

LAND VALUE AS A FUNCTION OF DISTANCE FROM THE CBD: THE CASE OF THE EASTERN SUBURBS OF PRETORIA

A C Jordaan, B E Drost and M A Makgata

Department of Economics, University of Pretoria

Abstract

The greater the benefit derived from using a piece of land for any particular purpose the higher the price the prospective user is willing to pay. The demand for land is thus a reflection of the utility derived from its use by current or potential users. The ability to compete for sites depends on whether they have the means to benefit from accessibility and complementarity within the urban framework. Conventional theory states that productivity determines urban rent, which is the highest at the place of maximum accessibility, i.e. the central business district (CBD). This paper review selected residential location theories and the factors influencing location decisions. Using selected eastern suburbs of Pretoria, the paper tries to determine whether residential land values decrease as distance from the CBD increase as theory suggests.

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1 Introduction

The most distinctive characteristic of urban areas, which distinguishes it from rural areas, is the high concentration of activities and people. The price of urban land tend to be higher than rural land due to the competition between different uses to make use of the advantages offered by sites of high accessibility. Accessibility to commercial and industrial areas is important for many reasons, including a decrease in transportation cost. Agglomeration economies also tend to evolve in places of high accessibility. Access is also important to residential location. The importance of accessibility to residential land is illustrated when the utility of particular sites depends upon monetary factors such as travelling costs to work, schools, shops and public and private open space, and upon non-monetary considerations such as peace and quite (or the converse), compatible neighbours, fresh air and other less tangible amenities.

Theories of Von Thünen (1826) and Alonso (1960) dictate that the value of land decrease as distance from the Central Business District

(CBD) of a city increases. The purpose of this paper is to look at the value of residential properties in the Eastern suburbs of Pretoria to determine if there is a relationship between the value of residential property and the distance that it is located from the CBD.

2 Location theories

Pioneers in land economics viewed distance as a “social friction” that needed to be overcome. Friction is a metaphor for transportation and communication costs. According to Isard (1956: 24) both time and space must be vital considerations in any theory of the economy. He emphasises that: “If there is any sense at all to location economics, it is because there are certain regularities in the variations of costs and prices over space. These regularities arise primarily because transport cost is some function of distance. Since it is the distance factor that is the heart of locational analysis, there is every reason to speak of transport inputs wherein distance and weight are the two basic factors, and of transport rates as prices of these inputs.”

Williams (1971), however, defines the aspect of distance more narrowly and emphasises the role of access as a factor in the evolution of cities. He argues that urban location decisions, especially the creation of cities, are the net product of many people trying to become more accessible to one another.

According to Blair (1991: 354) the residual to land depends upon how the land is used. The land use that provides the highest residual to land is the highest and best use. Access is the principal determinant of highest and best use in an urban environment. As the accessibility of land to urban goods increases, its productivity and hence value also increase. He concludes that the locational choice involves a trade-off between access to a variety of other locations on one hand and the cost of real estate at a given location on the other.

As a general rule, the more accessible a location is to the positive elements in the environment, the more valuable it will be. However, different types of land use call for access to different things. Businesses seek access to a productive labour force and other businesses, commercial establishments may seek access to markets and households also desire access to amenities. As a result, land planners and developers recognise that the more accessible a location, the greater its profit potential. Time and convenience are important elements of access. Modern transportation networks have made access as much a function of urban infrastructure as of simple physical distance.

3

Residential location factors

Housing constitutes the largest urban land use (in some towns over 50 per cent of the total area) and may account for over 25 per cent of personal expenditure (Balchin, Bull & Kieve, 1995: 84). Forced out of areas of good business accessibility, housing land is less frequently redeveloped compared with other uses, but marginal changes may have important economic and social ramifications. Although there is a relationship between personal income,

place of employment and place of residence, this relationship is subject to different and conflicting interpretations. Individuals choose where they want to live and larger social forces shape decision. The cumulative effect of this is the formation of recognisable neighbourhoods (Blair, 1995: 244).

Some neighbourhoods may provide access to services that households do not currently require but may demand in future. This component of demand for residential locations is known as option demand (Hirsch, 1973: 50). Option demand refers to the demand for the availability of goods and services whether they are consumed or not. Some households will appear willing to pay for the value of certain unchosen alternatives such as a good university that will not necessarily be used. Neighbourhood differences affect the demand of housing services more than the supply of these services.

Five major characteristics, identified by Segal (1979: 214) normally used when evaluating the attractiveness of a residential location, are the following:

- Physical characteristics of the neighbourhood such as housing structures.
- Socio-economic characteristics such as the characteristics of people living in the neighbourhood.
- Public services such as quality of schools, roads and local recreation.
- Environmental qualities such as topographical features, landscape and weather.
- Accessibility of the neighbourhood in terms of the sites to which the household commonly travels.

In terms of residential location decisions, both aspects of special accessibility - concentration and complementarities - are relevant. Concentration of population promotes the provision of libraries, churches, schools and recreational and cultural facilities. Not only does proximity to parks, golf-courses, and open spaces enhance the residential attractiveness of a district, but often households prefer to live alongside others of the same social and cultural

background, religion or race (Harvey, 1996: 204).

According to Harvey (1996:206) there are three major determinants of residential location, namely accessibility, environmental characteristics and rent. There is a trade-off of accessibility and environmental characteristics against rent. It is difficult to measure environmental characteristics and the level of utility that a household receives from it. In a mono-centric city, where all employment opportunities and shopping facilities are located in the CBD, it is also easy to determine accessibility however, dynamic changes within cities that establish employment opportunities, shopping centres and commercial uses in suburban areas complicate the determination of accessibility. This lead to the establishment of an individual accessibility curve for every household, which basically leaves the price of land as the one factor that can easily be estimated.

3.1 Bid-rent relationship

A location model proposed by Von Thünen (1826) stresses the distance-cost relationship assigned to land values. Although the Von Thünen model has been criticised because it assumed unlikely conditions such as production taking place around an isolated market and soil being of constant fertility, it nevertheless established a distance-cost relationship. According to Von Thünen (Balchin, Bull & Kieve, 1995: 16) land in close proximity to the market (CBD) would be in great demand because of low transport cost. The highest rent would be gained for this advantage. In the outer belt there would be little demand for land because of high transport cost, rents would be low and the corresponding value of extensive production would be low.

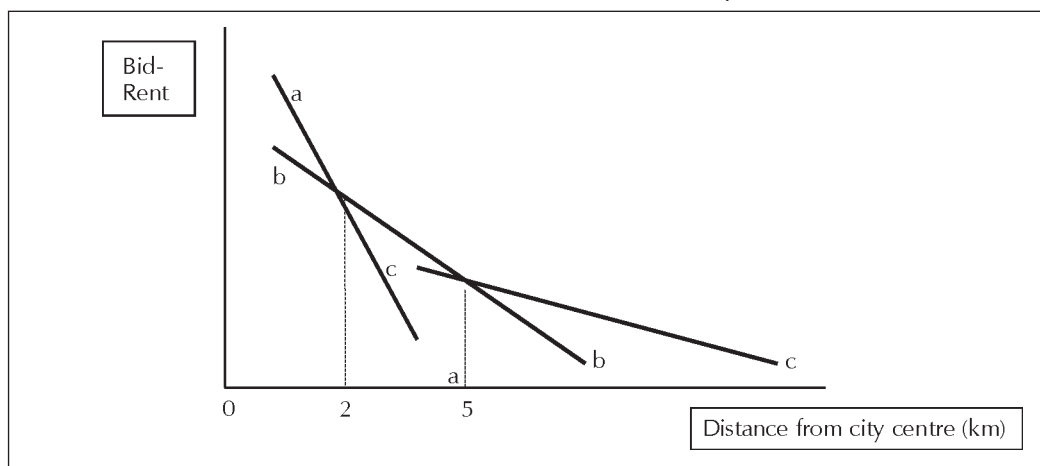
Based on similar reasoning, the neo-classical theory became concerned with rent as a determinant of optimum location. The bid-rent distance relationship, which was established by Alonso (1960), may be viewed as an important theory relevant to residential location. Other residential location models often assume the

same bid-rent distance relationships. The approach of urban location theory by Alonso evolved in the 1960's and was based on the principle that rents diminish outward from the centre of a city to offset both lower revenue and higher operating costs not least transport cost. A rent gradient would emerge consisting of a series of bid-rents, which would exactly compensate for falling revenue and higher operating costs. Different land uses would have different land rent gradients, with the use indicated by the highest gradient prevailing.

A simple diagram indicated in Figure 1 may illustrate the concept (Balchin, Bull & Kieve, 1995: 52). In Figure 1, use *a* prevails up to a distance of two kilometres from the CBD, use *b* is dominant between two to five kilometres and beyond five kilometres use *c* prevails. A change of use could be expected to take place through the price mechanism when one gradient falls below another. Where rent gradients intersect there would be a change of use to that activity which could afford to pay the higher rent. Rent gradient *a* could coincide with the CBD, category *b* with the transition zone and category *c* with the residential areas. In the CBD the gradient would be steep because of intense competition for a very limited number of sites, but would be very slight in the outer zones with a comparative abundance of land. It must be assumed that on the edge of the urban area there is a separate agriculture rent gradient.

The Alonso model assumes that the urban area has a single nucleus and that the market for land is perfect, it does however not assign specific land uses to each rent gradient (Balchin, Bull & Kieve, 1995: 53). Although the model specifically refers to commercial and industrial land uses, the bid-rent relationship can be applied in general. If land is located further away from the CBD, the price tend to decrease (in a single nuclei city). The principle thus also applies to residential location, viewing travelling time and cost to work as the operating cost of a household. Alonso's theory is clearly a very idealised view of reality, but it has some merit in that it attempts to demonstrate the nature of the land market and emphasises the notion of efficiency in the use of urban land.

Figure 1
Alonso's bid-rent distance relationship



Source: Balchin, Bull & Kieve, 1995.

It should be noted that the theories of Von Thünen and Alonso are general theories that may be applied to any land use. A number of location theories specifically formulated to explain residential location will follow now.

3.2 The filtering down theory

The filtering down theory explains how different socio-economic groups come to occupy particular neighbourhoods. The theory was originally put forward by Burgess (1952) to explain his observations about Chicago, where higher-income households moved further from the city centre and slightly lower-income groups occupied the vacated housing. The durability of a housing unit increases the probability that several households will occupy it during its lifetime. The filtering model is one in which housing is constructed for high-income households and over its lifetime is passed on to ever lower-income households (Mills & Hamilton, 1994: 251). As incomes among a high-income group rise, demand for housing increases. Some individuals will be able to satisfy their increased demand for housing by buying newly constructed houses. The newly constructed house will probably be located further away from the city-centre where vacant land is available. It is usually cheaper to build on vacant land than to bear the opportunity cost

of demolition and clearance expenses of building on a site with existing buildings. Furthermore, inner-city lots are generally too small to accommodate the preferences of high-income households (Blair, 1995: 244).

Although the Filtering Down theory provide some explanation as to why certain income groups may move further from the CBD, the Trade-off model further elaborate on this issue.

3.3 The trade-off model

According to Muth, (1969), the Trade-off model explains the predominance of high-quality housing on the city perimeter in terms of the trade-off between access to central locations and household demand for space. The model is based on the assumption that as incomes rise the rate at which households are willing to substitute access for cheaper land changes. The model deals with two categories of changes namely: space versus access within a central city and trade-offs in a multiple nuclear city, which will be elaborated upon below (Blair, 1995: 248).

3.3.1 Space versus access/travel cost minimisation theory

According to Balchin, Bull & Kieve, (1995: 84), if travel costs to work are nil or very low, households will be prepared to pay the highest

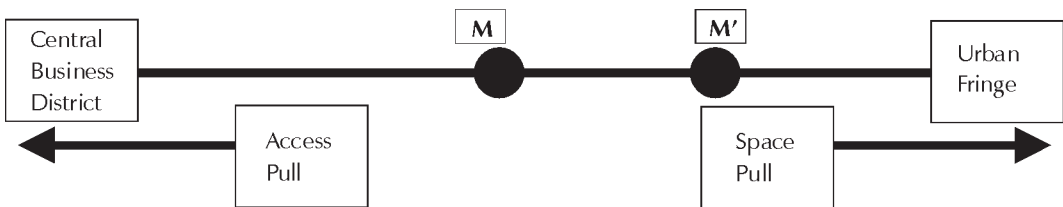
rents or prices for accommodation. Through the working of the price mechanism this would imply that the rich live very close to the central business district and the poor live in less expensive outer areas. The opposite is however generally true. Low income earners live close to their work (usually within the inner areas of cities) to minimise their cost of travelling, rents are mainly regulated, and housing densities are high. As incomes rise, there has been a tendency for people to live further away from their work in areas of lower density and more expensive housing. Balchin, Bull & Kieve (1995) also argue that the outward spread of cities would only be compatible with travel cost minimisation if employment was simultaneously decentralised, but that this decentralisation of employment opportunities usually does not take place, which implies that

travelling cost remains important. It is also seldom possible for a firm to relocate to an area that is close to all its employees. But, according to Balchin & Kieve (1982), the travel cost minimisation theory is valid to some extent. Although house prices may be very high in the commuter belt, residential values per square meter (m^2) tend to diminish outwards from the central area as competition from business uses gets less.

According to Blair (1995: 249) the increased distance from the CBD also increases the opportunity cost of commuting. The increased opportunity cost of commuting tends to orient the optimal location toward the city's centre where access is best. Which pull will dominate cannot be determined theoretically and may be illustrated with the help of a simple diagram, depicted in Figure 2.

Figure 2

Space versus access as income rises



Source: Blair, 1995.

Initially, the household is in equilibrium at point M. As income increases, the household will relocate because the desire for more space plus the cheaper land near the fringe is stronger than the increased pull of the desire for better access. A relocation to M' would reflect the stronger space pull caused by the income increase (Blair, 1995: 149). The contrast suggests that the trade-off is affected by attitude regarding the value of non-work time and preferred living accommodation.

Critics pointed out that a trade-off model of the above sort is least satisfactory in explaining residential location within a conurbation where there may be several central business districts and a complex pattern of commuting. Patterns and relationship will also be distorted by the decentralisation of employment. Blair took the

model a step further and expanded the theory to make provision for the Multiple Nuclear City, which is discussed below.

3.3.2 Trade-offs in the multiple nuclear city

The structure of cities has however changed in recent years and locations other than the CBD have become very popular for commercial uses. There are increasingly multiple points within a metropolitan area that represent points of substantial access. The CBD is no longer the controlling access point in most major metropolitan areas. During the past few years, jobs have shifted from the central city to suburban locations, so the assumption of minimum transportation costs at the CBD are unrealistic for most families. The CBD remains the site of the plurality of jobs, but many large

business agglomerations exist throughout most metropolitan areas. Within limited areas, land costs may actually decline, moving towards the central city (Blair, 1995: 250).

Evans (1985) also expanded the trade-off hypothesis by suggesting that a household might move further out from the city centre if their demand for space increase, but if their income increase and their demand for space remains constant, they will probably move closer to the city centre. Evans further suggested that following a general increase in pay, higher income household out-bid lower income groups both on the periphery of urban areas and in the inner cities, in the latter case often by means of gentrification. High-income groups can bid for land in any location because they can afford high transportation cost and expensive housing, which implies that increases/decreases in transportation cost will not have an impact on their location. High-income commuters do not have to trade-off travel cost and housing cost – they can afford both. A pattern of household distribution with a more than proportionate number of high-income households in both inner and peripheral areas and a more than proportionate number of lower and middle-income groups in between, results from this competition between income groups. Highways, moreover, may make outer locations more accessible from the central business district than many inner suburban locations (Balchin, Bull & Kieve, 1995).

Households often stay in a neighbourhood even if their income changes, because they enjoy living in that neighbourhood. They may prefer to live in the commuter belt where they can benefit from a better environment and open space and when they can segregate themselves from lower socio-economic groups (Balchin & Kieve, 1982). The cultural agglomeration model addresses these issues more thoroughly.

3.4 The cultural agglomeration model

Blair (1995: 250) states that cultural factors are important in neighbourhood formation. People often believe they will find congenial friends (or friends for their children) if they live near people like themselves. Thus, neighbourhoods where individuals with similar

social characteristics are found, will form based on social desires and agglomeration economies. Balchin & Kieve (1982) base this on households with similar incomes, and presume that they will, in the long run, be willing to incur the same price for travelling and housing. If travelling costs increase, certain groups will migrate to areas where the cost of housing is relatively cheaper, while people will tend to move to more expensive housing if travelling costs decrease. The actual direction of change, if any, will depend upon the relative strength of these two opposing forces. It should, however, be noted that even if there were an inverse correlation between house prices and travel costs it is unlikely that all households would trade-off. Harvey (1996: 206) also points out that environmental characteristics are important in the location decisions of a household. Certain environmental qualities may be more important to certain social groups, be it on the basis of income, culture or religion.

3.5 Maximum housing expenditure theory

This theory states that income and the availability and conditions of mortgage finance determine residential location. Their choice is fairly restricted and the point on the housing cost curve will be determined largely by mortgage availability (Balchin & Kieve, 1982). The theory is based on the assumption that house-buyers will attempt to acquire a house as expensive as they can afford with the maximum mortgage, which they can raise in the area of their choice. But although house-buyers may seek a property over a wide area, transport costs may be a relatively minor consideration and may vary in relation to the distribution of houses within a specific price range. Environmental and social factors are likely to be a much greater influence over choice. This hypothesis evolved by Ellis (1967) and Stegman (1969) implies that there is no overall relationship between income, travel cost/time and place of work, and that there is no effective trade-off. Other residential location theories that concentrate more on government and its involvement will now be described.

3.6 The Tiebout model

The Tiebout model (1956) describes the relationship between local government programs, taxes, and housing prices.

The model relies on the existence of four postulates, namely:

- A house purchased in a particular area embodies a bundle of services that vary depending on government activity;
- Individuals form preferences for an area based on the public services and other features of the external environment together with the private services of the house;
- Different levels of service provisions will often result in different tax burdens among municipalities; and
- Individuals differ in their preference and willingness to pay for private housing services and also for the goods associated with housing in a particular neighbourhood (Blair, 1995: 251).

The Tiebout model presents a combination of different aspects models that was also discussed in the other models, but also puts a strong emphasis on differences in preference resulting from government policy and programmes. This model recognises that individuals in the same position might not make the same decisions. If they are not satisfied with the way things are, they will not necessarily bear with it. Individuals “vote with their feet” for the combination of amenities and disamenities they prefer.

3.7 The aggregate economic fallout model

Hill and Bier (1989) developed a model of neighbourhood change that links changes in the economic base to neighbourhood formation. Changes in the national economy may affect particular local sectors, and these impacts are in turn translated into changes in neighbourhood characteristics. This model suggests that neighbourhoods have identifiable links to occupations and industries in the local economy. It can therefore also be used in collaboration with the cultural agglomeration

model in which households, where members occupy similar occupations, may prefer the same type of neighbourhood. In order to determine the current applicability of these theories, a sample survey of the Eastern suburbs of Pretoria was selected and compared.

4

Empirical analysis

4.1 Methodology

As a first step, the target population is defined, in other words, the totality of cases that conform to some designated specifications. The specifications define the elements that belong to the target group and those that are to be excluded. The target population selected for this study was the land value of all erven (business and residential) in the selected Pretoria suburbs of Hatfield, Brooklyn, Lynnwood and Faerie Glen, according to the City of Tshwane’s valuation roll. Hatfield shows a mix between residences and businesses, Brooklyn is an established residential area with some businesses, Lynnwood is also an established residential area with some businesses and Faerie Glen is the most recently developed residential area with some businesses. All these suburbs lie in an easterly direction away from the CBD at varying distances. In Hatfield, a total of 1516 erven are listed, 1703 erven in Brooklyn, 1581 in Lynnwood and 3919 in Faerie Glen. Since the size of the target population is large, a sample was drawn which constitutes a selection of a subset of elements from a larger group of objects (Churchill & Lacobucci, 2002: 981). The basic principle of sampling is, that by selecting some of the elements in a population, conclusions about the entire population may be drawn (Malhotra, 1996: 359).

Next, the sampling frame, which is the listing of the elements from which the actual sample will be drawn, was identified. The sampling frame for this study was all residential erven in the selected suburbs. It should be noted that the City of Tshwane’s valuation roll does not provide a complete and accurate listing of all residential erven, due to the fact that some properties do not reflect their current status as some are in

the process of being transferred to other parties or in the process of being rezoned. Reality dictates that there is seldom a perfect correspondence between the sampling frame and the target population of interest. However, given these limitations the City of Tshwane's valuation roll was used to determine the approximate number of residential erven in each of the selected suburbs. Approximately 303 residential erven are located in Hatfield, 698 in Brooklyn, 795 in Lynnwood and 3527 in Faerie Glen.

The sample for this study was drawn by means of systematic sampling. Systematic sampling has many desirable features because such a sample is relatively simple to draw, it is easy to check and it can be done relatively inexpensive (Zikmund, 2003: 363). With this method, the sample is chosen by selecting a random starting point and then selecting every i -th element in succession from the sampling frame (Malhotra, 1996: 370). The sampling interval, i , is determined by dividing the population size, N by the sample size, n , and rounding to the nearest integer. In general, the sample size should have a minimum of at least five times as many observations as there are variables to be analysed. Based on the fact that the study only investigated one item in four different areas, namely the average r-value per square meter for residential erven in the selected eastern suburbs, it was decided that a ten per cent sample per suburb would suffice.

Data was obtained from the City of Tshwane's valuation roll for the period 2002/07/01 to 2003/07/01. The value of improvements was not taken into account, since it is difficult to compare improvements with each other (houses differ in size, the quality of the construction materials used, the number of rooms, age of the home, etc. all impact on the price of the improvements, but differs from one property to the next). It should be noted that agricultural holdings and business erven were excluded from the study, because location factors, as well as property value of these holdings differ from those of normal suburban residential areas. The suburbs chosen are all located at different distances to the east of the Pretoria CBD, to indicate the rent-bid distance relationship as distance from the CBD increases.

4.2 Residential erven

The land value, according to the valuation roll was taken, which might be biased towards the City Council's principles of determining these values. However, residential property taxes are based on these valuations and as such are being used to differentiate between property values and thus the perceived "market value". The land valuation values obtained for residential erven in each of the suburbs chosen are summarised in Table 1 below. The distance of the suburb from the CBD and the average land value (R/m²) of residential properties show a definite pattern.

Table 1
Land values of residential erven

Suburb	Distance from CBD	Avg. size (m ²)	Avg. site value (R)	Avg. R/m ²
Hatfield	4km	1094	176 333	159
Brooklyn	5km	1316	202 657	157
Lynnwood	6km	1769	184 350	111
Faerie Glen	15km	1224	95 805	81

Diagram 1
Average R/m² value of residential land

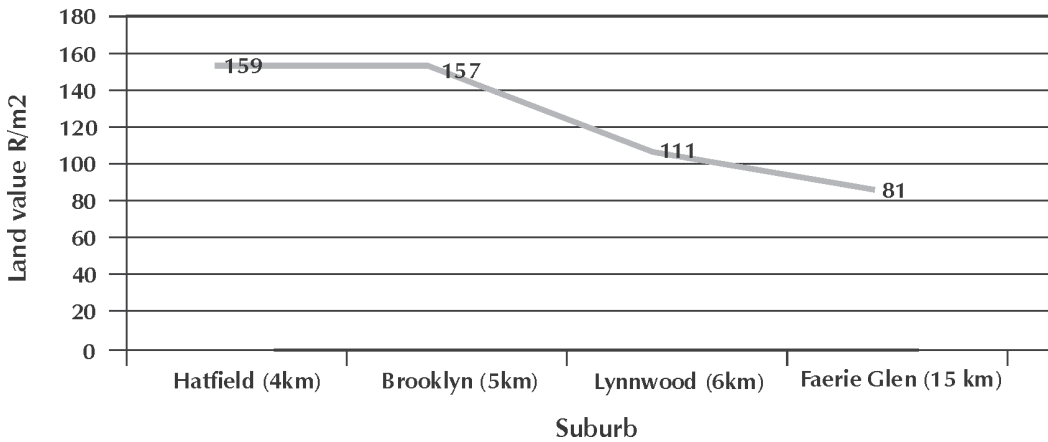


Diagram 1 illustrates the difference in average land values for the different areas. The properties all follow the same pattern, namely a decrease in the average land value of residential properties, the greater the distance from the CBD.

Data thus indicates that the average R/m² value of residential land in the eastern suburbs of Pretoria is an inverse function of the distance from the CBD. This seems to conform to theories of especially Von Thünen and Alonso as well as some other related theories. It should be noted that the exact locational decision of a household couldn't be constructed theoretically and that theories only serve as a general guideline. Different models are thus relevant in different situations. The different models can, however, be viewed as different sides of the same coin in that it all adds to the explanation of another fragment of residential location decision.

It would, however, be wrong to assume that outward-decreasing site values and rents are only due to higher transport costs, and that higher values and rents inward are only due to a saving in transportation cost. This might have been true in a single nuclei city, although currently an activity's location is rarely determined by a single location requirement. Economic conditions, population, other land uses, both public and private, and the size of the urban areas continually change, subjecting the

urban land market to forces of perpetual adjustment. A mixture of interacting influences usually explains each locational decision. After an assessment of various advantages and disadvantages, the location of any activity is determined by the desire to maximise utility in the case of residential users.

It thus seems as if the relative higher availability of land and less competition between residential uses in the outlying areas, still tends to decrease the value of residential land in general. This generalisation that preferences for increased space are more easily attainable at the urban fringe remains valid, particularly if newly constructed housing is desired. It seems as if households value the increased amount of space, although the trade-off is not necessarily against higher transportation costs as stated in some theories.

5

Conclusion

Although the valuation of residential properties in future seems to be based on improvements (which will obviously make provision for a progressive residential tax system), the valuation used in this paper was only based on land value without improvements. The authors are convinced that current market values of residential properties and not municipal valuations would probably be a better proxy to

test these location theories. However, recent property transactions represented by the property title deeds, were not obtainable from the powers that be.

In formulating policies, central and local government need to know why people live in a certain areas, what types of houses should be constructed and in which locations. It is also important to show the significance of journey-to-work considerations, enhancement of the residential environment and how desirable it is to decentralise employment. A policy of decentralising employment would benefit particularly low-income households in the outer suburbs. If it is thought that there is a trade-off between housing expenditure and travelling costs then policy should concentrate on reducing travelling costs to work and/or developing high-density housing in the inner areas of cities. It could be assumed that high-income households would rather opt for an improved residential environment with attractive amenities because they can afford transport costs. However, this might not be true for low-income households and government could rather adopt a policy of improving and reducing the transport cost from these residential areas to the central business district. Future research might focus on the role of urban residential and transport policies and how low-income households would be affected.

In terms of this study, it is important to realise that the valuation of residential properties by the city council of Tshwane would not necessarily reflect the perception of the residents in terms of locational choice. It might be that other factors, besides distance, is the main cause the depreciating land values further away from the CBD. Although other factors might influence current residential location decisions, it is still interesting that the data conforms loosely to theoretical models discussed in the paper.

Endnote

Views expressed are those of the authors and do not necessarily reflect those of any institution that they may be associated with.

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