, the margin that occurs where $V_a = V_b$ will be the same as the one that occurs where the urban and agricultural rent bid functions are equal. The effects of preferential tax assessment will also be the same.

Expectations of change in R_y will change the value of V_z. Assume that urban land users expect rents in future time periods to increase on parcels of land in the urban-rural fringe or on agricultural lands just outside of the fringe area. Expectations of rent will be assumed to be related to the expectations of growth in the demand for land which in turn is related to past observations of the demand for land. It will be assumed that agricultural users will not have expectations of future rent increase. Cases A and B will be used in this analysis.

Time will be handled differently. Potential urban land users have a planning period which will be the time period over which they have expectations of urban rent increase. The planning period exists in a framework of

discrete, measured time rather than continuous time. Time will consist of periods labeled t_k. The units of time will be years. The year which is numbered k will be labeled as t_k. For example, year 1 is labeled t_1. Once t_0 is set, the labels for the following time period are set. The value of t_k can be k = 0, 1, 2, 3, ... to infinity. Time t_0 is a point in time. Imeediately after t_0, time period t_1 begins and extends for a year whereupon t_2 begins. Time period t_n-t_0 is the time period against which the rate of urban rent bid increase is measured. The value of t_n is n. By definition, urban land users will expect rent to increase by $5.00 per acre during t_n-t_0. The value of $5.00 was chosen because that value was used earlier in this analysis when discussing rent bid increases. This value is identical to the increase in rent per acre on agricultural land that results from preferential tax assessment. The urban land user's planning period is superimposed upon the general framework of time. Each time period within that planning period is labeled by a value of y. The first year in the planning period has a value of y = 1. The planning period is assumed to be five years long so that the time periods in the planning period which are years take on the values y = 0, 1, 2, ..., 5. A year in the planning period beginning at t_k is symbolized by t_{k+y}. Thus the yth year in the planning period is year k+y in the general framework of time. The value of k+y is always an integer. It is assumed

that at the end of the planning period, urban land users will expect the rent occurring in t_{k+5} to be constant for perpetuity. It is important to realize that there can be only one integer value assigned to t_{k+y} while any value of y can be assigned to a year depending upon the value of k, once a starting point, t_0, is defined. The net present value of land is calculated for a year t_{k+y} where y = 0. The value becomes:

$$V_{b,k,x} = \sum_{y=0}^{4} \frac{R_{u,k+y,x} - (1-s)P_{k+y} - C_{k+y}}{(1+i)^y} + \frac{R_{u,k+y,5} - (1-s)P_{k+5} - C_{k+5}}{i(1+i)^5}$$

$V_{b,k,x}$ = net present value of urban land in t_k at distance x from the urban center

$R_{u,k+y,x}$ = expected gross rent in t_{k+y} at distance x from the urban center

P_{k+y} = expected property tax in t_{k+y}

C_{k+y} = other expected costs in t_{k+y}

$R_{u,k+5,x}$ = expected gross rent in time period t_{k+5} at x

P_{k+5} = expected ad valorem property tax in time period t_{k+5}

C_{k+5} = expected other cost in time period t_{k+5}

s = marginal income tax rate

i = interest rate.

With preferential tax, the net present value of agricultural land at distance x from the urban center is:

$$V_{a,k,x} = \frac{R_{f,k,x} - (1-s)P'_k - C_k}{i}$$

$V_{a,k,x}$ = net peresent value of agricultural land calculated in t_k at distance x from the urban center

$R_{f,k,x}$ = gross agricultural rent per acre at time t_k at distance x from the urban center

P'_k = agricultural property tax after preferential tax assessment in time period t_k.

It will be assumed that P_{k+y}, C_{k+y}, P'_k and C_k, when y = 0, 1, 2, ..., 5, are all constant and will be specified in each case. Through algebraic manipulation, when $V_{a,k,x} = V_{b,k,x}$; that is, the margin between urban and rural highest and best use defined at time t_k, it is found that:

$$t_{k,x} = \frac{c\left[\frac{i_1}{i_2} ef - r'_{0,x}g\right] - h}{g}$$

$t_{k,x}$ = the time period at which distance x from the urban center is the margin between urban and rural use

$c = (t_n - t_0)/5$

$e = r^*_{0,x} + 5$

$f = (1+i_1)^5$

$g = 1+i_1 \sum_{y=0}^{4} (1+i_1)^{5-y}$

$h = 5 + i_1 \sum_{y=0}^{4} (1+i)^{5-y} y$

$r'_{0,x} = R_{u,0,x} - (1-s)P_k - C_k$, when k = 0

$$r^{*}_{0,x} = R_{f,0,x} - (1-s)P_k - C_k, \text{ when } k = 0$$

i_1 = urban interest rate

i_2 = agricultural interest rate.

See Appendix B for a derivation of this equation. The value of $t_{k,x}$ is specific to a value of x, a distance from the urban center. This equation solves for the time of conversion from rural to urban land use given a set of rent bid curves, costs, interest rates, expectations of rent increase, and a context of time. The location with which this analysis will be concerned is the margin between agricultural and urban highest and best uses at t_0 with ad valorem taxation. Once preferential tax assessment is applied at t_0, the margin will move toward the urban center. At t_0, urban land users will begin to have expectations of future rent increase which are a function of past urban growth. A value, $t_{k,x}$, will be calculated to show when the margin at t_0 with ad valorem taxation and no expectations will be converted from agricultural to urban highest and best use for various expectations of growth for cases A and B. When the value of $t_{k,x}$ calculated is a non-integer value, it will be rounded up to the next integer. All negative values become zero.

With case A, $i_1 = i_2 = 0.06$, $s = 1/2$, $C_k = C_{k+y} = 10$, $P_k = P_{k+y} = 20$, and $P'_k = 10$. These values are constant. $R_{u,0,1.10} = R_{f,0,1.10} = 50$ at 1.10 miles from

the urban center, the margin at t_0 without preferential tax assessment. The urban rent bid curve shifts from:

$$R_{u,0} = 105 - 50x$$

to

$$R_{u,n} = 110 - 50x.$$

The agricultural rent bid function with ad valorem taxation is:

$$R_{f,0} = 60 - 9.1x.$$

After preferential tax assessment, the agricultural rent bid function becomes:

$$R'_{f,0} = 65 - 9.1x.$$

When there are no expectations, the value of x at the margin between urban and rural uses is 0.98 miles from the urban center at t_0 and 1.10 miles at t_n when preferential tax assessment is applied. The value of $V_{a,k,x}$ at all values of k when x = 1.10 and there is preferential tax assessment is $584. Table 5 shows the value of $t_{k,1.10}$

Table 5.--Values of $t_{k,1.10}$ for various values of t_n-t_0 for case A.

t_n-t_0	$t_{k,1.10}$
10	5
5	1
2	0
1	0
1/2	0

for various values of $t_n - t_0$. Potential urban land users expect the rent per acre of any location to increase by $5/(t_n - t_0)$ dollars per year.

In case B, $i_1 = i_2 = 0.06$, $s = 1/2$, $C_k = C_{k+y} = 20$, $P = P_{k+y} = 30$, $P'_k = 20$, and $R_{u,0,11.42} = R_{f,0,11.42} = 86$ at the margin between urban and rural use at t_0 without preferential tax assessment. The urban rent bid curve shifts from

$$R_{u,0} = 1000 - 80x$$

to

$$R_{u,n} = 1005 - 80x.$$

The agricultural rent bid curve with ad valorem taxation is:

$$R_{f,n} = 200 - 10x.$$

The agricultural rent bid curve with preferential tax assessment is:

$$R'_{f,0} = 205 - 10x.$$

The value of x, which is the distance from the urban center of the margin between urban and rural land use, is 11.35 miles at t_0 and 11.42 miles at t_n when preferential tax assessment is applied. Table 6 shows the value of $t_{k,11.42}$ when $V_{a,k,x} = V_{b,k,x}$ at x = 11.42 miles from the urban center for various values of $t_n - t_0$. Potential urban land users expect the rent per acre of any location to increase by $5/(t_n - t_0)$ dollars per year.

Table 6.--Values of $t_{k,11.42}$ for various values of t_n-t_0 for case B.

t_n-t_0	$t_{k,11.42}$
10	5
5	1
2	0
1	0
1/2	0

Expectations of future rent increase by potential urban land users on lands in the urban-rural fringe increases the rate at which the margin between urban and rural highest and best uses moves away from the urban center. Without preferential tax assessment, the margin between urban and rural highest and best uses at t_0 with ad valorem taxation will be converted to urban highest and best use at t_0 when there are expectations of rent increase, that is, $t_{k,x} = 0$ for all values of t_n-t_0 and therefore at all rates of expected rent increase greater than 0. This is not difficult to demonstrate:

$$V_{b,0,x} = r'_{0,x} + \frac{r'_{1,x}}{(1+i)} + \frac{r'_{2,x}}{(1+i)^2} + \frac{r'_{3,x}}{(1+i)^3} + \frac{r'_{4,x}}{(1+i)^4} + \frac{r'_{5,x}}{i(1+i)^5}$$

$$V_{a,0,x} = r^*_{0,x} + \frac{r^*_{0,x}}{(1+i)} + \frac{r^*_{0,x}}{(1+i)^2} + \frac{r^*_{0,x}}{(1+i)^3} + \frac{r^*_{0,x}}{(1+i)^4} + \frac{r^*_{0,x}}{i(1+i)^5}.$$

Since $r^*_0 = r'_0$, the value of $r'_{f,x}$ is always greater than $r^*_{0,x}$ when f = 1, 2, ..., 5. Thus:

$$\frac{r^{*}_{0,x}}{(1+i)^{y}} < \frac{r'_{f,x}}{(1+i)^{y}} \text{ , when } y = 1, 2, 3, 4$$

and

$$\frac{r^{*}_{0,x}}{i(1+i)^{5}} < \frac{r'_{5,x}}{i(1+i)^{5}} .$$

As a result, $V_{b,0,x} > V_{a,0,x}$ at t_0 and at the margin between urban and rural highest and best use with no expectations, x, when there are expectations of future rent increase.

In both cases A and B, the results of preferential tax assessment are different from those of ad valorem tax assessment only when the rate of expected rent increase is relatively low and $t_n - t_0$ is 10 or 5. When $t_n - t_0$ is 2, 1, or 1/2, the margin at t_0 with ad valorem taxation is converted from rural to urban highest and best use at t_0, the same point in time when that point would be converted if there were no preferential tax assessment. Any effects in delaying the conversion of land from rural to urban use caused by preferential tax assessments when there are expectations of future rent increase are noticeable only when the expected rates of increase are relatively low.

Differences in interest rates between urban and agricultural land users will cause the margin between agricultural and urban highest and best use to change. The interest rate, which was called the discount rate in Chapter I, reflects the interest rate on alternative

sources of funds and an uncertainty factor. This interest rate guides the rate of return that is desired by any individual. When the interest rate of urban land users is greater than that of agricultural land users, the margin between urban and rural highest and best use defined by $V_{a,k,x} = V_{b,k,x}$ at any t_k tends to move toward the urban center relative to the location of that margin when interest rates are equal. When the interest rate of urban land users is less than agricultural land users, the margin tends to move away from the urban center relative to the margin where the interest rates are equal. This effect is not difficult to demonstrate. When there are no expectations of future rent increase, the net present value of land becomes:

$$V_{b,k,x} = \frac{R_{u,0,x} - (1-s)P_0 - C_0}{i_1} = \frac{r'_{0,x}}{i_1}$$

i_1 = urban interest rate

$$V_{a,k,x} = \frac{R_{f,0,x} - (1-s)P_0 - C_0}{i_2} = \frac{r^*_{0,x}}{i_2}$$

i_2 = agricultural interest rate.

The above two equations hold for all values of t_k when rents do not increase. Preferential tax assessment has not been applied, but it is not central to this short discussion of interest rates. $R_{u,0,x}$ will be set equal to $R_{f,0,x}$ so that $r^*_{0,x} = r'_{0,x}$. When $i_1 = i_2$, $V_{a,d} = V_{b,d}$. If $i_1 > i_2$, $V_{a,k,x} > V_{b,k,x}$; the margin moves nearer to

the urban center relative to the margin defined when the interest rates are equal. If $i_1 < i_2$, $V_{a,k,x} < V_{b,k,x}$; the margin moves away from the urban center relative to the margin defined when the interest rates are equal.

Given the rent bid functions for case A, the urban interest rate, i_1, will equal 0.07, while the agricultural rate, i_2, remains at 0.06. Without preferential tax assessment, the margin between urban and agricultural highest and best use decreases from 1.10 miles to 0.98 miles from the urban center at t_0. With preferential tax assessment, the margin decreases to 0.945 miles from the urban center at t_0. In case B, without preferential tax assessment, the margin moves from 11.42 miles to 11.33 miles from the urban center at t_0. With preferential tax assessment, the margin moves to 11.24 miles from the urban center at t_0. If i_1 becomes 0.05 while i_2 remains at 0.06, the margin in case A is 1.22 miles from the urban center at t_0. With preferential tax assessment, the margin moves to 1.12 miles from the urban center at t_0. In case B, without preferential tax assessment, the margin moves to 11.55 miles from the urban center at t_0. With preferential tax assessment, the margin moves to 11.49 miles from the urban center at t_0.

Two tables show the values of $t_{k,x}$ corresponding with values of $t_n - t_0$ for the conversion of the margin that exist between urban and rural highest and best uses at

t_0 with ad valorem taxation to urban use after the application of preferential tax assessment. The two cases are illustrated with both combinations of interest rates. Urban rents per acre are expected to increase at a rate of $5/(t_n-t_0)$ dollars per year. Table 7 shows the calculations for case A while Table 8 shows the calculations for case B.

Table 7.--Values of $t_{k,x}$ for case A.

t_n-t_0	$t_{k,0.98}$ $i_1=0.07$ $i_2=0.06$	$t_{k,1.22}$ $i_1=0.05$ $i_2=0.06$
10	7	6
5	2	1
2	0	0
1	0	0
1/2	0	0

Table 8.--Values of $t_{k,x}$ for case B.

t_n-t_0	$t_{k,11.33}$ $i_1=0.07$ $i_2=0.06$	$t_{k,11.55}$ $i_1=0.05$ $i_2=0.06$
10	8	5
5	3	1
2	0	0
1	0	0
1/2	0	0

The calculations of $t_{k,x}$ for cases A and B are very similar. For both cases and both combinations of interest rates, it is only when the value of t_n-t_0 is 5 or 10 that $t_{k,x}$ has a greater value than zero. Preferential tax assessment delays the conversion of the margin between urban and rural highest and best uses at t_0 with ad valorem taxation to urban use only at the relatively low rates of expected rent increase. There seems to be no difference between the results of preferential tax assessment and ad valorem taxation when t_n-t_0 is 2 or less. The differences in interest rates affect the location of the margin. When the urban interest rate is higher than the agricultural rate, the difference in interest rates works with the preferential tax assessment. When the urban interest rate is lower than the agricultural rate, the difference tends to work against the preferential tax assessment. This effect is noticed only at the lower rates of urban growth when t_n-t_0 is 10 or 5.

Given a rate of land use conversion, if the urban interest rate becomes greater than the interest rate on less intensive uses, it will take longer for the margin between urban and rural uses to reach the original margin once preferential tax assessment is enacted than if the urban and rural interest rates were equal. This occurs because more land will have to be converted when the urban interest rate is higher than the interest rate on less

intensive land uses. If the urban interest rate is lower than the interest rate of less intensive uses and there is a preferential tax assessment, the margin will tend to move toward the original margin when there was no preferential tax assessment and the interest rates were equal for urban and less intensive uses. The combination of preferential tax assessment with urban interest rate higher than agricultural interest rate would seem to be a more effective policy for keeping land in less intensive uses than preferential tax assessment combined with (1) the urban interest rate equal to the agricultural interest rate or with (2) urban interest rate less than agricultural interest rate.

The effectiveness of preferential tax assessment in preventing the conversion of a margin defined at t_0 with ad valorem taxation given a set of rent bid curves will be affected by changing transportation technology and changing transportation pricing policies. These changes can increase the rents on lands in the urban-rural fringe relative to the rents on lands closer to the urban center. When such a situation occurs, preferential tax assessment will become less effective in preventing the conversion of a margin defined at t_0 with ad valorem taxation. This margin exists in the context of the rent bid curves existing prior to the change in transportation technology or pricing policies. As an example, suppose that the urban rent bid function in case A changes from:

$$R_{u,0} = 105 - 50x$$

to

$$R^*_{u,0} = 100 - 40x$$

$R^*_{u,0}$ = gross urban rent at t_0 after a change in transportation technology or pricing policy.

The agricultural rent bid curves remain the same with or without change in urban rent bid curves. The margin between urban and agricultural highest and best use at t_0 with ad valorem taxation would move out to 1.29 miles from the urban center. With preferential tax assessment, the margin will be 1.13 miles from the urban center at t_0. Once this change in rent bid functions takes place, preferential tax assessment will fail to keep the margin within 1.10 miles from the urban center.

In case B, if the urban rent bid curve, due to a change in transportation technology or pricing policy, changes to:

$$R^*_{u,0} = 900 - 70x,$$

and the agricultural rent bid curves with and without preferential tax assessment do not change, the margin between urban and agricultural highest and best uses will occur at 11.58 miles from the urban center when there is preferential tax assessment at t_0. Preferential tax assessment will not be able to keep the margin between land uses inside the radius of 11.42 miles from the urban center, which is the margin that occurs at t_0 with ad valorem taxation before a change in transportation technology or pricing policy.

The conclusions that can be made about simple preferential tax assessment are listed. (1) Preferential tax assessment, given a set of rent bid functions, affects the location of the margin between urban and agricultural highest and best uses. (2) Preferential tax assessment, has little effect upon the rate of conversion of land from agricultural to urban highest and best use. The effect that preferential tax assessment has upon the location of the margin, however, does affect the rate of land use conversion. The rate of land use conversion is affected by the portion of the circular city being affected provided that the rate of urban rent bid curve shift is not affected as the margin moves away from the urban center. (3) Interest rates, particularly the differences between agricultural and urban rates, affect the location of the margin between urban and less intensive uses. (4) Expectations of land rent increase in lands in the urban-rural fringe increase the rate of conversion of lands from agricultural to urban highest and best use. (5) Preferential tax assessment becomes more effective in buying time for the formulation of land use policies as the rate of growth of an urban area decreases. (6) Preferential tax assessment does not affect the original urban rent bid functions. If the urban rent bid functions change, the margin that results from the simultaneous solution of the original rent bid functions no longer applies. It

appears, then, that simple preferential tax assessment does not attack the crux of the urban sprawl problem.

It is now time to deal with the roll-back modification of preferential tax assessment as outlined by H.4100 and H.6229. The equation for $t_{k,x}$ follows:

$$t_{k,x} = \frac{c\left[\frac{i_1}{i_2} ef + Zi_1 f - r'_{0,x} g\right] - h}{g}$$

$c = (t_n - t_0)/5$

$e = r^*_{0,x} + 5$

$f = (1+i_1)^5$

$g = 1 + i_1 \sum_{y=0}^{4} (1+i_1)^{5-y}$

$h = 5 + i_1 \sum_{y=0}^{4} (1+i_1)^{5-y} y$

i_1 = urban interest rate

i_2 = agricultural interest rate

$r'_{0,x} = R_{u,0,x} - (1-s)P_k - C_k$, when $k = 0$

$r^*_{0,x} = R_{f,0,x} - (1-s)P_k - C_k$, when $k = 0$

$t_{k,x}$ = the time period at which distance x from the urban center is the margin between urban and rural use

$Z = \sum_{y=3}^{5} (1-s)\ (P_y - P'_y) = 3(1-s)(P_y - P'_y)$ = the value of the rollback in dollars when H.4100 is discussed

$$Z = \sum_{y=1}^{5} (1-s)(P_y - P'_y)(1.06)^y = (1-s)(P_y - P'_y) \sum_{y=1}^{5} (1.06)^y$$

= the value of the rollback in dollars when H.6229 is being discussed.

Table 9 shows the value of $t_{k,1.10}$ for case A in which the margin defined at t_0 with ad valorem taxation at 1.10 miles from the urban center is converted from agricultural to urban highest and best use for simple preferential tax, H.4100 and H.6229, given various values of $t_n - t_0$. Urban rents per acre are expected to increase by $5/(t_n - t_0)$ dollars per acre. The table shows the time period, t_k, in which the margin defined at 1.10 miles from the urban center will be converted from rural to urban use if simple preferential tax assessment, H.4100, or H.6229 was applied at t_0 given a rate of expected rent increase equal to $5/(t_n - t_0)$. The rate of expected rent increase varies as $t_n - t_0$ varies.

Table 9.--Values of $t_{k,1.10}$ for three tax policies in case A.

$t_n - t_0$	Simple preferential tax	H.4100	H.6229
10	6	8	10
5	1	2	4
2	0	0	0
1	0	0	0
1/2	0	0	0

For case B, Table 10 presents the value of $t_{k,11.42}$ for when the margin defined at t_0 with ad valorem taxation and at 11.42 miles from the urban center is converted from agricultural to urban highest and best use. Simple preferential tax assessment, H.4100, or H.6229 is applied at time t_0.

The rollback provision in both bills increases the effectiveness of preferential tax assessment in slowing the conversion of the margin defined at t_0 with ad valorem taxation from rural to urban highest and best use. The effectiveness of preferential tax assessment in buying time to formulate other land use policies will be increased. The form for the equation for $t_{k,x}$ shows that the greater the value of the rollback, the greater will be the value of $t_{k,x}$:

$$t_{k,x} = kZ + K$$

Z = value of rollback in dollars

Table 10.--Values of $t_{k,11.42}$ for three tax policies in case B.

$t_n - t_0$	Simple preferential tax	H.4100	H.6229
10	5	8	9
5	1	2	3
2	0	0	0
1	0	0	0
1/2	0	0	0

$$k = \frac{ci_1 f}{g}$$

$$K = \frac{c\left[\frac{i_1}{i_2} ef - r'_{0,x} g\right] - h}{g}$$

House Bill No. 6229 has a provision whereby if land is converted from rural to urban use without first withdrawing the land from the less intensive land use classification, a penalty of six percent of the sale value or the assessed value, whichever is higher, is assessed. This penalty tends to slow the conversion of the margin defined at t_0 with ad valorem taxation. The margin between rural and urban highest and best use occurs when:

$$V_{b,k,x} = V_{a,k,x} + Z + 0.06V_{b,k,x}$$

which reduces to:

$$V_{b,k,x} = 1.06(V_{a,k,x} + Z).$$

The equation for $t_{k,x}$ becomes:

$$t_{k,x} = 1.06kZ + K'$$

$$k = \frac{ci_1 f}{g}$$

$$K' = \frac{c\left[\frac{i_1}{i_2} 1.06ef - r'_{0,x} g\right] - h}{g}$$

The values $t_{k,x}$ for cases A and B for the various values of t_{n-0} are shown in Table 11.

Table 11.--Values of $t_{k,x}$ for cases A and B with the penalty provision in H.6229.

$t_n - t_0$	Case A $t_{k,11.10}$	Case B $t_{k,11.42}$
10	13	15
5	6	7
2	0	1
1	0	0
1/2	0	0

The penalty provision in H.6229 increases the effectiveness of preferential tax assessment in slowing the conversion of the margin defined at t_0 with ad valorem taxation. For the first time, when $t_n - t_0$ is 2 in case B, the effect of preferential tax assessment results in a value of $t_{k,11.42}$ greater than zero.

Increasing the difference between preferential tax and ad valorem tax will make preferential tax a more effective stop-gap measure. In both cases A and B, $(1-s)(P_y - P'_y) = p$ will be doubled to \$10.00, keeping P_y constant. All other values will remain the same in finding values of $t_{k,x}$. The equation for $t_{k,x}$ is again:

$$t_{k,x} = kZ + K.$$

Table 12 shows the values of $t_{k,1.10}$ for the conversion of the margin between rural and urban highest and best uses defined at t_0 with ad valorem taxation calculated for preferential tax assessment, H.4100 and H.6229 for case A. Table 13 gives the values of $t_{k,11.42}$ for case B.

Table 12.--Values of $t_{k,1.10}$ for case A with increased rollback.

t_n-t_0	Simple preferential tax	H.4100	H.6229
10	16	19	23
5	6	8	10
2	0	1	1
1	0	0	0
1/2	0	0	0

Table 13.--Values of $t_{k,11.42}$ for case B with increased rollback.

t_n-t_0	Simple preferential tax	H.4100	H.6229
10	15	20	23
5	6	8	10
2	0	1	1
1	0	0	0
1/2	0	0	0

The greater the difference between preferential and ad valorem tax payments, the more effective the preferential tax assessment will be in preventing the conversion of the margin between rural and urban highest and best uses defined at t_0 with ad valorem taxation. When t_n-t_0 is 10 or 5, the value of $t_{k,x}$ increases for both cases and all forms of preferential tax assessment. When t_n-t_0 is 2, the value of $t_{k,x}$ is greater than zero for H.4100 and H.6229 in both cases. However, the faster the expected rate of growth and therefore the greater the promise of

capital gain, the less will be the effectiveness of these preferential tax assessment policies.

Two more conclusions can be added to the six enumerated earlier. (1) Roll-back procedures and penalty provisions increase the effectiveness of preferential tax policies. The greater the value of the rollback, the more effective preferential tax assessment will be in preventing the conversion of land from agricultural to urban highest and best use. Also, the greater the percentage of sales value that is paid as a penalty when land is converted without going through the proper reclassification, as provided in H.6229, the more effective will preferential tax assessment be. (2) The effectiveness of preferential tax assessment increases as $(1-s)(P_y - P'_y)$ increases. The main conclusion of this paper is that none of the preferential tax assessment schemes deal with the crux of the problem, that is, with inefficient land use pattern and sub-optimal population density.

CHAPTER V

CONCLUSIONS

Land use problems are being more noticed and are gaining in importance. Land use changes in an urbanizing society are producing land use patterns that are considered undesirable by some people. One of the major land use problems is that of urban sprawl, gluttonous land use development on the edges of urbanized areas.

Two aspects of the problem of sprawl seem to be sub-optimal population density and inefficient land use pattern. The pricing of utilities and of transportation systems have contributed to the problem of rent distortion and redistribution that contribute to the problems of population density and land use pattern. The land-market structure also contributes to the problem. One of the more important aspects is the flow of information. Governmental fragmentation is also an important factor. Credit markets may be an important influence. Sprawl seems to be one of the results of the urban expansion and technological change given the structure of markets and institutions and the policies of governments.

Taxation of farmland has been cited as a cause of the sprawl situation. The Governor's Special Commission on

Land Use has called for preferential tax assessment to attack that problem. The Commission felt that ad valorem taxation is a very important cause of undesirable land use development. It appears, however, that taxation is not all that important a factor. The factors of urban growth are complex and the system is not well understood. The Governor's Special Commission on Land Use should be criticized for describing the system as simple.

Preferential tax legislation has been introduced into the Michigan House of Representatives and has been referred to the House Committee on Taxation. The legislation takes the form of H.4100 and H.6229. Preferential tax assessments appear to be, at best, a short-run land use policy tool. These assessments may be effective in slowing urban development. Preferential tax assessments do not seem to be able to reconcile the problems of sub-optimal population density and inefficient land use pattern.

The geometric analysis shows that preferential tax assessment does not necessarily result in an efficient land use pattern. This result occurs because the rent bid functions do not necessarily express values of marginal product over space. Sprawl, however, may be contained by preferential tax assessment. Preferential tax assessment is more effective in containing sprawl in areas where urban growth is relatively slow. Preferential tax assessment

does not affect the urban rent bid functions that are distorted due to highway construction or changing transportation technology.

Several conclusions result from the mathematical analysis. (1) Preferential tax assessment, given an urban rent bid curve and an agricultural rent bid curve with ad valorem tax assessment, affects the agricultural rent bid curve and thus affects the location between urban and rural highest and best uses. (2) Preferential tax assessment has little effect upon the rate of land use conversion. Effects upon the rate of land use conversion are brought about by the effect by preferential tax assessment upon the location of the area converted from rural to urban land use. (3) Interest rates, particularly the differences between urban and rural interest rates, affect the location of the margin between urban and rural highest and best uses. (4) Expectations of land rent increase on lands in the urban-rural fringe area increase the rate of conversion of lands from agricultural to urban highest and best use. (5) Preferential tax assessment becomes more effective as the rate of growth of the urban area decreases. (6) Preferential tax assessment does not affect any of the urban rent bid functions. (7) Roll-back and penalty procedures in H.4100 and H.6229 increase the effectiveness of preferential tax policies. (8) The effectiveness of preferential tax assessment increases as

the difference between ad valorem and preferential tax payments increases. Preferential tax assessment does not seem to deal with the problem of rent bid distortion that results from transportation and utility pricing problems as well as those that result from externalities.

Effectiveness of preferential tax assessment decreases as the rate of urban growth increases. This implies that preferential tax assessment may not be worth the cost of implementation in areas where effective land use policy is most needed.

Problems with these conclusions arise from the analytical tools used. The analysis used linear rent bid functions. If the functions were simple downward sloping curves, the conclusions might not change much. Many simplifying assumptions were used. Once these assumptions are relaxed, an urban area may no longer be circular. The rent bid functions could also become very complex increasing and decreasing over space in no way resembling the functions used in this analysis. However, the rules would still apply but the resulting patterns would be more complex than a series of concentric circles.

The analysis is limited by the analytical concepts used. If the system's behavior can be described by rent bid functions and compound interest formulas, the analysis will not apply directly. This thesis has been

an attempt to analyze the effects of preferential tax assessment, an increasingly promoted land use policy tool, upon the processes of urban sprawl.

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APPENDICES

APPENDIX A

APPENDIX A

t_k = period of time on the absolute time scale, where k=1, 2, 3, ... to infinity

t_{k+y} = time period in a planning period for a net present value calculated at t_k, where y = 0, 1, 2, ..., 5

$t_{k,x}$ = period of time when a point at distance x from the urban center is converted from rural to urban highest and best use

C_k = holding costs, excluding property tax, at time t_k

i = interest rate

i_1 = urban interest rate

i_2 = agricultural interest rate

m = last time period in the planning period

P_k = ad valorem property tax at time t_k

P'_k = preferential tax payment at time t_k

p = rent per acre resulting from preferential tax policy = $(1-s)(P'_k-P_k)$

$R_{u,k}$ = gross urban rent at time t_k

$R_{u,k,x}$ = gross urban rent at time t_k and distance x from the urban center

$R_{f,k}$ = gross agricultural rent per acre at time t_k

$R_{f,k,x}$ = gross agricultural rent at time t_k and distance x from the urban center

$R'_{f,k}$ = gross agricultural rent per acre with preferential tax assessment at time t_k

$R'_{f,k,x}$ = gross agricultural rent with preferential tax assessment at time t_k and distance x from the urban center

$R^*_{u,k}$ = gross urban rent per acre after a change in transportation technology or pricing policy at time t_k

$R^*_{u,k,x}$ = gross urban rent per acre after a change in transportation or pricing policy at time t_k and distance x from the urban center

r'_k = net urban rent per acre at time t_k

$r'_{k,x}$ = net urban rent per acre at time t_k and distance x from the urban center

r^*_k = net agricultural rent per acre at time t_k

$r^*_{k,x}$ = net agricultural rent per acre at time t_k and distance x

s = marginal income tax rate

t_0 = point in time where urban rent at any given x begins to increase and preferential tax assessment is applied

t_n = point in time where the urban rent has increased by a specified amount, in this thesis it was $5.00 per acre, over all points in space

x = distance from the urban center

$V_{z,k,x}$ = net present value of land in use Z at time t_k and distance x from the urban center, where z = a for agricultural use and z = b for urban use

$$c = \frac{t_n - t_0}{5}$$

$$e = r^*_{0,x} + 5$$

$$f = (1 + i_1)^5$$

$$g = 1 + i_1 \sum_{y=0}^{4} (1 + i_1)^{5-y}$$

$$h = 5 + i_1 \sum_{y=0}^{4} (1 + i_1)^{5-y} y$$

$$K = \frac{c\left[\frac{i_1}{i_2} ef - r'_{0,x} g\right] - h}{g}$$

$$K' = \frac{c\left[\frac{i_1}{i_2} 1.06ef - r'_{0,x} g\right] - h}{g}$$

Z = the value of the rollback in preferential tax in dollars

for H.4100:

$$Z = \sum_{y=3}^{5} (1-s)(P_y - P'_y) = 3(1-s)(P_y - P'_y)$$

for H.6229:

$$Z = \sum_{y=1}^{5} (1-s)(P_y - P'_y)(1.06)^y$$

$$= (1-s)(P_y - P'_y) \sum_{y=1}^{5} (1.06)^y$$

$$k = \frac{ci_1 f}{g}$$

APPENDIX B

APPENDIX B

$t_k = t_{k,x}$ when distance x is converted from rural to urban use. $V_{a,k,x} = V_{b,k,x}$ at distance x from the urban center and at time t_k. It is assumed that rent is paid at the beginning of the time periods, that is, at y = 0.

$$V_{b,k,x} = \sum_{y=0}^{4} \frac{r_{y,x}}{(1+i_1)^y} + \frac{r_{5,x}}{i_1(1+i_1)^5}$$

It is assumed that urban land users assume the expected rent in t_5 to be constant for perpetuity. The term:

$$\frac{r_{5,x}}{i_1}$$

defines what the net present value would be in t_5. The term:

$$\frac{r_{5,x}}{i_1(1+i_1)^5}$$

discounts the net present value for t_5 back to t_0.

$$r_{y,x} = r'_{0,x} + (k+y)\,\frac{t_n - t_0}{5}\,, \text{ as } y = 0, 1, 2, \ldots, 5.$$

$$V_{b,k,x} = \frac{r'_{0,x} + (k+0)\,\frac{t_n - t_0}{5}}{(1+i_1)^0} + \frac{r'_{0,x} + (k+1)\frac{t_n - t_0}{5}}{(1+i_1)^1}$$

$$+ \frac{r'_{0,x} + (k+2)\frac{t_n - t_0}{5}}{(1+i_1)^2} + \frac{r'_{0,x} + (k+3)\frac{t_n - t_0}{5}}{(1+i_1)^3}$$

$$+ \frac{r'_{0,x} + (k+4)\frac{t_n - t_0}{5}}{(1+i_1)^4} + \frac{r'_{0,x} + (k+5)\frac{t_n - t_0}{5}}{i_1(1+i_1)^5}$$

$$V_{b,k,x} = \frac{i_1(1+i_1)^5\left[r'_{0,x} + (k+0)\frac{t_n - t_0}{5}\right]}{i_1(1 + i_1)^5}$$

$$+ \frac{i_1(1+i_1)^4\left[r'_{0,x} + (k+1)\frac{t_n - t_0}{5}\right]}{i_1(1 + i_1)^5}$$

$$+ \frac{i_1(1+i_1)^3\left[r'_{0,x} + (k+2)\frac{t_n - t_0}{5}\right]}{i_1(1 + i_1)^5}$$

$$+ \frac{i_1(1+i_1)^2\left[r'_{0,x} + (k+3)\frac{t_n - t_0}{5}\right]}{i_1(1 + i_1)^5}$$

$$+ \frac{i_1(1+i_1)^1\left[r'_{0,x} + (k+4)\frac{t_n - t_0}{5}\right]}{i_1(1 + i_1)^5}$$

$$+ \frac{i_1(1+i_1)^0\left[r'_{0,x} + (k+5)\frac{t_n - t_0}{5}\right]}{i_1(1 + i_1)^5}$$

$$V_{b,k,x} = \frac{\sum_{y=0}^{4} i_1(1+i_1)^{5-y}\left[r'_{0,x} + (k+y)\frac{t_n-t_0}{5}\right]}{i_1(1+i_1)^5}$$

$$+ \frac{r'_{0,x} + (k+5)\frac{t_n-t_0}{5}}{i_1(1+i_1)^5}$$

$$V_{b,k,x} = \frac{i_1 \sum_{y=0}^{4}(1+i_1)^{5-y} r'_{0,x}}{i_1(1+i_1)^5} + \frac{\frac{t_n-t_0}{5} i_1 \sum_{y=0}^{4}(k+y)(1+i_1)^{5-y}}{i_1(1+i_1)^5}$$

$$+ \frac{r'_{0,x} + (k+5)\frac{t_n-t_0}{5}}{i_1(1+i_1)^5}$$

$$V_{b,k,x} = \frac{\frac{t_n-t_0}{5} i_1 \sum_{y=0}^{4}\left[(1+i_1)^{5-y} y + i_1 \sum_{y=0}^{4}(1+i_1)^{y} + (k+5)\right]}{i_1(1+i_1)^5}$$

$$+ \frac{r'_{0,x}\left[1 + i_1 \sum_{y=0}^{4}(1+i_1)^{5-y}\right]}{i_1(1+i_1)^5}$$

$$V_{b,k,x} = \frac{\frac{t_n-t_0}{5}\left[k\left[1+i_1 \sum_{y=0}^{4}(1+i_1)^{y}\right] + 5 + i_1 \sum_{y=0}^{4}(1+i_1)^{5-y} y\right]}{i_1(1+i_1)^5}$$

$$+ \frac{r'_{0,k}\left[1+i_1 \sum_{y=0}^{4}(1+i_1)^{5-y}\right]}{i_1(1+i_1)^5}$$

$$V_{a,k,x} = \frac{r^*_{0,x}}{i_2}$$

Since $V_{a,k,x} = V_{b,k,x}$ at distance x from the urban center:

$$\frac{t_n - t_0}{5}\left[k\left[1 + i_1 \sum_{y=0}^{4}(1+i_1)^y\right] + 5 + i_1 \sum_{y=0}^{4}(1+i_1)^{5-y}y\right]$$

$$+ r'_{0,x}\left[1+i_1 \sum_{y=0}^{4}(1+i_1)^{5-y}\right]$$

$$= \frac{i_1}{i_2} r^*_{0,x}(1 + i_1)^5$$

$$\frac{t_n - t_0}{5}\left[k\left[1 + i_1 \sum_{y=0}^{4}(1+i_1)^y\right] + 5 + i_1 \sum_{y=0}^{4}(1+i_1)^{5-y}y\right]$$

$$= \frac{i_1}{i_2} r^*_{0,x}(1+i_1)^5 - r'_{0,x}\left[1+i_1 \sum_{y=0}^{4}(1+i_1)^{5-y}\right]$$

$$k\left[1+i_1 \sum_{y=0}^{4}(1+i_1)^y\right] + \left[5 + i_1 \sum_{y=0}^{4}(1+i_1)^{5-y}y\right]$$

$$= \frac{5}{t_n - t_0}\left[\frac{i_1}{i_2} r^*_{0,x}(1+i_1)^5 - r'_{0,x}\left[1 + i_1 \sum_{y=0}^{4}(1+i_1)^{5-y}\right]\right]$$

Since k is the numerical value of $t_{k,x}$:

$$t_{k,x} = \frac{\frac{5}{t_n - t_0}\left[\frac{i_1}{i_2} r^*_{0,x}(1+i_1)^5 - r'_{0,x}\left[1 + i_1 \sum_{y=0}^{4}(1+i_1)^{5-y}\right]\right]}{1 + i_1 \sum_{y=0}^{4}(1+i_1)^y}$$

$$- \frac{\left[5 + i_1 \sum_{y=0}^{4} (1+i_1)^{5-y} y\right]}{1 + i_1 \sum_{y=0}^{4} (1+i_1)^{y}}$$

APPENDIX C

HOUSE BILL No. 4100

February 3, 1971, Introduced by Reps. Spencer, Sharpe, Robert D. Young, Kehres, Gast, Cramton, Jim Brown, Trezise, Prescott, Powell, Sackett, Geerlings, Buth, James F. Smith, Brennan and Warner and referred to the Committee on Taxation.

A bill to amend Act No. 206 of the Public Acts of 1893, entitled as amended

"The general property tax act,"

as amended, being sections 211.1 to 211.157 of the Compiled Laws of 1948, by adding section 5a.

THE PEOPLE OF THE STATE OF MICHIGAN ENACT:

Section 1. Act No. 206 of the Public Acts of 1893, as amended, being sections 211.1 to 211.157 of the Compiled Laws of 1948, is amended by adding section 5a to read as follows:

SEC. 5A. ON WRITTEN APPLICATION OF THE OWNER ON FORMS PREPARED BY THE DEPARTMENT OF TREASURY AND FILED WITH THE LOCAL ASSESSOR PRIOR TO DECEMBER 31 OF EACH YEAR, FARMLAND ZONED EXCLUSIVELY FOR AGRICULTURE OR HORTICULTURE OR DEVOTED EXCLUSIVELY TO AGRICULTURAL OR HORTICULTURAL USE FOR 3 PREVIOUS YEARS AND FROM WHICH THE OWNER DERIVES 1/3 OR MORE OF HIS NORMAL TOTAL INCOME SHALL BECOME ELIGIBLE FOR DEFERRED TAX STATUS. SUCH FARMLAND SHALL BE ASSESSED ONLY ON THE CRITERIA IN THIS SECTION AND SHALL BE EXEMPT FROM ANY OTHER FACTOR. THE STATE TAX COMMISSION SHALL ESTABLISH CRITERIA FOR THE ASSESSMENT OF QUALIFIED FARMLAND ON THE BASIS OF ITS PRODUCTIVITY AND NET EARNING CAPACITY FOR AGRICULTURAL OR HORTICULTURAL USE AND CAPITALIZED AT A RATE REPRESENTING A FAIR RETURN ON INVESTMENT. THE CAPITALIZATION RATE SHALL BE PREDICTED ON A RATE OF RETURN WHICH IS BASED ON ALLOWANCE FOR RISK, INTEREST AND PROPERTY TAXES, WHICH SHALL NOT BE DERIVED FROM SALES DATA FROM OTHER LANDS. THE COMMISSION SHALL PUBLISH A RANGE OF VALUES FOR LAND BASED UPON THESE CRITERIA. WHEN FARMLAND ASSESSED UNDER THE PROVISIONS OF THIS SECTION IS SOLD OR USED FOR OTHER THAN AGRICULTURAL OR HORTICULTURAL PURPOSES, IT SHALL BE SUBJECT TO A SPECIFIC TAX IN AN AMOUNT EQUAL TO THE DIFFERENCE, IF ANY, BETWEEN THE TAXES PAID OR PAYABLE ON THE BASIS OF ITS ASSESSMENT AS FARMLAND AND THE ASSESSMENT

BASED ON ITS NEW USE. SUCH SPECIFIC TAX SHALL BE FOR 3 YEARS, INCLUDING THE CURRENT YEAR AND THE 2 IMMEDIATE PREVIOUS YEARS. DIFFERENCES BETWEEN THE 2 AMOUNTS OF TAXES ON THE LAND SHALL BE A LIEN ON THE PROPERTY UNTIL PAID IN FULL TO TAXING UNITS AS PROVIDED BY LAW. THIS SECTION SHALL TAKE EFFECT ON DECEMBER 31, 1971.

HOUSE BILL No. 6229

May 17, 1972, Introduced by Reps. Warner, Traxler, Folks, Ziegler, Heinze, Robert D. Young, Hoffman, Cawthorne, Mowat, Strang, Sackett, Weber, Buth, Holbrook, Powell, Damman, Trezise, Prescott, Serotkin, Geerlings, Roy Smith, Engler, Payant, Stackable, Spencer, Dively, Mittan, Jim Brown, Jowett, Groat, De Stigter, Cramton, Gast, Loren D. Anderson, F. Robert Edwards, Mrozowski, James F. Smith, Mastin, Allen and Nelson and referred to the Committee on Taxation.

A bill to provide for a specific form of taxation on certain agricultural and other open lands; to provide for taxation of improvements; and to provide for a roll back of taxes under certain conditions.

THE PEOPLE OF THE STATE OF MICHIGAN ENACT:

Sec. 1. This act shall be known and may be cited as the "agricultural and other open land taxation act of 1972".

Sec. 2. "Farm agricultural or horticultural land" means a farm of 100 or more acres in 1 ownership which has been devoted primarily to agriculture or horticulture during 3 of the 5 calendar years preceding the date of application for classification under this act, or a farm using 5 acres or more

but less than 100 acres devoted primarily to agriculture or horticulture, which has produced a gross income from agriculture or horticulture of $100.00 or more per acre during 3 of the 5 calendar years preceding the date of application for classification under this act.

Sec. 3. (1) "Open land" means open space land of 100 or more acres designated by an official comprehensive land use plan adopted by a regional planning and development district or regional planning district, or council of governments, or a county, city, village or township, and zoned accordingly, using 1 or more of the following criteria, or other criteria:

(a) Conservation and enhancement of natural or scenic resources.

(b) Conservation of soils, wetlands,beaches or marshes.

(c) Enhancement of the value to the public of adjoining parks, forests, wildlife preserves, nature reservations, sanctuaries or other open land.

(d) Protection of streams or water supply.

(e) Enhancement of recreation opportunities.

(f) Preservation of historic sites.

(2) A tract of land of less than 100 acres but not less than 5 acres situated in an urban area and open to public use on such conditions as may be reasonably required by the legislative body granting the open space classification is also open land if retained in its natural state.

Sec. 4. An owner of land desiring specific taxation under this act shall apply to the assessing officer on forms prepared by the state tax commission. The application shall be accompanied by a processing fee of $10.00 for each assessing unit in which the property is located, which fee shall be deposited to the local government general funds. The assessing officer shall review the then current qualification of land for specific taxation within 5 calendar years after classification and at least once each 5-year period thereafter.

Sec. 5. Each year the assessing officer shall record on the assessment roll the assessed value of improvements and the assessed value of the land if it were being assessed under the general property tax act. The appropriate tax rate shall be applied to the state equalized value. The property tax shall be levied only on the improvements as long as the land remains in the specific use classification. The specific tax is to be paid in lieu of the property tax on the land.

Sec. 6. (1) If a landowner desires to withdraw his land from the specific tax category he shall give notice to the assessing officer. The assessing officer, when 2 annual tax days have elapsed after receipt of notice, shall withdraw the land from such classification on the next annual tax day. If the landowner changes the use of the land to a use which

conflicts with the classification, or gives notice but changes the use before the land has been withdrawn from classification, he shall pay a penalty equal to 6% of the appraised value or sale price, whichever is higher.

(2) Upon withdrawal from classification the landowner shall pay an amount in the current tax year equal to the tax on the full assessed value of land and improvements plus an amount equal to the difference between the specific tax and the tax which would have been paid on the assessed value of the land during each of the preceding tax years during which the land was classified, but not more than 5 years total, plus 6% annual interest compounded, on the amount of the accumulated total difference.

Sec. 7. Penalties, if any, and rollback taxes shall be placed on the tax roll in the calendar year following the annual tax day after which the land is withdrawn from the specific tax category. All taxes and penalties under this act shall be a lien on the property until paid in full to the taxing unit or units.

Sec. 8. The specific tax per acre for each category of agricultural land qualifying in section 2 is based upon the land capability classifications as defined in the United States department of agriculture handbook number 210 published in 1966:

USDA Soil Conservation Service Land capability classes	Category	Annual Tax per acre
I & II	A	$10.00
III	B	8.00
IV	C	6.00
V, VI, VII, VIII	D	4.00

Sec. 9. The specific annual tax per acre for the open land qualifying in section 3 is $7.00 per acre.

Sec. 10. The specific tax shall be distributed in the same proportion as the general property taxes are apportioned in the October session of the county board of commissioners.

Sec. 11. The owner of land as to which a rollback tax is imposed shall have with respect to assessment of the land and imposition of the additional tax all remedies provided by sections 30 and 152 of Act No. 206 of the Public Acts of 1893, as amended, being sections 211.30 and 211.152 of the Compiled Laws of 1948.

Sec. 12. The department of treasury shall promulgate rules to implement this act in accordance with and subject to Act No. 306 of the Public Acts of 1969, as amended, being sections 24.201 to 24.315 of the Compiled Laws of 1948.