1980

Locational determinants of apartment rent in Windsor 1978-79.

Randy James. Risk
University of Windsor

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LA THÈSE A ÉTÉ MICROFILMÉE TELLE QUE NOUS L'AVONS RÉCUÉ
Locational Determinants of Apartment Rent in Windsor 1978-1979

by

Randy James Risk

A Thesis Submitted in Partial Fulfillment of the Requirements of the Degree of Master of Arts

Department of Geography, Faculty of Graduate Studies
University of Windsor
Windsor, Ontario
1980
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Randy James Risk
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CHAPTER I
INTRODUCTION

The provision of a variety of housing is of concern to the developer, the public, and the planner. Developers desire to maximize profit through the construction of the right mix of dwelling units at reasonable cost while the public's goal is to try to attain high quality housing at acceptable rates. Urban planners, interested in the social and physical structure of the city, study housing trends and plan future developments in order to reach a satisfactory compromise between the developer and the public. This variety of interests has resulted in the development of various types of housing with a wide variation in price. Ranges in housing attributes have created a number of housing markets or sub-markets within an urban area.

Researchers undertake housing-market analyses as one approach to the planning and assessment of urban subareas. The evaluation of subareas which exhibit socially and physically homogeneous housing zones is one attempt to understand how best to provide housing units which cater to the needs of the population; for the composition of the housing stock influences the number of choices a resident has in his
selection of shelter.

In recent years high-rise/high-density apartment structures have become an increasingly important form of housing, as is noted by the increased supply and subsequent occupancy of such units. Moreover, a wide variation in dwelling attributes such as those related to internal, external and locational factors, appears to exist among such residential units as is indicated by the range in rental charges. Limited research on this price variation has been carried out on high-rise/high-density apartment units due to the relative newness of this form of housing and to the unavailability of adequate data especially in smaller urban centres.

This study will focus on some demand aspects of housing, more specifically, on the aspect of demand analysis which examines locational factors as opposed to cosmetic or internal considerations that a household takes into account before finally deciding to purchase or rent accommodation. Today's consumer often makes locational price comparisons of various types of dwellings as part of the house-search process before arriving at a final decision on a particular residential unit in an effort to maximize his housing purchase with respect to costs incurred and benefits received. This search procedure is determined by the particular householder's needs, desires, perceptions, and ability to purchase a unit. Personal biases as well as differences in housing with respect to type, price, and location result
in the formation of distinct spatial housing patterns within residential developments. Previous studies on housing preferences have not specifically analysed high-rise apartment units in smaller urban housing markets arising from locational preferences. This study will view these spatial price differentials in the Windsor apartment sector and try to determine what proportion of these variations can be explained through locationally related variables.

The residential spatial structure of urban areas and the resultant house prices have generally been explained by one of four theories and/or models of urban form. These incorporate:

1) Assignment and gravity models of spatial interaction which draw heavily on accessibility parameters based on mass and distance. Such models identify the minimization of transportation costs in the residential decision-making process.

2) Land-rent theories and their impact on residential prices and spatial urban structure. These theories suggest that economic factors are the prime determinants of residential location accounting for land and real estate costs.

3) Human ecological studies which argue that housing prices are a function of social and economic neighbourhood factors and thus introduce social variables into the question of residential location.

4) The behavioural approach which views the residential
decision-making process from the standpoint of 
the individual decision-maker. This approach 
incorporates personal characteristics, desires, 
perceptions, and attitudes into the house-selection 
process. The greater the desire for a certain 
residential unit by an individual the more that 
individual is willing to pay for that unit.

Scope and Purpose

This study will draw on all of the above in analysing 
the variation in apartment rents in Windsor, Ontario. One 
objective of the study is to incorporate a wider theoretical 
base in the development of a model to explain apartment rents. 
Although all of the above approaches have been used to explain 
price variation within the housing market, little work has 
been done in ascertaining the contribution of each of the 
determinants of housing costs with regard to the spatial 
variations of rent especially in the apartment sector. One 
aspect of this study will be to examine the validity of such 
theories/models in explaining apartment rents.

A second objective of the study is to contribute to 
the understanding of the factors which influence housing 
prefersences and rents. This is to be accomplished by test-
ing whether a relationship exists between the observed 
market prices of selected housing units and the characte-
istics which the unit and its environment possess. Relation-
ships of this type are of use to the municipal planner who,
on the basis of these data, can make suggestions with regard to possible changes in housing characteristics of future residential developments.

A basic premise underlying this work will be that actual rent per unit of housing is a reasonably accurate measure of the desirability of a particular housing bundle. This measure of relative desirability can be expressed as rent per standardized unit of dwelling space per month. Areas with high rent values per unit are assumed to be the most desirable locations in which to reside. Single-family detached housing units have been studied under these assumptions with reasonable success. However, caution must be taken in that an analysis of this type does not account for the action of the landlord in the establishment of rent or for the individual resident's financial standing with regard to his ability to pay rent.

The major thrust of this paper is the development of a framework which explains spatial differences in rent levels of standardized apartment units in Windsor, Ontario for the October 1978 - April 1979 time period. The resultant determinants of rent will be discussed with respect to those previously revealed for other urban markets. In addition it is hoped to assess the relative importance of various attributes of place utility.

It has been stated that systematic models linking intra-urban housing choice to urban spatial structure do not exist (Brown and Holmes, 1971). Therefore, one aim
of this study is to contribute to the understanding of such linkages and thereby assist in the future development of such systematic models. The identification of the particular dwelling and neighbourhood attributes which are related to apartment rent variations is one step in this procedure.

Within the general scope of this proposal several specific objectives are studied. Initially, the importance of various factors involved in the determination of rent variations in Windsor will be evaluated. Secondly, the significant factors identified in the Windsor study will be compared to research findings arising from work carried out at the national, regional, and local levels. Finally, suggestions will be made as to some practical application of the Windsor model and its findings to urban planning and land development.

Conclusions drawn from this study may be useful in determining apartment site locations which mesh demand factors most effectively. The influence which each site and its surrounding environs have on the economic rent of apartment units may be useful in the prediction of housing demand and subsequently valuable as an input into the future site planning of apartment residential units; and in the understanding of the significance of national, regional, and local factors in the provision of various forms of housing.
General Hypothesis

The overall objectives of the study will be fulfilled through the testing of a series of hypotheses. The hypotheses examine the impact of selected variables (which have been found to be effective predictors of housing unit prices in previous studies) on apartment rents. The variables reflect the following general categories of housing price determinants:

1) accessibility factors;
2) neighbourhood - social factors;
3) neighbourhood - environmental factors;
4) structural - design criteria.

Identification of the relative importance of each variable in explaining rent variation in the Windsor area will enable comparisons to be made with findings in previous studies of other rental housing markets.

Organization of the Thesis

This study consists of five chapters: In Chapter II the concept of land rent is reviewed and the major studies dealing with the spatial determinants of housing prices and rents are examined. Chapter III outlines the procedural steps taken during the course of the present study. The preliminary analysis, hypotheses, model, verification procedures, study area, data type and source, and units of analysis are stated. Chapter IV includes the testing of the hypotheses and the analysis. Chapter V summarizes the study,
arrives at conclusions pertaining to the results, and suggests avenues of future research.
CHAPTER II

REVIEW OF THE LITERATURE

Literature dealing with the determinants of housing cost can be found in many fields of social-science research. Attention has been concentrated on single-family detached dwellings with ownership costs the most frequently studied phenomena. Research into the rental housing market is limited and recent in nature. However, results have indicated that the rental market is similar to the single-family detached housing market.

In recent years the high-rise apartment complex has dominated the skyline of most urban areas. Bourne (1968) has attributed the dominance of apartment style housing complexes to changing market conditions of the time. Traditionally, the question of rent versus homeownership has been viewed by comparing and contrasting the land value and land use of various locations within the urban area. Bourne (1976) suggests that the popularity of rental accommodation is due to the high cost of land; high local taxes and educational expenses; changes in family income, family size and age structure; changes in types of housing;
and changes in locational and social preferences.

Shelton (1968) has stated that the question of cost in the renting or purchasing of a housing unit is dependent upon the expected duration of tenancy. If the resident chooses to inhabit a household for less than four years, Shelton finds it more financially advantageous for the individual to rent. Due to the increasingly large proportion of non-family households in today's society a greater demand for rental units has occurred. This segment of the population is characterized as having a relatively high income and as being highly mobile; thereby creating a readily available consumer in the rental market (Bourne, 1976). With this brief prologue in mind a review of the pertinent literature associated with the scope of this thesis will be presented.

Initially, a brief recount of land rent and urban land-use theories will be presented to provide a historical perspective to the study of housing rent where economic and accessibility parameters are established as being valid influences in the determination of rent. This is followed by a review of the literature dealing with the human ecological school's approach to housing-market research. Here social and economic factors are introduced and solidified as valid influences in the attraction of a resident to a particular housing area. Then the theories of residential behaviour are reviewed. Behavioural research relies upon the individual consumer's actions in the housing market for
data. The decision-making process of the individual comes under close review and conclusions regarding factors which are significant in the house price/rent question are formulated.

**Theories of Land Rent and Urban Land Use**

Literature encompassing the theories of land rent and urban land-use originates in the early 1800's and continues to the present in an attempt to explain the value of land at varying locations within and around urban areas. These theories begin on a very general note dealing with the ability of certain agricultural activities to pay for the locational advantages of being close to the market, and proceed to the study of accessibility-cost parameters which influence the distance a resident is willing to live from the central business area.

The concept of land rent evolved during an era when economists dealt with the study of agricultural land. Land rent is taken as the price of services yielded by land during a specific time period (Romanos, 1976). The first of the land rent works appeared in the studies of Ricardo (1819) and a few years later by Von Thunen (1826). The Ricardo/Von Thunen model of agricultural production became the basis of many future studies. These studies used the concept of land cost as a prime indicator of land value and subsequently housing costs. The land rent of any particular point in the study area has been stated as the
value of the point's product minus the production and transportation costs incurred from that point to the central market (Romanos, 1976). The resultant land rent per acre was found to decrease with distance from that central place. A major flaw in this approach is the difficulty encountered when applied to urban lands with their more intensive land uses and subsequently more complex production factors applying to a variety of products.

One of the first to deal with the complexities of urban land values and urban structure was Richard Hurd (1903) in *Principles of City Land Values*. He replaces Von Thunen's productivity criterion with desirability differentials among various locations within the urban complex. The land rent or value is determined by the proximity of a particular location to the centre of the urban area. However residential land within the urban sphere which is directly related to housing cost, is purposely omitted because he felt that residential land values were socially determined rather than economic. This was one of the initial indications that something in addition to land rent was needed to explain housing costs. The resultant research tried to explain residential land values on the basis of site rent, time value, and transport cost. Transportation factors thus became the major determinants of rent as research concentrated on the effects of distance and time on land costs.

The concept of 'friction of space' was used as the
basis of residential land studies. Robert Haig (1927) expounded these land-use theories by allowing transportation innovations to become a chief determinant in the minimization of transport costs. The minimization of these costs remain a prime concern to the individual resident in his selection of housing services. Haig's work however, failed to incorporate the influence of an individual's personal preference; for example, a large lot size on the perimeter of an urban area may be of more importance to the individual than the economic effects of increased transport costs associated with such an area. This raised the possibility that spatial variations in housing cost may not be solely dependent on the accessibility parameter, and that existing land uses may play a part in the value of urban land and subsequently housing costs.

Empirical evidence that spatial variations in land values within urban areas are related to land use patterns in those areas was studied by Hoyt (1933). Hoyt traced the development of land values in Chicago over a one-hundred-year period using the assumption that the residential developer is a type of economic man who satisfies a residential building demand while maximizing profit (Romanos, 1976). However, conclusions regarding the relationship between land value and land use were biased by the assumptions that urban areas are monocentric and that transportation costs are the primary factors in locational decisions. Urban rent has also been viewed as consisting
of two distinct components (Richardson, 1977). These components are locational rent and externality rent. The former refers to the actual location of a study unit within the urban complex with respect to other areas such as the CBD, while the latter represents the value of the neighbourhood and environmental qualities associated with that particular location. In traditional location theory, market equilibrium was based on locational rent which depends on rents declining with distance from the centre of the city. Richardson (1977) introduces externality rent which is positively associated with distance to explain the preferences of consumers for a lower density environment. If neighbourhood and/or environmental factors become more important to the potential inhabitant of an area than accessibility rent will increase in the suburbs as a result of competition which may create a positive rent gradient from the Central Business District (CBD) outwards. This is opposite to the traditional negative rent gradient theories of the locational minded researchers of the past. Richardson (1977) uses low population densities as surrogates for favourable environmental externalities in his attempt to illustrate positive rent gradients. He discovered that such gradients did exist if the external rent compensated for the lower locational rents of more distant locations. The lack of socially related variables in the application of location theory in residential studies led to a re-thinking of the question of housing cost. The result was a new approach to housing
studies based upon social and economic variables carried out by human ecologists.

The Human Ecological Approach to Housing Costs

Human ecologists have taken the basic economic theories of land rent and coupled them with social variables to arrive at a more socially orientated representation of the determinants of housing costs. Theories associated with these works are based on the fact that the delineation of urban subareas of housing can be carried out by the identification of various physical, social, and economic characteristics of the areas in question. Housing locations with the most favourable physical, social, and economic environments will command the highest prices.

Urban structure has been viewed from two different perspectives in the literature on human ecology. Researchers such as Robert Park (1952) and Ernest Burgess (1926) have proposed that land values determine land uses. Land values influence the segregation of local market areas and determine the type of buildings to be constructed in a given region. Others such as Amos Hawley (1950), in discussions of residential location theory, suggested that the rent value of residential land was the key to discovering differences in an urban area's residential structure. This rent value is a result of land values, the proximity of amenities, and the time and financial costs of transportation.

Initial attempts at defining an orderly spatial
structure by human ecologists for residential areas were incorporated into generalized theories of urban spatial patterns. Hurd (1924) used central or axial growth based on rent and income data to project growth outwards along transport routes. Burgess (1926) established a series of concentric zones based on socio-economic status, with the wealthiest residents occupying housing locations furthest from the urban core area. H. Hoyt (1933) projected axial growth in his sector theory, hypothesizing that higher status areas would form near amenities and on higher ground. Harris and Ullman (1945) introduced a multiple nuclei concept which has several centres or nodes of activity within a single urban area. Some recent studies using social area analysis have supported aspects of urban spatial theories (Shevsky and Bell, 1955). However, social area analysis works have concentrated mainly on the socio-economic factors and not on the physical factors involved in the structure of the city. This has resulted in conclusions which may be suspect, in that transportation innovations have lessened the importance of distance and changing social values have drawn apartment dwellers to the suburbs (Mowbray, 1962). W. F. Smith (1964) states that accessibility is of importance to the developer rather than the tenant due to the fact that it is easier to rent apartment units if they are readily visible to the public. With the questioning of accessibility as a major component in the study of residential structure, recent investi-
gations have centred on the delineation of housing market and submarket regions through the use of socio-economic factors. More recently the importance of the individual householder in the house purchasing process has been realized. This has led to the behavioural approach to residential location centering on the individual resident's actions and needs as the basis for study.

**Behavioural Theories of Residential Location**

Behavioural theories of residential location deal with residential patterns and land use changes by analysing the actions and decisions of the inhabitants of the study area with respect to housing choices.

This study does not deal directly with the inhabitants of the housing units under review but behavioural research findings are of use in the overall context of this work. A limited review of the pertinent literature is required. From the literature dealing with behavioural theories of residential location, the determinants of housing price and subsequently rental rates are of the most benefit to the purposes of this study. A discussion of this literature follows.

**Determinants of Relative House Prices**

The study of rent levels in various apartment buildings stems from the research originated in the 1960's concerning the determinants of relative house prices. The
chief concern of these studies was how the homebuyers' valuation of housing qualities was expressed in the market. Difficulty was encountered in the empirical works in identifying and qualifying the significant determinants of housing prices particularly those dealing with the buyers' valuation of the natural and social environment.

The findings of recent empirical works are summarized by M. J. Ball (1973) who classifies each study with respect to the sample type, sample size, statistical method used, significant variables, and critical omissions. The significant variables of the studies between 1960 and 1970 can be classified into three categories; locational, house related, and environmental.

The locational variables consist of those determinants of house prices related to distance from or access to various features in the urban area. Access to the CBD was by far the most predominant significant variable in the grouping of locational factors (Anderson and Crocker, 1971; Ridker and Henning, 1968; Wilkinson, 1973; Brigham, 1965; Evens, 1971). Other locational variables that proved significant were access to employment and schools (App, 1971), and access to main highways (Ridker and Henning, 1968).

House related variables consist of features found within the particular structure of the house which play a major part in influencing the buyer in his final purchase. The most significant variable in the house related segment of many studies was floor area (Wabe, 1971; Evens, 1971;
Apps, 1971; Wilkinson, 1973; Cubbin, 1970; Lane, 1970; Kain and Quigley, 1970). The number of rooms in the house was also significant in a number of studies (Wilkinson, 1973; Kain and Quigley, 1970; Ridker and Henning, 1968; Massell and Stewart, 1971). Floor area and number of rooms both indicated that space is the key determinant in the house related variable category. Other variables which proved significant were central heating (Wabe, 1971), age of the house (Apps, 1971), garage (Cubbin, 1970; Lane, 1970) and lot size (Massell and Stewart, 1971).

Environmental factors which proved to be significant as determinants of relative house prices dealt with both the physical and social environment of an area. The major physical variable was air pollution. Ridker and Henning (1968), and Anderson and Crocker (1971) all found air pollution significant, the former in St. Louis and the latter in Washington, Kansas City, and St. Louis. The other physical environmental factor was proximity to a green belt which indicated that Wabe's (1971) London study group viewed the natural environment as having as much importance in their decision-making process as locational and housing-related variables.

A wide variety of social environmental determinants of housing prices were found. The most predominant concerns neighbourhood quality and the socio-economic status of the area. The prime method of evaluation was a neighbourhood or socio-economic index of the area (Wilkinson, 1973;
Ridker and Henning, 1968; Massell and Stewart, 1971; Brigham, 1965). The better the quality of housing and the higher in status the inhabitants, the more desirable the area becomes. Other researchers were more specific in their findings, concluding that population density (Wade, 1971), housing density (Wilkinson, 1973; Ridker and Henning, 1968), school ratio (Wilkinson, 1973), percent non-white (Ridker and Henning, 1968), education of residents (Kain and Quigley, 1970), and average family income (Ridker and Henning, 1968) were all significant as determinants in the decision to purchase a particular house.

More recently the determinants of relative house prices have been emphasized in a number of residential location theories. H. W. Richardson, J. Vipond, and R. A. Furbey (1974) have put forward four such examples: the housing characteristic model which argues that housing prices are determined solely by the features of the dwelling; the spatial model which explains the determinants of house prices in terms of space and topological phenomena; the accessibility model which is based on the trade-off approach to housing as formulated by Alsonso (1964); and the area preference models which state that neighbourhood attractiveness is the most important attribute in the decision to locate in a particular location (Stegman, 1969). Richardson, Vipond, and Furley's results indicate that no single model of residential location can adequately account
for the determinants of house prices. They suggest that
the quality-controlled approach which deals with differences
in quality of various housing units by breaking the unit
into component characteristics and making price adjustments,
would have been an improvement but cite data limitations
as the limiting consideration. R. K. Wilkinson and C. A.
Archer (1973) also conclude that no clear-cut procedure
for selecting regression equations to explain the deter-
minants of house prices exists. J. Mark (1977) suggests
the development of a hybrid model is needed due to the
apparent lack of confidence in the previously suggested
models. The successful formulation of such a hybrid model
has not, as yet, been successfully undertaken.

The problem facing the behavioural scientist is the
application of the results of determinants of house-price
studies to rental-housing situations. The decision to
purchase a house may involve factors not associated with
the rental-housing process. Apartment dwellers, the most
common form of renting householders, are often thought to
be classified as young or old in age, single, financially
unstable, highly mobile consumers of housing facilities.
Recently, studies involving this segment of the urban
population have been carried out in an effort to reveal
the determinants of house rent and thereby more fully
understand the spatially distinct higher and lower cost
apartment housing subareas of the city. A detailed
discussion of apartment rental works follows.
Apartment Rent per Housing Unit

In view of the fact that the determinants of housing price may be different in composition and or ranking from those of apartment rents, a separate discussion of the determinants of apartment rent per housing unit will be presented.

Conventional theory defines rent as the amount a consumer is willing to pay for a particular good (G. W. Davis, 1976). The actual rent paid for housing has been directly attributed to a number of factors by a number of researchers. These include the number of housing units available per household, price of alternative forms of housing, the income of the potential inhabitant, mortgage rates of alternative forms of housing, and rent levels of housing units (Davis, 1976).

The actual amount of rent charged and subsequently paid is related to the behaviour of the renter and the methods of the landlord. Renters must initially decide what form and what quality of housing services to consume; they then enter the market and by weighing the advantages and disadvantages of each location, make a selection. The landlord must establish a rent level which accounts for the operating costs of the structure, is similar to what other landlords charge, and is within all government guidelines, if some type of rent-control legislation exists. This approach to rent fixing should supply the essential services associated with that particular type of structure while
maximizing profits (de Leeuw and Ekanem, 1973). However, the concept of supply and demand is not as complete as it may seem. The knowledge of renters pertaining to the entire market area is neither complete nor equal and Rapkin (1966) discovered that the landlords' selection of tenants is often influenced by skin colour or social status of the potential inhabitant which may limit competition and thereby affect rents. F. de Leeuw and N. F. Ekanem (1971) view the price adjustment process of rent levels in a stock-flow manner. They found rent levels, vacancy rates, and property tax rates to be significant variables in the rent adjustment process. Smith (1974) supports these findings and proposes that the responsiveness of rents to vacancy rates declines as vacancy rates increase. Rent adjustments have been found to be slow due to tenants' and landlords' limited knowledge of the market. High-rent areas are often a result of historical market forces rather than current developments (de Leeuw and Ekanem, 1973). M. Stegman (1978) furthers this point by stating that distance to the CBD and accessibility in general may be a historical effect. He feels rent determination is a result of the character of the dwelling and the neighbourhood, not location with respect to the CBD. Substantial premiums in the form of higher rent levels have been paid for suburban amenities by middle and upper income groups (Smith, 1974).

Until recently very little research pertaining to
the actual rent levels of apartment structures within a single urban area has been attempted. The major stumbling block in this type of research is data availability and consequently much of the initial research deals with the development of methods of predicting rent levels rather than explaining actual rent levels. The following is a review of the literature dealing strictly with the analysis and prediction of rent levels.

Interest in the analysis of rent levels of housing units was initiated in the late 1960's and early 1970's due to the rapidly increasing construction of rental style housing and the rapid increase in the cost of homeownership. The bulk of the current research is orientated towards the consumer, the price he pays and the goods he receives. As the selection of a housing unit is carried out within a limited range of suitable properties there appears to be a need for a type of method to evaluate the relative desirability of a select group of households. Ball (1973) in a review of housing price studies, found problems with previous research attempts in that data were excluded, dependent variables were estimated, small-city studies minimized accessibility components, and there was a lack of environmental variables. A technique of creating quality controlled methods of analysis was put forward (Ball, 1973; Romanos, 1976). The price per unit of housing was arrived at and an evaluation process of the desirability of each particular housing bundle was carried out. These
standardized values are determined through evaluations carried out by skilled assessors. Conclusions regarding these quality controlled standardized housing values revealed a price difference of twenty percent between the CBD and the suburbs (Goodman, 1978). These studies indicated a significant difference in the quality of homes selling for similar prices in the CBD and suburban areas. The findings reflect the composition and location of existing housing units and their related neighbourhood components. Goodman (1978) feels that the relative valuation of physical improvements is greater in the suburbs and subsequently housing units of lesser quality are subject to high sales prices.

The method of using standardized quality controlled housing data does have certain weaknesses in its design. Maclellan (1977) states that the approach is lacking in its housing supply factors. He feels that an effective utilization of this approach requires;

1) clearly stated assumptions;
2) properly identified submarkets;
3) spatial determinants of price should be divided into:
   a) spatial structure (economic and social);
   b) spatial processes (distance).

Problems pertaining to non-market factors such as the absence of zoning and mortgage rates in the assessed price are also identified (Palm, 1977). Murray (1978) warns
that submarkets of housing are not necessarily indicated by widely varying standardized prices across an urban area in that subareas of a single housing market may exist.

The major problem with the quality controlled approach is that the dependent variable, house price or rent, is estimated at the outset without taking into account the actual market price for that particular unit. One study which did use market transactions as its basis of data studied rent differences among major United States cities on an inter-urban basis (de Leeuw and Ekanem, 1971). The results indicated that land prices, wage rates, and utility costs were major determinants of inter-city rent variations. Unfortunately, these variables are of little significance in a single urban area within which these variables differ very little. While this method has proven effective on an inter-urban scale little has been completed in the intra-urban context. The standardized approach has been found to be effective in static cross-sectional studies to explain determinants of house prices and in deriving the importance of environment and neighbourhood in house price (Maclellnan, 1977). Due to the apparent applicability of this approach to the study of rent variations of standardized apartment apartment housing units in Windsor, and the availability of actual rent data on a city-wide basis, this methodology will be implemented here.

The literature has revealed that the development of apartment complexes is proceeding at a rapid rate throughout
the entire urban area. The study of land rent and traditional land-use theories has entrenched the importance of the central city firmly in the literature. Recently, the importance of access in locational choice seems to have been minimized with more and more emphasis being given to the neighbourhood and environment of residential areas. Attempts by researchers to explain spatial variations in rent levels on an intra-urban basis have largely been invalidated by a lack of data. The spatial aspects of quality controlled rent indexes have been minimized while problems involving the accurate valuation of estimated rent levels are being solved. Most urban economic researchers have concentrated on the development of an economic index which will accurately predict rent levels while this paper deals with the evaluation of variables significant to the formation of spatial variations in actual rent levels on an intra-urban basis.

**Apartment Location in the Residential Land Market**

Apartment construction can take two forms; the redevelopment of an existing area, or new development on previously vacant lands (Bourne, 1968). The locational factors involved in the final decision-making process of apartment construction are made by the developer within the guidelines established by the city in which construction is deemed to be profitable. Bourne and Berridge (1973) identify these developer related site factors as:
1) the character and distribution of existing building stock;
2) accessibility to CBD, transit, and employment;
3) physical and social quality of the local environment;
4) site factors including cost and ease of land assembly;
5) city policy constraints such as zoning;
6) local demand for such facilities.

Builders realize that people put different values on the same housing units. Houghton (1971) found that it is possible to explain existing residential distribution by ascertaining when the net benefit to the resident is maximized and when the cost to the builder is minimized. To reduce cost and ensure a receptive customer, builders are drawn to areas with non-ethnic populations, a high proportion of existing rental units, high mobility characteristics, and to locations with few specific vested interests (Bourne and Berridge, 1973).

Traditionally, apartment location has been thought to have been dependent upon surrounding land use, its characteristics, and land value. The price of land was found to be directly related to access to the city centre. It has been shown that apartment complexes are capable of paying a high land rent and subsequently locate at the prime CBD locations. Bourne (1976) counters by arguing that most location theorists assume costs to be constant
allowing only for land to vary as a price factor, thereby ignoring the standing stock of buildings and implying that all high-rise/high-density apartment structures are in the CBD. Bourne does reveal a constraint in the construction of apartment complexes which deals with the quality at which the new housing is added to the existing stock. Most new housing is added to upper income household areas creating a clustering of upper social and income groups. Although new apartments are rented and are therefore supposedly not directly dependent upon income, they do comply to the income stratification constraint common to other forms of housing. Bourne suggests that recently constructed apartment buildings cater to the upper socio-economic segment of society and are located within more 'well to do' areas of the city.

The current trend of apartment location in the suburban areas of the city has been explained through trade-offs among accessibility, local amenities, and space. Recently, accessibility has been questioned as a fundamental factor in the residential location decision-making process while the positive aspects of suburban locations have been stressed. Smith (1978) found that substantial premiums are being paid by middle and upper class citizens for neighbourhood amenities. New apartment structures are being built in two primary locations; 1) near or in the CBD to maximize accessibility or 2) in more aesthetically pleasing areas frequently associated with 'nice' neighbourhoods or
unique physical environments.
CHAPTER III

METHODOLOGY

The methodology utilized in this study consists of the preliminary analysis, hypothesis formulation, model specification, verification procedures, study area, and data type and source. Hypothesis formulation and testing, and model specification are the major procedural tools used to ascertain the validity of previously revealed determinants of rent variations in the Windsor apartment housing market. Location variables found to be significant in the determination of rent in the literature review and through the preliminary analysis will be hypothesized to be significantly correlated with rent per standardized apartment unit of housing in Windsor. After the individual testing of the hypotheses, the significant variables will be tested in an apartment rent model to determine the proportion of variation in apartment rent in Windsor accounted for by locational factors. In addition, the results will be compared with previous findings.
Preliminary Analysis

The preliminary analysis consists of the gathering and standardizing of apartment rent data for the Windsor study area, and the mapping of those data to delineate any possible housing submarkets with regard to price within the urban area. A discussion of the resultant map and the patterns in rent with regard to general location is presented in order to complement the literature review and arrive at a set of properly rationalized hypotheses. Data are expressed as rent in dollars per square foot per month per average unit per building under study. This value was computed in cost per square foot per month due to the fact that this unit of measurement is the most easily recognizable and comparable form of analysis. The entire population of the rent values was taken and a range of sixteen ($0.16) cents per square foot per unit was noted between the upper ($0.46) and lower ($0.30) extremes in the data set, (53% difference). Table 3.1 illustrates the distribution of rent data with regard to the frequency of occurrence over each of the price categories.

To ascertain whether any spatial variations of the rent data existed, the data were mapped using a SYMAP computer program. This program consists of the mapping of rent data in the city of Windsor by grouping the values into a number of subsets of the total range. A map featuring four rental subsets was selected as it most
TABLE 3.1

FREQUENCY DISTRIBUTION OF APARTMENT RENT DATA

<table>
<thead>
<tr>
<th>($) Rent/Sq. Ft./Month</th>
<th>Frequency</th>
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</thead>
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<tr>
<td>0.30</td>
<td>4</td>
</tr>
<tr>
<td>0.31</td>
<td>14</td>
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<tr>
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<tr>
<td>0.46</td>
<td>2</td>
</tr>
</tbody>
</table>
clearly illustrated upper and lower rental regions in Windsor. The program plots a pattern for each of the subsets with the resultant map exhibiting regions of higher and lower rental units.

The results of the SYMAP computer program are illustrated in Figure 3.1. Three regions of higher rent apartment structures are noted. They are located in the western area of the city in close proximity to the Detroit River, in the CBD, and in the far eastern area of the city along the riverfront. Lower rent regions are located in the far south western, east central and far eastern areas of the city. With the exception of the south western zones low rental areas are situated away from waterfront locations. The zones appear to correspond to subareas of the city which offer physically and socially homogeneous locational housing characteristics.

The preliminary analysis has revealed a 53 percent difference between the extremes in the rents of similar apartment structures within the City of Windsor. The SYMAP mapping exercise has revealed that certain regions in the city exhibit higher rent levels than others. Physical and social attributes of location appeared to be related to rental patterns and this substantiated the general research approach of the paper, that is to examine social, economic, physical and structural attributes of the apartment housing stock in Windsor and their relation to rent. These findings and the review of the literature
Figure 3.1

STUDY UNIT RENT LEVEL DISTRIBUTION IN WINDSOR
will act as the basis for hypothesis formulation.

Hypothesis Formulation

A number of hypotheses are formulated in order to test the magnitude of the relationship between rent and the hypothesized determinants of rent, and to group and rank the effect of these variables on the overall distribution of apartment rent in Windsor. The set of hypotheses is used to develop a preliminary apartment rent model. The results arising from testing of the hypotheses are used to specify a final locational apartment rent model.

Hypotheses

Rent charged per square foot of apartment dwelling space in Windsor varies:

1) directly with the general automobile accessibility in Windsor;
2) inversely with distance from the Detroit River;
3) inversely with travel time by public transit to the Central Business District (CBD);
4) directly with the general economic characteristics of the census tracts;
5) directly with the perceived air quality in the area around each study unit;
6) directly with recent housing sale prices in the respective residential areas;
7) directly with the population densities around
each study unit;
8) directly with the percentage of renters in each respective census tract;
9) directly with the percentage of single inhabitants of the respective census tracts;
10) inversely with the percentage of citizens over the age of sixty-five in the surrounding census tracts;
11) inversely with the vacancy rate of similar apartment units in the surrounding area;
12) inversely with the age of the particular apartment structure;
13) directly with the number of storeys associated with each apartment structure.

Preliminary Model Formulation

The above variables are all individually hypothesized to be significant locational determinants of apartment rent in Windsor. Rent charged per unit of dwelling space is a result of many inter-related factors including the locational determinants hypothesized above. It is the aim of this paper to examine through the derivation of an apartment rent model, the overall effect of these locational determinants of rent in the Windsor apartment housing sector. The framework of such a model follows the conceptual form of many previous studies on house prices (a logarithmic data transformation is implemented to derive the linear nature
of the relationship):

\[
\log R = \log a + b_1 \log X_1 - b_2 \log X_2 - b_3 \log X_3 + b_4 \log X_4 + 
\quad b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + b_8 \log X_8 + b_9 \log X_9 - 
\quad b_{10} \log X_{10} - b_{11} \log X_{11} - b_{12} \log X_{12} + b_{13} \log X_{13} + E
\]

Where:

\( R \) = Standardize rent value of apartment unit \( i \); during
the October 1978 - April 1979 study period;
\( X_1 \) = Accessibility index of location \( i \);
\( X_2 \) = Distance from \( i \) to Detroit River, in kilometers;
\( X_3 \) = Travel time by public transit to CBD from \( i \), in minutes;
\( X_4 \) = Poverty index of location \( i \);
\( X_5 \) = Perceived pollution index of location \( i \);
\( X_6 \) = Recent house sale prices of location \( i \), in dollars;
\( X_7 \) = Population density of Census Tract (CT) of \( i \);
\( X_8 \) = Percentage of renters in CT of \( i \);
\( X_9 \) = Percentage of single residents in CT of \( i \);
\( X_{10} \) = Percentage of residents over 65 years old in CT of \( i \);
\( X_{11} \) = Vacancy rate of two bedroom apartment units in market
area of \( i \) (as defined by Canada Mortgage and Housing
Corporation);
\( X_{12} \) = Age of structure \( i \), in years;
\( X_{13} \) = Number of storeys of \( i \);
\log = logarithmic transformation;
\( a \) = constant;
\( b_1 - b_{13} \) = regression coefficient;
\( E \) = residual (error term).

The variables employed in this model are discussed more fully
in the section - data and source.

**Verification Procedure**

The purposes of the study will be fulfilled through the testing of the hypotheses, evaluation of the conceptual framework or model, and a comparison of the findings with those of previous works. The verification procedure consists of:

1) The testing of the simple 'r' - correlation coefficients - between the dependent variable (rent) and the hypothesized independent variables (n=13). As the dependent variable consists of the entire population (100%) a correlation value of greater than zero can be considered statistically significant. In this case in an effort to add substantive significance to the findings, only r values greater than .10 will be considered significant.

2) The evaluation of the framework or model to account for the relationship between the entire independent variable bundle and rent will be accomplished through the use of multiple regression. The SPSS program used provides a correlation matrix for all the variables, a regression equation at each step of the analysis, a summary table of the stepwise process listing the multiple correlation, $R^2$ and $b$ values at each step, and a list of residuals remaining at the termination of the model. The $b$ values are used to assess the joint effect of the locational determinants of rent in the Windsor housing market.
3) The comparison of these research findings with those in other housing markets. The relative contributions of each of the four major components of rent (accessibility, social neighbourhood, physical neighbourhood, and structural design criteria) to the explanation of rent in Windsor are compared with previous research findings at the national, regional, and local levels.

Study Area

The study area consists of the high-rise/high-density housing rental market in the Windsor metropolitan area as specified by CMHC, Windsor. Figure 3.2 illustrates the area under study.

Data for the delineation of the study area are drawn from the files of CMHC (Windsor) for the October 1978 - April 1979 time period. All of the units are situated within the City of Windsor. Rent levels for all apartment buildings (n=96) with at least ten units (of which two must have been two-bedroom units) built since 1966 by private concerns were gathered. Two-bedroom-apartment unit rent levels for October 1978 and April 1979 were recorded along with the location of each building. The average rent calculated over the October to April time period was used as the raw rent value for each apartment location. These raw rent data were then adjusted as required on the basis of appraisal values carried out by Mr. John Care of CMHC to account for any cosmetic or internal variations among each building,
and the effects of rent control on the units. This was completed in an attempt to minimize factors which affect rent in addition to locational variables. Inaccuracy in this appraisal process may lead to an error component in the analysis but there is no reason to suppose such errors are not randomly distributed.

Collection and availability of data are one of the most important aspects of this research. As noted in the literature review, housing cost estimates are frequently used in this type of study due to the confidentiality of rent data. The rent data from CMHC was made available through the guarantee of confidentiality. The opportunity to use these data is one reason for the above specification of the dependent variable. Furthermore, recently constructed apartments (construction completion dates from 1966 to 1977) should help to minimize the impact of age on apartment structures. In addition, the vast majority of apartment structures in Windsor have been constructed during this period and thus the sample incorporates the bulk of apartments available for rent. Secondly, in an attempt to attain a politically uniform study area and a relatively uniform housing market area, the City of Windsor municipal boundary of 1966 to the present will be used. Prior to this date, which signifies the amalgamation of various townships into the city, the Windsor housing market may have been fragmented by political boundaries creating an uncoordinated planning strategy. Thirdly, in an effort to obtain a population
sample representative of the family rental market two-bedroom apartments were selected as the study units. This criterion may limit the influence of single households and the elderly upon the housing market, since these inhabitants of apartment dwellings are more likely to occupy one-bedroom housing units. The study is limited to renters of two-bedroom units in relatively new structures. This does however, incorporate the majority of apartment buildings. Fourth, high-rise and/or high-density buildings with greater than nine units were selected because they offer many standard conveniences such as parking, balconies, and laundry facilities which rental units with less than ten units may not. Selection of these units is done in order to avoid a transitional style of housing, the small apartment building which often resembles the single family detached style of living. Finally, only housing units with living space of between 750 and 900 square feet are analysed in an attempt to eliminate residential accommodations at the extreme ends of the socio-economic scale. The above criteria are used in order to attain a more clearly defined homogeneous type of housing and thereby evaluate more accurately the hypothesized locational relationships between selected variables and rents.

Data and Source

Data utilized in this study are derived from a number of sources including: 1976 Canada Census, CMHC Apartment
Vacancy Surveys for October 1978 and April 1979, previously completed University of Windsor Theses, government funded Department of Geography studies, Transit Windsor bus schedules, and field work by the author pertaining to distance and storey measurements.

The dependent variable is standardized rent value in dollars per square foot per month for each of the study units under consideration in this proposal. The population (n=96) consists of rent levels for all apartment structures within the City of Windsor which meet the previously mentioned criteria and have been included in CMHC's semi-annual Apartment Vacancy Survey. As a 100 percent population is used, any error sources that may occur would be the result of random human error in the tabulation of the above data sources, in the appraisal process, or in the exclusion of relevant independent variables.

The literature and the preliminary analysis have revealed thirteen variables which act as determinants of relative housing prices which will be applied to the Windsor study area. The variables utilized are:

1) accessibility index of Windsor – ACCIND;
2) distance from the Detroit River – DISTRV;
3) travel time to the CBD by public transit – TRVLTM;
4) poverty index of census tracts – PVTYCT;
5) perceived pollution index of air quality – PLNIND;
6) recent housing sale prices in census tracts – HSPRCT;
7) population density of census tracts – POPDCT;
8) percentage of renters per census tract – RENTER;
9) percentage single (never married) inhabitants of census tracts – SINGLE;
10) percentage of citizens of census tracts over sixty-five years old – SIXTYF;
11) vacancy rates of two-bedroom apartment units within Windsor 1978 – 1979 – VACRAT;
12) age of the apartment building – AGEAPT;
13) the number of storeys per apartment structure – STOREY.

A detailed discussion of the above variables follows. For the purpose of brevity the variables will be referred to in their abbreviated forms, and grouped into the four major components in the determination of rent; accessibility, physical environment, social neighbourhood, and structural design.

Accessibility

In most works concerned with the determinants of housing prices accessibility was deemed to be significant in explaining cost levels. Accessibility is associated with rent levels in that rent is hypothesized to be dependent upon access to various commercial, employment, and recreational opportunities found throughout the urban area. Apartment locations featuring direct access to most or all city amenities should exhibit evidence of intense rental bidding between potential inhabitants creating high
rent levels. Subsequently, the lower the accessibility of a particular location the lower the respective rent levels. In monocentric urban areas this is assumed to occur as the location of apartment structures moves further from the CBD. Therefore, as the potential resident's accessibility to areas he considers important decreases, the rent which he is willing to bid for that location also decreases. One would expect that accessibility and apartment rent would be positively related. Accessibility will be measured in three distinct ways:

a) accessibility index of Windsor - ACCIND;

b) travel time to the CBD by public transit - TRVLT;

c) distance from the Detroit River - DISTRV

The values used in the evaluation of each apartment structure with respect to its relative street network accessibility are based on a general accessibility index of Windsor derived by St. Antoine (1976) for the 1972 and 1974 time periods. As St. Antoine's index provides an overall accessibility rating it reflects the multi-nodal nature of Windsor and therefore reduces biases associated with monocentric accessibility measures. Traffic flow data for later periods were examined and no major changes were noted between those and the 1972 and 1974 time periods. It is therefore assumed that the relative street network accessibility of various locations within the city has not drastically changed in the last six years.

A separate CBD variable has been included in the
study as the downtown area of Windsor does act as a focal point of the city with regard to various governmental, shopping, and service activities. The presence of a distinguishable CBD in the study area and the fact that past studies closely associate the CBD with accessibility parameters warrants its inclusion in this work. TRVLTLM accounts for two important aspects of accessibility in the city. It allows for an appraisal of the importance of access to the CBD by the resident and it evaluates the relationship between the use of public transit and the apartment dweller. In the homeownership related studies there may be some justification for the exclusion of public transit accessibility variables due to the fact that the decision to purchase a home is generally made by someone who is in a financially secure position and subsequently owns and drives an automobile. However, in apartment rental studies the TRVLTLM is a necessary addition to the list of variables because rental housing units are also occupied by residents who are less financially secure than homeowners and may rely heavily on public transit systems to supply much if not all of their transport needs. As with the ACCIND, one would expect the highest rental bidding to be done by the potential residents for apartment units with the shortest travel time by public transit to the CBD. Therefore, a negative relationship would be expected as a result of less bidding and subsequent lower rents in apartment units with increased travel times to the
CBD. Travel time is measured as the number of minutes it takes an 'on schedule' Windsor public transit bus to make a one-way trip from each apartment location to the CBD. These times are obtained from the 1979 Transit Windsor Route Map: Bus Schedule.

Distance as it relates to accessibility to specific outstanding natural features has been included in much of the previous research in this field. Therefore, it has also been included in this study. Distance from the Detroit River involves a measurement of the attractiveness of the waterfront which features park development over much of the area, scenic views of the Detroit skyline, and various recreational facilities. As the distance from the river increases accessibility to this amenity-laden area decreases and should thus reduce rental value.

Physical Neighbourhood

The literature has revealed various aspects of the physical environment or neighbourhood which act as forces in the determination of rent. The more pleasing the natural environment is deemed to be by the potential resident the higher the housing rent he should be willing to pay. For the purposes of this study two variables have been selected as being representative physical neighbourhood characteristics. The first PWTYCT involves an appraisal of the physical condition of the existing residential structures in the area of each study unit, while the second deals with
the environmental quality of the area as perceived by the resident through his rating of the air pollution in his residential area (PLNIND).

The literature has revealed that the higher the social status of a particular area the higher the structural quality of housing units in that area. This also holds true for the rent bidding process of apartment units. People are willing to pay a premium to live in a 'nice' area of the city. With this in mind it is felt that some sort of overall index of quality for the study area around each apartment complex is required. Due to the complexity of such an index, L. H. T. Oliver's (1977) poverty index of Windsor was utilized. Oliver identified poverty pockets in the city based on census tract data. The lower the index value the less the attraction of an area will be to a potential inhabitant. One would expect that the PUTYCT would be positively related to rent levels of each apartment structure.

It is generally accepted that the quality of air in a particular location is a contributing factor in an inhabitant's satisfaction level with that location. Areas with poor air quality should receive less rental bidding than areas in which the potential resident feels a cleaner environment exists. In the case of high-rise apartment structures this may prove to be of great significance due to the importance of the view, and of balcony living to the inhabitant. Hence, areas of Windsor in which potential in-
habitants feel an air pollution problem exists will reflect lower rent levels. A positive relationship should evolve between the satisfaction level of the renter and the amount of rent he is willing to pay.

Data for PLNIND are obtained through a previous study by the University of Windsor, Department of Geography (1973) which evaluated the Cognition of Urban Environmental Hazards, in Windsor. These data take the form of a satisfaction ranking (1 to 7) completed by residents of Windsor. The higher the satisfaction value, the less the air pollution problem is perceived to be by the inhabitant. It is assumed that the perception values exhibited during the 1974 time period have not significantly changed in the last six years. A positive relationship between satisfaction levels and rent is expected.

Social Neighbourhood

The demand for housing services involves the measurement of a wide variety of factors, the most complex of which are those associated with the social environment or neighbourhood of a particular area. Problems arise in the definition and measurement of such variables in that they are dependent on the individual resident's thoughts and perceptions of the area in question. Many surrogate variables have been used in the evaluation of the social environment of an area to solve the problem of effectively measuring each individual's perception of the neighbourhood. A
number of these surrogate variables will be implemented here to gain as accurate a measure as possible of the effect various social parameters have on the rent of the apartment units under study. These variables are:

a) recent housing sale prices in census tracts - HSPRCT;

b) population density of census tracts - POPDCT;

c) percentage renters per census tract - RENTER;

d) percentage single inhabitants per census tract - SINGLE;

e) percentage of citizens over the age of sixty-five - SIXTFV;

f) vacancy rate - VACRAT.

The average sale prices of single-family detached houses are associated with rent levels in two ways. First, the actual cost of a house in a certain area of the city may restrict potential householders to rented premises. Secondly, rent levels in areas of the city with high single-family detached house sale prices should reflect the benefits of that area, in that the more prestigious a neighbourhood is, the higher the rent bidding will become. One would expect a positive relationship to exist between HSPRCT and the rent levels of that area.

The HSPRCT were tabulated in dollars for the January to March 1979 time period. These data were gathered and tabulated from initial field work on the study of housing prices by census tract in Windsor by T. K. Tan (1980).
Past studies of the determinants of rent have found that population density of an area plays a dual role. In some instances the crush of high-density locations creates a strong push to lower-density locations. POPDCT is also put forward as a variable which creates high rental bidding due to the accessibility advantages of high-density central locations. For the purposes of this study the latter has been accepted because of the apparent high marketability of centrally located apartment structures in Windsor. Rent levels should vary directly with population densities of the census tracts within which each building is situated.

The population densities for 1976 are provided in 1976 Census of Canada, Volume 6, (Bulletin 6.31) Census Tract: Population and Housing Characteristics, Windsor. The data are recorded as number of people per square kilometer in each census tract.

The percentage of renters per census tract appears in the literature as a direct influence on the rent levels of various segments of the city. As the number of renters in an area increases, increased competition for the existing units is expected. Census tracts with high concentrations of renters are assumed to provide the most favourable housing opportunities for those particular individuals.

The RENTER data are recorded as the percentage of the population living in rented private dwellings at the time of the last census. The RENTER statistics for 1976 are provided in 1976 Census of Canada, Volume 6 (Bulletin
6.31 Census Tract: Population and Housing Characteristics, Windsor.

Past studies have dealt with the single individual as the prime consumer of rental housing. The rationale is based on the view that single persons may not require additional household space or value the apparent advantages of single-family detached houses in the same manner as married couples with growing or planned families. Many other single people, namely the young, find apartment living the only affordable housing alternative while trying to finalize their career ambitions. It has been revealed the general population prefers residential areas which exhibit a stable housing environment, subsequently preferring areas with a low proportion of single inhabitants. This creates high-cost single-family detached housing areas which are primarily accessible to well established families and apartment orientated regions which cater to the single inhabitant. This assumes that the majority of individuals in these categories inhabit apartments. The SINGLE data are recorded for only those people who were never married. One would expect areas of the city with high percentages of single inhabitants to exhibit higher rent levels than other more stable areas due to competition for existing apartment units. The SINGLE data for 1976 were obtained from the 1976 Census of Canada, Volume 6, (Bulletin 6.31) Census Tracts, Population and Housing Characteristics, Windsor.

The literature has shown that large concentrations
of elderly people in one particular neighbourhood are often a result of smaller cheaper housing units and historical factors. The larger the number of elderly in an area the more likely it is that low apartment rent levels exist.

These lower levels are a result of less rental bidding on the various units by the general population who perceive older portions of the city's housing stock to be less desirable than those units of more recent construction. One would expect that SIXTYF and rent level are negatively related.

SIXTYF data for the 1976 census period were obtained from 1976 Census of Canada, Volume 6, (Bulletin 6.31) Census Tracts: Population and Housing Characteristics, Windsor.

Research has concluded that vacancy rates exhibit an influence on the supply and cost of rental housing. Developers are conscious of a high vacancy rate for apartment units when planning new apartment complexes. High VACRATs may create a consumers' market and subsequently lower rents may be charged. Intense competition between apartment complex owners results if high vacancy rates persist. The VACRAT data are in percentage form. They measure the vacancy rate of two-bedroom privately funded apartment units over housing submarkets in the Windsor Census Metropolitan Area (CMA) for the October 1978 to April 1979 time period. Vacancy rates may also be a measure of housing preferences on the part of the consumer.
in that the popularity of one form of housing may create a high vacancy rate in another.

These data were obtained from the Apartment Vacancy Survey October 1978 and April 1979 for the Windsor CMA completed by the Windsor office of the Canada Mortgage and Housing Corporation (CMHC).

**Structural Design**

A number of structural qualities frequently associated with apartment buildings have been revealed in the literature as being significant as determinants of rent. These structural features deal with the specifics of the building and its site. For the purposes of this study two representative structure qualities are used. These are the age of the structure in years and the height of the building in storeys.

The components of a particular apartment unit have a direct relationship to the attractiveness of that unit. In the definition of the dependent variable the most common characteristics of the study units were accounted for; however, it is difficult to appraise the effects of time on a particular apartment building. As a structure ages its attractiveness decreases as it gradually falls into a state of disrepair. By limiting the study units to apartment structures built since 1966 much of the deterioration common to buildings constructed prior to this date is eliminated. However, it is felt that AGEAPT is a valid variable in that the 'polish' of a new building is a def-
inite factor in the attraction of a building. The more recent the construction of the structure the higher the relative rent levels should be. One would expect a negative relationship to exist between AGEAPT and rent level.

The AGEAPT data are expressed in number of years old and are obtained through the Apartment Vacancy Rate Survey April 1979 - Field Notes Canada Mortgage and Housing Corporation (CMHC).

Since the initial construction of high-rise apartment units, those units which are found on the upper floors have commanded higher rent rates. The view of the horizon coupled with the escape from the city below is the basis for the price differential between upper and lower floors. Following this thought, apartment complexes which feature high-rise amenities are often viewed with a greater degree of satisfaction than low-rise walk-up structures. The higher the building projects into the air the greater its attraction to the potential inhabitant and subsequently the greater the rent levels. One would expect a positive relationship to exist between STOREY and rent level.

Data are in the form of number of storeys and are obtained through field work by the author.

Unit of Analysis

Six of the thirteen independent variables in this analysis are determined using the census tract as the basic unit of analysis. Due to recent studies which deal with data
on smaller and larger scales it is felt that a brief recount of the rationale behind the selection of the census tract as a unit of study is required.

The census tract has been employed in housing studies for many years for the following reasons. Census data are aggregated into census tract categories providing the smallest area from which statistics of this accuracy can be compared. The smallest unit of measurement, the enumeration area, undergoes constant alteration with respect to its boundaries between census-taking periods. Larger units of analysis, planning districts, which are utilized by the municipal planning departments may camouflage rental market trends by aggregating the data. Results of this study can be applied to planning district study units by incorporating the individual census tract findings into their corresponding planning districts. Secondly, the census tract is the most convenient geographical area for which detailed data are available. Thirdly, the location of apartment complexes throughout the city creates the situation that smaller units of analysis may result in many areas without sufficient data, while larger units may statistically explain determinants of apartment rental rates in areas where no such structures exist. Finally, by implementing the census tract as the basic unit of analysis, comparisons can be made with previous studies which in the majority of cases analyzed similar data at the census tract level.

All census tract data are in percentage form to
account for variations in the characteristics of each particular tract.
CHAPTER IV

ANALYSIS

The analysis of the determinants of rent in high-rise/high-density apartment housing units in Windsor will consist of three basic procedures. As outlined in the methodology a number of preliminary hypotheses will be tested, a model will be formulated from the results of this testing, and conclusions drawn regarding the four major components of rent from the results of an analysis of the model. The analysis will be concluded with a discussion and summary of the findings.

Testing of the Hypotheses

Test of Hypothesis I

Hypothesis I: rent charged per square foot of apartment space in Windsor varies directly with general automobile accessibility in Windsor.

Hypothesis I is based on the literature which has shown that as the general accessibility of a particular location within an urban area increases, the more desirable a site at that location is deemed to be with regard to the
choice of residential location. The relationship between automobile accessibility and rent has been tested in many urban centres throughout North America. In Windsor however, the relationship between rents and motorcar accessibility has not been examined.

As seen in Table 4.1, r is significantly greater than ±.10 (r = .17). As a result, general automobile accessibility in Windsor does have a significant direct relationship with rent levels of the apartment structures under study within the urban housing study area.

Hypothesis I, that a direct positive relationship exists between rent charged per square foot of apartment dwelling space in Windsor and general automobile accessibility in the city is therefore accepted.

Test of Hypothesis II

Hypothesis II; states that rent charged per square foot of apartment space in Windsor varies inversely with distance to the Detroit River.

This hypothesis is derived from studies which revealed that proximity to amenity laden areas is a prime pull factor in the decision to locate a household in a particular housing market. The preliminary analysis which mapped the rent data also indicated the need for an investigation of the accessibility to the waterfront by illustrating that higher apartment rent levels were found for buildings on riverfront locations. The suggested relationship between distance to
<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>( r )</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1 ACCIND</td>
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</tr>
<tr>
<td>X2 DISTRV</td>
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</tr>
<tr>
<td>X3 TRVLTM</td>
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</tr>
<tr>
<td>X4 PUTYCT</td>
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</tr>
<tr>
<td>X5 PLNIND</td>
<td>0.58</td>
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<tr>
<td>X6 HSPRCT</td>
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</tr>
<tr>
<td>X7 POPDCT</td>
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</tr>
<tr>
<td>X8 RENTER</td>
<td>0.37</td>
</tr>
<tr>
<td>X9 SINGLE</td>
<td>0.41</td>
</tr>
<tr>
<td>X10 SIXTYF</td>
<td>0.33</td>
</tr>
<tr>
<td>X11 VACRAT</td>
<td>0.31</td>
</tr>
<tr>
<td>X12 AGEAPT</td>
<td>-0.25</td>
</tr>
<tr>
<td>X13 STOREY</td>
<td>0.60</td>
</tr>
</tbody>
</table>
a waterfront (Detroit River) and rent is tested. As $r = -0.37$ is greater than $\pm 0.10$, the distance to the Detroit River from the various apartment locations appears to be a prime determinant of household rent.

In conclusion Hypothesis II is accepted in that the relationship between rent and distance to the river is significant and inverse in nature. This indicates that accessibility to waterfront locations plays a part in the determination of rent in the Windsor housing market.

Testing of Hypothesis III

Hypothesis III; rent charged per square foot of apartment space in Windsor varies inversely with the travel time by public transit to the CBD.

Hypothesis III is based on the assumption that the CBD is the focal point of much of the urban area's activities. Although recent studies have criticized the monocentric assumptions of such studies a thorough investigation of the Windsor study area shows that the CBD remains a vital component of the city. In this regard the travel time to and from this area of intense interaction is considered a valid variable in the rental process.

The relationship between travel time by public transit to the CBD is hypothesized to be inversely related in that the longer the travel time to this area the lower the rent a prospective tenant is willing to pay.

The resultant value of $r = -0.37$ is greater than
\*1.10. Therefore the correlation between travel time to the CBD by public transit and rent per square foot of dwelling space is significant and inverse in nature. Hypothesis III is accepted.

**Test of Hypothesis IV**

Hypothesis IV; rent charged per square foot of apartment dwelling space in Windsor varies directly with the general economic characteristics of the census tracts within which each apartment structure is located.

Hypothesis IV is presented to allow for some type of economic assessment of the physical characteristics of the neighbourhood within which each building is located. The general economic characteristics of each census tract have been accounted for in Oliver's (1977) work on the identification of poverty pockets in Windsor. One would expect from a summary of previous works in this field that a positive relationship should exist between the quality of the neighbourhood and the rents being charged by apartment structures in those neighbourhoods. Hypothesis IV is established to evaluate the effect of the poverty index variable in the determination of rent in the Windsor housing market.

As seen in Table 4.1, \( r = -0.18 \) is greater than \( \pm 0.10 \). It is concluded that the strength of the relationship between the general neighbourhood characteristics of a residential area and the rent charged per dwelling unit
in that region is significant. However, the r value is negative thus indicating an inverse relationship between the economic characteristics of a housing area and rent. Hypothesis IV is rejected in that a negative relationship exists between the two variables. This result may indicate a lack of concern by the apartment resident regarding the physical quality of the environment surrounding his particular apartment structure due to the easy accessibility of more aesthetically pleasing environments.

**Test of Hypothesis V**

Hypothesis V; rent charged per square foot of apartment dwelling space in Windsor varies directly with the perceived air quality in the area around each study unit.

Hypothesis V was derived from the literature which revealed that air quality has a decided effect on the potential resident's perception of an area. Some urban areas are free from much of the air pollution associated with heavily industrialized centres, but Windsor is not. Being heavily dependent upon the automobile industry and its associated foundries, Windsor is a city with historical pollution problems. This, coupled with Windsor's location to the southeast of Detroit and its related industries, justifies the inclusion of an air pollution related variable in the analysis.

The relationship between the perceived air quality of various residential areas in Windsor is thought to be
directly related to rent. The perception values are drawn from a previous work in the Department of Geography (1974) at the University of Windsor. The higher the perceived air quality values were, the less air pollution there was deemed to be by the respondent to the study. In this way it is thought that a positive relationship would exist in that the greater the resident's satisfaction with air quality, the more rent he will be willing to pay for housing accommodation.

The correlation coefficient $r = 0.58$ is significantly greater than $±1.0$. Thus the perceived air quality in the immediate vicinity of residential areas in Windsor is significant and direct in nature in the determination of rent.

In conclusion, hypothesis V is accepted in that the strength and direction of the relationship were as expected. The perceived air quality in residential areas of Windsor does play a major role in the determination of the amount of rental bidding for a particular residential package. This supports the previous literature on other major urban areas and confirms the author's notions that the quality of the air in Windsor varies to the extent that residents consider it a significant variable in their residential decision-making processes.
Test of Hypothesis VI

Hypothesis VI: rent charged per square foot of apartment dwelling space in Windsor varies directly with recent housing sale prices in the surrounding residential areas.

Hypothesis VI has been derived in an attempt to link apartment rental charges to the actual cost of single-family detached houses in the immediate area. The literature has shown that the cost of single-family detached housing within homogeneous subareas of the urban housing market directly influences the cost of apartment housing units in the same area. The better the quality of the single detached house in an area the higher the subsequent rent in apartment units is likely to be. The relationship between single-family detached housing prices is −0.19. Although the relationship is significant, it is inverse in nature, therefore Hypothesis VI is rejected. This may be due to a disregard for single-family detached style of housing by the apartment dweller, creating high-rental market areas in all types of rental zones regardless of the composition of the existing housing stock.

Test of Hypothesis VII

Hypothesis VII: rent charged per square foot of apartment dwelling space in Windsor varies directly with the population densities around each study unit.

Hypothesis VII has been established to determine
whether high-density population areas of the urban housing market create an intense rental-bidding process in the central core of the city where housing densities are highest. It is hypothesized that rents will vary directly with population densities of residential areas due to the apparent high marketability of centrally located apartment complexes in high-density areas of Windsor.

As \( r = 0.21 \), it appears that the population density of various residential sectors significantly affects rent charges for apartment units within those areas and is direct in nature.

In conclusion, Hypothesis VII is accepted. The strength and positive direction of the relationship have been analysed and correspond to the hypothesis which states that rent per apartment unit in Windsor varies in direct proportion with population density. This finding reinforces the traditional literature which hypothesizes that high-density living in close proximity to the CBD commands the highest rent per unit of dwelling space. Although the preliminary analysis indicated areas to the east and west of the CBD as alternative high-rent regions, the frequency of high-rent apartment units in the CBD substantiates much of the previous work along this line.

**Test of Hypothesis VIII**

Hypothesis VIII: rent charged per square foot of apartment dwelling space in Windsor varies directly with
the percentage of renters in the census tract.

Hypothesis VIII was based on the literature which indicated that residential sectors of the city with a high proportion of renters as householders, exhibit higher rental values than the norm. The findings suggest that as the number of renters per housing area increases, competition for existing units increases. Housing areas with the greatest attractability to renting households should contain the highest densities of renters and subsequently the highest rents. Hypothesis VIII tests the strength and direction of the relationship between the percentage of renters in an area and the apartment rents being charged in that area. It is hypothesized that as the proportion of renters increases a corresponding increase in rental charges will occur.

The correlation coefficient of 0.37 is greater than \( \pm 0.10 \) and the strength of the relationship between the proportion of renters per census tract and rent is said to be significant and direct in nature. The hypothesis that the relationship between rent charged per square foot of apartment dwelling space in Windsor is significant and positive in nature, is accepted. The proportion of renters in the surrounding neighbourhood exerts a positive influence on rent levels. This conclusion supports previous research findings that potential renters are attracted to subareas of the housing market with high concentrations of rented accommodation. These areas are thought to offer the best residential package for this form of living and subsequently
experience the greatest market competition and highest prices.

Test of Hypothesis IX

Hypothesis IX; rent charged per square foot of apartment dwelling space in Windsor varies directly with the percentage of single inhabitants of the respective census tracts.

Hypothesis IX has been derived in an attempt to determine the influence of single (never married) residents on rental charges for housing units in various sectors of the city. The single individual is often considered the prime consumer of rental housing in the literature. It is assumed by these works that apartment orientated areas of the city are composed of a high proportion of single residents. This high proportion creates a large rental market and keen competition for existing housing. The single inhabitants are often young and relatively wealthy with regard to their ability to pay high rent charged for accommodation. Consequently, it has been hypothesized that as the proportion of single individuals per census tract increases the rents associated with apartment structures in the areas also increases.

As seen in Table 4.1, it must be concluded that $r = 0.41$ is a significant, positive correlation between the proportion of single inhabitants of an area and the rents paid in apartment structures of that area. Hypothesis IX is accepted.
Test of Hypothesis X

Hypothesis X; rent charged per square foot of apartment dwelling space in Windsor varies inversely with the percentage of citizens over the age of sixty-five in the surrounding census tracts.

Hypothesis X attempts to measure the effect of large concentrations of elderly people on the relative rent in apartment structures. The literature has identified this as a valid determinant of rent in that large concentrations of elderly citizens within one housing area often indicate older housing units and thus affect the perceptions of the area by potential residents. Hypothesis X will test the strength and direction of the relationship. It is expected that the greater the proportion of elderly citizens in an area the lower the apartment rents will be in that area.

The relationship between the proportion of elderly citizens and rent is significant in that \( r = 0.33 \) is significantly greater than \( \pm 0.10 \). However, Hypothesis X is not accepted due to the fact that although the strength of the relationship \( (r = 0.33) \) was confirmed, the direction of the relationship was positive. Unlike previous research in other centres, the rent charged per square foot of apartment dwelling space in Windsor varies directly with the percentage of citizens over the age of sixty-five in the surrounding census tracts. This may be due to a large number of older citizens inhabiting these particular structures or it may be due to the fact that a large number
of the study units are situated in older sections of the city due to lower construction costs.

Test of Hypothesis XI

Hypothesis XI: rent charged per square foot of dwelling space in apartment dwellings in Windsor varies inversely with the vacancy rate of similar apartment units in the surrounding area.

Hypothesis XI accounts for one of the concerns of the landlord which may influence his actions in the question of raising or lowering rent. The literature reveals that the higher the vacancy rate of a particular type of housing unit, the lower the asking price for that unit by the landlord. Secondly, subareas of the housing market with high vacancy rates are said to exhibit the least desirable residential package to the potential inhabitant. Hypothesis XI tests the strength and direction of the relationship between the vacancy rate of two-bedroom apartment units and the rents being charged for these units. The relationship is thought to be negative in nature in that as the vacancy rates increase the rent levels decrease.

The calculated $r$ of 0.31 is a significant, positive correlation. Hypothesis XI is rejected in that although the strength of the relationship was significant the direction of the relationship was opposite to that which was predicted. An inverse relationship was hypothesized between vacancy rates and rent levels but a significant
positive result occurred. This apparent contradiction of the literature may have been a result of the generalized vacancy rate which determines housing markets along physical boundaries that may not correspond to apartment sites adequately. Logically the greater the number of vacancies within a particular building, the lower the rents are likely to be, as a result of management attempting to attract tenants. However, the positive explanation may be that although higher vacancy rates may exist in one particular housing location no real fluctuation in the asking price of rent may occur. This decision is made by individual building owners and their decision may have rationalizations other than those hypothesized. Due to the lack of data there is no ownership variable involved in this study; the inclusion of such a variable may have very well explained some of the decision-making processes of the individual owner or groups of owners with regard to their rental pricing policy.

Test of Hypothesis XII

Hypothesis XII; rent charged per square foot of apartment dwelling space in Windsor varies inversely with the age of the particular apartment structure.

Hypothesis XII is based on the literature review which has revealed that the greater the age of an apartment complex the less the rent charged per unit is likely to be. The attractability of a building generally declines with age
unless regular maintenance procedures are adhered to. As the 'newness' of an apartment complex wears off there is little that can be done by the owners to restore the building to its original condition. Although the validation of apartment age as a determinant of rent has been accomplished in the past, little work has been done on the effects of age on rents in apartment structures built within such a short time span, 1966-1977.

Hypothesis XII will test the strength and direction of the relationship between the age of the apartment building and the rent charged per unit in that building. It is hypothesized that as the age of a building increases its ability to command high rents decreases.

As \( r = -0.25 \) and is significantly greater than \( \pm 0.10 \), the relationship between apartment building age and rent is said to be valid in that as the age of the building increases the corresponding rents associated with units in those buildings decrease.

Hypothesis XII is accepted, due to the strength and direction of the relationship between rent and apartment age. As in previous research, as the age of an apartment building increases, the rents paid in that building decrease. To supplement the literature this study revealed that the age of apartment complexes is of significance in the determination of rent over a relatively brief construction period 1966-1977.
Test of Hypothesis XIII

Hypothesis XIII: rent charged per square foot of apartment dwelling space in Windsor varies directly with the number of storeys associated with each apartment structure.

Hypothesis XIII has been established to test previous research findings concerning the positive effect of the relative height of apartment structures on the rent of units in each particular building in the Windsor housing market. High-rise living offers an escape from the congestion of the city below and in Windsor's example, offers a scenic view of the Detroit skyline and the waterfront. Hypothesis XIII will test the strength and direction of the relationship between the height of apartment buildings in storeys and the rent charged per unit in those buildings. It is hypothesized that the relationship will be positive in nature.

From Table 4.1, it is noted that \( r = 0.60 \) is significant and that a relatively strong direct relationship exists between the number of storeys in a particular apartment and the rents charged for individual units in that apartment.

In conclusion, Hypothesis XIII is accepted in that the strength \( (r = 0.60) \) of the relationship between rent charged per square foot of apartment dwelling space in Windsor and the number of storeys associated with each apartment structure, has been proven significant. As in
the literature, the Windsor apartment dweller seems to rank the amenities associated with high-rise structures very highly. Recent criticism by Windsorites of the Detroit skyline and the automobile foundries associated with it, does not appear to hinder the high-rise apartment resident's desire for a first-hand view of the area.

**Model Verification**

Part two of the analysis consists of the formulation of a multiple regression equation explaining the variation in apartment rent in Windsor. This equation will consist of thirteen independent determinants of rent previously tested in the hypotheses section of the analysis. The resultant equation will be discussed as to the effectiveness of the equation ($R^2$) in explaining the variations in apartment rent in Windsor, and as to the direction of the relationship ($b$ values) between the individual variables in the equation to determine if the joint effect of the factors influences the variables' separate effect on rent. A mapping of the residuals will follow to determine if any spatially distinct subareas of the city are over or under predicted in an effort to improve the predictability of the model.

**Model**

The multiple regression values computed by the stepwise SPSS program take the following model form:
\[ \text{log } R_i = -1.67 + 0.06\text{log}X_{13i} + 0.13\text{log}X_{5i} - 0.03\text{log}X_{9i} +
0.09\text{log}X_{1i} - 0.06\text{log}X_{2i} + 0.19\text{log}X_{11i} + 0.29\text{log}X_{4i} -
0.03\text{log}X_{12i} - 0.07\text{log}X_{10i} + 0.04\text{log}X_{8i} + 0.05\text{log}X_{7i} -
0.05\text{log}X_{6i} + E \]

Where:

- \( R_i \) = Standardized rent value of apartment unit \( i \); during the October 1978 - April 1979 study period;
- \( X_{1i} \) = Accessibility index of location \( i \);
- \( X_{2i} \) = Distance from \( i \) to Detroit River, in kilometers;
- \( X_{3i} \) = Travel time by public transit to CBD to \( i \), in minutes;
- \( X_{4i} \) = Poverty index of location \( i \);
- \( X_{5i} \) = Perceived pollution index of location \( i \);
- \( X_{6i} \) = Recent house sale prices around location \( i \), in dollars;
- \( X_{7i} \) = Population density of CT around \( i \);
- \( X_{8i} \) = Percentage single residents of CT around \( i \);
- \( X_{9i} \) = Percentage single residents of CT around \( i \);
- \( X_{10i} \) = Percentage residents over 65 years old of CT around \( i \);
- \( X_{11i} \) = Vacancy rate of two-bedroom apartment units in market area of \( i \);
- \( X_{12i} \) = Age of structure \( i \), in years;
- \( X_{13i} \) = Number of storeys of \( i \);
- \( E \) = Residual (error term).

The final equation consisted of 12 of the 13 variables identified in the hypotheses. The travel time by the public transit to the CBD was excluded from the equation by the SPSS program when the F value associated with the particular variable fell below .01. This standard was set because it
was felt that the contribution to the $R^2$ value by a variable with an $F$ value of less than .01 would be minimal. Although the $r$ is significant the variable was not included in the final regression equation. Consequently, no valid results or conclusions can be drawn on the validity of the relationship between time to the CBD by public transit and the rent charged per square foot of apartment dwelling space in the Windsor housing market. The matter of accessibility as it relates to the CBD must be questioned in its role as an indicator of rent levels in apartment structures in Windsor. Possibly the importance of the CBD to the occupant of the study units is not as great as originally believed. The outward growth of the city into a multiple nuclei array may be responsible for the lessening of the importance of access to the CBD as a determinant of apartment rent. The popularity of modes of transit other than the Windsor bus system may also have had an effect on the apparent lack of applicability of this variable.

The $R^2$ value indicates that the final model explains 71% of the variation in two-bedroom apartment unit rents in Windsor for the October 1978 to April 1979 time period. Table 4.2 illustrates the final results of the regression program. These results can be considered satisfactory in that the explanation of variation in rent in any housing market must be determined through a number of variables, not all of which are locationally related. A knowledge of the individual resident's reasons for purchasing a particular
TABLE 4.2

MULTIPLE REGRESSION RESULTS

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cumulative $R^2$</th>
<th>b</th>
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<tr>
<td>STOREY</td>
<td>0.36</td>
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<td>PLNIND</td>
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<td>ACCIND</td>
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<td>DISTRV</td>
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</tr>
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<td>VACRAT</td>
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</tr>
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<td>PUTYCT</td>
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</tr>
<tr>
<td>AGEAPT</td>
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<tr>
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<tr>
<td>HSPRCT</td>
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</table>

Total $R^2 = 71\%$
housing unit would account for some of the unexplained variance (29%). An understanding of the rent-determination process on the part of the landlord and a study of the long-term apartment rental market may also allow for a more accurate picture of the rental process.

**Analysis of b Values**

An investigation of the b values of the individual variables in the final regression equation confirms the findings of many of the hypotheses. The b values, which signify the direction of the relationship, are all considered significant due to the fact that the entire population of apartment structures is under study. Table 4.2 lists the b values associated with each of the previously hypothesized values.

In the previous section of analysis, hypotheses testing, nine hypotheses were accepted and four were rejected. The reason for these rejections was that the direction of the relationship was opposite to that which was hypothesized. This section of the analysis of the regression model will investigate whether the hypothesized direction of the relationships between the individual variables in the set of hypotheses differs from the direction of those same variables acting as a group of locational determinants on rent in the overall regression.

An analysis of the b values reveals that in three instances the direction of the relationship between an independent variable and rent changed from that revealed
in the hypotheses testing. This occurs for the general economic characteristics of the census tract, the percentage of single inhabitants of the census tract, and for the percentage of citizens over the age of sixty-five of each census tract.

As noted in Hypothesis IV, the notion that rent and general economic characteristics of an area are directly related was rejected. However, the b value (0.29) indicates that as a part of the entire set of locational variables, the general economic character of an area acts as a positive force in the determination of rent. The same conclusion may be reached for Hypothesis X, which was thought to be a negative influence on rent but exhibited a positive r value. The percentage of citizens over the age of sixty-five did however, conform to the hypothesized notion that the relationship was negative when a b value of −0.07 was computed when the variable was considered as part of a group of determinants. Although these findings do not justify hypothesis acceptance in the initial stage of the analysis, these do allow for the inclusion of these variables as properly rationalized determinants of rent in a multivariate type of analysis.

The percentage of single (never married) inhabitants of a census tract was accepted as a valid direct influence on rent in Hypothesis IX. After viewing the computed b value (−0.03) doubt must be cast on the accuracy of the rationale behind the use of this variable as a positive
influence on rent in a multiple regression type of analysis. As part of a group of locationally related determinants of rent in Windsor, the percentage of single inhabitants of an area exerted a negative influence on that rent. Although the proportion of single inhabitants of an area, which are often stereotyped as young and relatively wealthy, appears to be positively related to rent, the presence of a large proportion of single inhabitants in an area exhibits a negative influence. This may be due to a backlash in the opinion of potential residents of two-bedroom apartment units against the style of living of a young single person.

Study of Residuals

All studies that utilize multiple regression analysis contain some sort of unexplained variance in the dependent variable. Such is the case in this work where the final regression equation succeeded in explaining 71% of the total variation in two-bedroom apartment unit rents in Windsor. To determine if any of the unexplained variance (29%) can be accounted for by additional locationally related variables a mapping of the residuals will be carried out. If any spatially distinct clusters of over or under predicted data locations are discovered, suggestions will be made as to the existence of further location variables.

The residuals greater than one standard error were mapped. Figure 4.1 illustrates the relative locations of the over (n=3) and under (n=3) predicted data points. As
Figure 4.1

WINDSOR
RESIDUALS
OF
PREDICTED APARTMENT
RENT LEVELS

RESIDUALS
●+ POSITIVE
●− NEGATIVE

North

Kilometres

1 2
0 1

Marchette
Quaillere
Huron
Church
Douglas
Cabana

Wyandotte
Loun
Tecumseh
can be seen, no clustering of the residuals appears to exist. It must be concluded that the existence of locationally related determinants of rent are not apparent in an analysis of the residual data points. The random distribution of the error terms in Windsor suggests that the unexplained variance (29%) in the determination of apartment rent in Windsor may be due to non-locationally related factors.

Locational Component of Rent

The final stage of the analysis has been established to determine the relative importance of the four major components - accessibility, social neighbourhood criteria, physical neighbourhood characteristics, and structural design features - involved in the final multiple regression equation which explains the variations in rent charged per square foot of apartment dwelling space in Windsor. To attain this end, the individual variables which were tested for significance in the hypotheses, were grouped under each of the four categories. Table 4.3 lists the major factors and their groupings. The final multiple regression equation and the subsequent SPSS print-out were utilized to determine the proportion of the total variation accounted for by each of the groupings of variables. Table 4.2 represents the final regression results. With a $R^2$ of 0.71 the proportion of variation of rents in the study area explained by the 12 independent variables in the equation (travel time by public transit to the CBD was
### Table 4.3 Components of Rent

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</table>

70.6%
not accepted by the SPSS program) was 71 percent. What is of interest in this section of the analysis is the relative proportion of the $R^2 = 0.71$ explained by each of the major factors in the determination of rent. To accomplish this end, the contribution of all variables in each grouping will be summed and the total contributions of each grouping compared to one another.

Table 4.3 shows that structural design criteria contributed the greatest proportion of explained variation in final regression results. This is followed by physical neighbourhood features, social neighbourhood characteristics, and accessibility measures.

Historically, accessibility factors were deemed to be the most significant determinants of rent while more recently the characteristics of a neighbourhood have been given more importance. This has been due to transportation innovations which have made all locations in the city highly accessible and due to a changing social attitude which prefers the more aesthetically pleasing environment of suburbia to central locations. In the investigation of apartment rents, structural-design criteria have played a prominent role in rents. This may be due to the isolation of apartment dwellers from the surrounding environment and the fact that the highly mobile individual may feel structural design qualities of a building have more of a direct influence over him during a short tenancy. His social contacts may very well be situated outside the immediate area. If this is the case
very little attention may be given to the social character of the neighbourhood within which he resides. The units under study appear to fit this mould.

The large difference in the regression results between $R^2$ values of structural design criteria and physical and social neighbourhood characteristics causes one to speculate as to the adequacy of the method. In the stepwise regression process the first variable entering the equation (in this case the number of storeys per apartment structure) accounts for a great proportion of the total explained variation in the analysis. With this occurring the factor which contains the initially entered variable (structural design) may exhibit a much higher proportion of total variation in rent explained than if the stepwise process had not been used. Other variables were entered into the regression program in the first step of the regression process as a test of the adequacy of the overall procedure and no great change in the $R^2$ was noted.
CHAPTER V

SUMMARY OF THE FINDINGS

This study has focused on the locational demand aspects of housing in the Windsor apartment rental market. The analysis examines the various locational factors that a householder takes into account before finally deciding to rent accommodation. The underlying premise of this work is that rent per unit of housing is a reasonably accurate measure of the desirability of a particular housing bundle. Data were analysed and hypotheses were tested regarding a number of variables revealed through a review of the literature and a preliminary analysis of the Windsor housing market. Multiple regression statistical techniques were employed to evaluate the impact of each variable on rent in the final regression equation. It was anticipated that the findings would evaluate the relative importance of each locational variable in the determination of rent in Windsor and that these findings would help determine apartment site locations which mesh supply and demand factors most effectively.
Hypotheses

The first set of hypotheses was established to evaluate the individual effects of predetermined variables on the apartment rental market in Windsor. The results of the analysis show that the following factors were significantly correlated with rent:

a) general automobile accessibility;
b) distance to the Detroit River
c) travel time by public transit to the CBD;
d) general economic characteristics;
e) perceived air quality;
f) housing sale prices;
g) population densities;
h) percentage of renters;
i) percentage of single inhabitants;
j) percentage of citizens over the age of sixty-five;
k) vacancy rate;
l) age of apartment structure;
m) number of storeys of apartment structure.

As a whole the findings of the hypotheses comply with previous research findings in the area of housing market analysis. However, the direction of the relationships exhibited by the variables in the final equation differed from those revealed in the hypothesis testing.

Accessibility indices were proven to be significant factors in the determination of rent. The general automobile accessibility in Windsor and the distance to the Detroit
River were both confirmed as valid determinants of rent. This confirms previous research findings on a national scale which have revealed various aspects of accessibility as significant in the determination of housing prices (Ridker and Henning, 1968; Apps, 1971). However, the travel time by public transit to the CBD was rejected as being a significant determinant of rent when viewed as a part of a collection of locational variables. This supports Mowbray's (1962) findings which indicated that the importance of accessibility to the CBD by a resident may be lessening due to changing social values which have drawn apartment dwellers to the suburbs. This differs from much of the previous locational research which has stressed the CBD as the focal point of urban life (Evans, 1971; Wilkinson, 1973). On a more localized or regional level these findings support previous research efforts by Dewer (1974) which revealed that apartment structures are being constructed throughout the Windsor housing market and are experiencing acceptance in all regions. Other works have found that substantial premiums are being paid by residents for neighbourhood amenities (Smith, 1978).

Physical neighbourhood characteristics were confirmed as being valid influences on apartment rents in Windsor. The general economic character of the area and air quality in the area were both proven statistically significant in the analysis. This confirms previous findings which state that the physical quality of the neighbourhood and air pollution are significant
determinants of housing costs (Ridker and Henning, 1968). Anderson and Crocker (1971) found air pollution to be significant in the large cities of Washington, Kansas City, and St. Louis. To further these findings it may be concluded here that air pollution is also a valid determinant of rent in medium-sized cities. The natural environment of a particular housing market appears to play a major part in the determination of rent (Wabe, 1971). Windsor, which features a heavily industrialized landscape, conforms to these findings. The desire of the apartment resident to rid himself of the industrial make-up of much of Windsor's environment has been expressed in his locational choice of housing.

Social neighbourhood characteristics have also been proven effective indicators of apartment rent in Windsor. The population density, the percentage of renters, and the percentage of citizens over the age of sixty-five were all accepted as valid determinants of rent. This confirms previous research efforts based on socio-economic indexes of housing areas (Brigham, 1965; Ridker and Henning, 1973), and on the population density of housing submarkets (Wabe, 1971). Like other studies of housing sale prices, the proportion of single inhabitants of an area did play a significant part in the determination of rent in Windsor (Kain and Quigley, 1970; Wilkinson, 1973).

The vacancy rate of similar apartment buildings with similar housing units has been proven a significant deter-
minant of housing price in many previous studies (de Leeuw and Ekanem, 1971; Smith, 1974). This study is no exception; however an interesting finding has arisen. Unlike Smith (1974) and all other contemporary studies, this work has revealed that in the Windsor apartment housing market the vacancy rate acts as a direct force on rent level; that is, as the vacancy rate of a particular submarket increases so do the corresponding rents in those areas. All theories regarding economic man and the free market indicate that the opposite of this should occur. Possibly the Windsor housing market is slow to react to a change in the market with respect to vacancy rates. In this way areas experiencing high vacancy rates may find some type of delay in the adjustment of rents due to the tenants’ and landlords’ limited knowledge of the housing market. This study only deals with the October 1978 – April 1979 time period and delays in the rental adjustment process may have a definite effect on the research findings.

Structural-design criteria have been proven significant determinants of apartment rents in the Windsor housing market. An attempt was made to account for the internal or cosmetic variations between the rental units under study. In this way much of the design variations between apartment buildings could be accounted for. However, caution must be exercised when considering the subjectiveness of the appraisal process. Previous research has been centred on the floor area and the number
of rooms in a particular unit, but this work has adjusted for both of these variables (Evans, 1971; Wilkinson, 1973; Kain and Quigley, 1970; Massell and Stewart, 1971). Other structural-design variables however, could not be accounted for in the appraisal process and subsequently make up the structural-design criteria under study. These include the age of the apartment structure and the number of storeys associated with each. Both of these variables were proven to affect rent levels in apartment units in Windsor. This confirms Apps’ (1971), and Massell and Stewart’s (1971) findings that the age and the height of a particular structure contribute to the locational advantages of a particular site.

Structural-design criteria were by far the largest contributor to the explanation of the variation in rent in the apartment rental housing market in Windsor. Although the stepwise regression process may have strengthened the position of these variables, as noted in the analysis, the fact remains that locations within the Windsor housing market which feature newly constructed high-rise apartment units command the greatest rental bidding.

**Limitations of the Study**

One of the principal aims of this study has been to contribute to the understanding of models which link intra-urban housing choice to urban spatial structure. The identification of locational neighbourhood and dwelling attributes
which are related to apartment-rent variations was one step in this procedure. It is hoped that the factors involved in the determination of rent in Windsor which are revealed in this study will provide a guideline to the selection of other appropriate variables in future research.

Limitations of data concerning characteristics of the Windsor housing study area have restricted the scope of this work. These limitations can be categorized under four main areas: unavailability of data, restricted study area, lack of temporal data, and lack of supply factors in the analysis.

An absence of ownership and zoning bylaw data has led to direct deficiencies in the explanation of rent in Windsor. A thorough knowledge of the ownership of the various structures may have revealed rental strategies of individual or groups of landlords. The presence of zoning data in the equation may have allowed for a review of the municipal government's actions in the spatial allocation of high-rise/high-density apartment structures.

A second concern involves the limited group of apartment units under study. Only two-bedroom units in relatively new apartment buildings were taken into consideration. The rental housing market consists of a much greater selection of accommodation and all of these should be studied before definite conclusions regarding the Windsor rental housing market are made.

The rent data utilized in the study comprised the average rent charged per unit per building during the
October 1978 - April 1979 time period. Had data been available over a multi-year period the temporal effects on the Windsor housing market could have been evaluated. The current study only deals with a specific moment in time and the market conditions during that period may have been quite different than those experienced over longer time periods.

Finally, the field of housing market analysis is composed of both supply and demand factors. This work deals strictly with a subset of the demand factors, that is those associated with location. Had the entire set of demand variables been studied and had the supply factors been taken into consideration, a wider view of the rental housing market in Windsor may have been attained.

**Direction of Future Research**

One of the most important products of all scientific research are the questions which it raises and the avenues of future research which it suggests. This work is no exception to the rule. Research should be carried out in an effort to minimize the limitations of this study. Data availability may play an important role in future research. A wider range of locational variables could be considered over longer time periods to allow for a more accurate picture of the apartment rental housing market. Concentration on the individual subareas of a housing market which exhibit uniform rent patterns may lead to conclusions pertaining to
the municipal planning of those specific regions. The successful delineation and analysis of such areas may allow the planner to develop those zones of the city in apartment style housing, which most effectively cater to the needs of the population in question. On-going research is required in the field of housing market analysis in that, as time passes by, the values and perceptions of the general population change. It is felt that research into apartment style housing is of the utmost importance due to the apparent shift by the general population from single-family detached forms of housing to apartment living. A knowledge of why this is taking place and which styles of rental housing are most attractive to the potential resident is of great importance in the future development of the urban sphere.

Conclusions

The results of this study indicate that the locational subset of demand variables associated with the determination of apartment rent in Windsor are capable of explaining seventy-one percent of the variation in those rents. Findings revealed that accessibility, social neighbourhood phenomena, physical neighbourhood characteristics, and structural-design criteria all play a definite part in the locational explanation of rent in Windsor. Of the total number of findings reached in this study perhaps the facts that vacancy rates were directly related to rent charges and that the storey-
related variable has proven to be a valid locational
(vertical) determinant of rent, will create the greatest
discussion.
WINDSOR OFFICE

P.O. Box 906,
Windsor, Ontario.
N9A 6P2

May 1979

Re: Rental Apartment Vacancy Survey

April, 1979

We are pleased to provide you with the results of our semi-annual rental apartment vacancy survey conducted in the Windsor Census Metropolitan Area.

The survey covers apartment buildings containing six or more self-contained units completed prior to September 30, 1978. Information was obtained through interviews with apartment owners and building superintendents. There are approximately 9,300 such apartment units in the privately initiated sector of the market.

In addition to vacancy information, we also collected data on the rentals being charged for both occupied and vacant units in the survey. The results of these tabulations are shown in an Appendix to this report.

If this survey needs to be explained in any way, you may contact my office at 253-7427.

G. W. Beardsall
Manager
ONTARIO RENTAL APARTMENT VACANCY SURVEYS

Survey Methodology

The CMHC Rental Apartment Vacancy Survey is conducted semi-annually and includes a sample of apartment buildings with six or more self-contained dwelling units which were completed and on the market at the end of September 1978. The survey is now being conducted in April and October each year rather than in June and December as was previously the case. In April, fifteen centres were surveyed in Ontario.

There are three universes* which comprise the total rental apartment universe. Apartments completed from October 1, 1977 to September 30, 1978 are called the "new" universe. Apartments completed prior to this period are referred to as the "old" universe. In addition, publicly initiated apartments which were on the market prior to October 1978, are known as the "public" universe. Apartments completed during the period October 1, 1978 to March 31, 1979 are not included in the survey as a six month lapse is allowed for market absorption.

The definition of vacant is "a dwelling unit that is available for immediate rental and physically unoccupied at the time of enumeration."

Vacancy rates were calculated for apartment dwelling units by structure size, by period of construction, by geographical area and by number of bedrooms.

The total Ontario rental vacancy rate for the private universe was 2.1 percent in April 1979 and 1.6 percent in October 1978.

* The universe is the total inventory of dwelling units in buildings containing six units or more within the survey area.
Survey Results - Windsor Census Metropolitan Area, April 1979

The overall vacancy rate in privately initiated apartment structures of six or more units was 1.5 percent, which is up slightly from the 1.1 percent in the previous survey.

This increase can be attributed to new buildings coming on the market. Buildings recently completed show a vacancy rate of 3.4 percent, as compared to an 0.8 percent in the previous survey. Older buildings, completed prior to October 1978, have an overall average vacancy rate of 1.3 percent. Zone 1 indicates this phenomenon most dramatically with a 4.8 percent vacancy in the newly completed buildings as opposed to 1.6 percent in older buildings.

As usual, the change in vacancy rates varied by geographic area. Zone 5 showed the highest overall rate of 2.3 percent, with zones 4 and 1 showing rates of 2.1 and 2.0 percent respectively. Zones 2 and 3 indicated tight market areas, with respective rates of 0.8 and 0.6 percent.

No unusual changes were evident in the vacancies according to structure sizes or unit types. The smaller buildings and unit types once again registered the highest rates.

The rental market in the Windsor C.M.A. shows a marginal loosening as a result of more units coming on the market. This trend is expected to continue as the impact of the high volume of apartment construction is felt.
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<td>2.1</td>
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(1) Weighted Average of Metropolitan Areas Surveyed. / Moyenne pondérée des régions métropolitaines faisant l'objet du relevé.

** Not available. / Non disponible.
### TABLE V

**Vacancy Rates in Apartment Structures of Six Units and Over Privately Initiated, by Number of Bedrooms**

**Windsor Metropolitan Area**

**1978 - 1979**

(Per Cent)

<table>
<thead>
<tr>
<th>Area</th>
<th>Bachelor</th>
<th>One</th>
<th>Two</th>
<th>Three or More</th>
<th>Total</th>
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<tbody>
<tr>
<td>Centre - Zone 1</td>
<td>5.1</td>
<td>2.8</td>
<td>1.2</td>
<td>1.9</td>
<td>0.6</td>
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<tr>
<td>East Inner - Zone 2</td>
<td>3.5</td>
<td>0.0</td>
<td>0.4</td>
<td>0.9</td>
<td>1.1</td>
</tr>
<tr>
<td>East Outer - Zone 3</td>
<td>2.0</td>
<td>1.4</td>
<td>0.7</td>
<td>0.1</td>
<td>0.4</td>
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<tr>
<td>West - Zone 4</td>
<td>1.2</td>
<td>3.0</td>
<td>0.6</td>
<td>2.1</td>
<td>0.2</td>
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<tr>
<td>Remainder of Metropolitan Area - Zone 5</td>
<td>**</td>
<td>**</td>
<td>4.5</td>
<td>4.1</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Total Metropolitan Area: 3.4 2.2 0.9 1.5 0.7 1.4 1.0 0.0 1.1 1.5

**Not available.**

The definition of vacant is "a dwelling unit that is available for immediate rental and physically unoccupied at the time of enumeration."
TABLE IV

VACANCY RATES IN APARTMENT STRUCTURES OF SIX UNITS AND OVER
PRIVATELY INITIATED BY SIZE OF STRUCTURE

WINDSOR

METROPOLITAN AREA

1978 - 1979

( PER CENT )

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<thead>
<tr>
<th>Area</th>
<th>6-9</th>
<th>10-19</th>
<th>20-29</th>
<th>30-49</th>
<th>50-99</th>
<th>100-199</th>
<th>200+</th>
<th>Total</th>
<th>20+</th>
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<td>4.3</td>
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<td>0.0</td>
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<td>1.4</td>
<td>**</td>
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<td>0.5</td>
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<tr>
<td>East Outer</td>
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<td>0.0</td>
<td>1.3</td>
<td>0.6</td>
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<td>0.7</td>
<td>0.2</td>
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<td>3.2</td>
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<td>-</td>
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</tr>
</tbody>
</table>

TOTAL METROPOLITAN AREA 2.6 2.1 1.4 2.7 0.9 1.7 0.5 1.5 2.0 1.1 0.8 0.7 ** ** 1.1 1.5 1.0 1.2

** Not available.
The definition of vacant is "a dwelling unit that is available for immediate rental and physically unoccupied at the time of enumeration".
### Actual Distribution of Apartment Units by Rental Range in Dollars

|      |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| Zone 1 | 2 | 1 | 9 | 27 | 41 | 44 | 22 | 26 | 62 | 5 | 15 | 22 | 70 | 39 | 8 | 20 | 16 | 24 | 920 | 296 | 238 | 2.3 |
| Zone 2 |   |   |   | 21 | 17 | 20 | 39 | 23 | 10 | 67 | 29 | 70 | 44 |   |   |   |   |   | 256 | 278 | 258 | 8.1 |
| Zone 3 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | 509 | 281 | 264 | 5.2 |
| Windsor City | 2 | 19 | 9 | 52 | 76 | 38 | 102 | 409 | 450 | 328 | 208 | 110 | 285 | 40 | 12 | 26 | 16 | 24 | 244 | 195 | 273 | 3.7 |
| Zone 5 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | 197 | 270 | 264 | 2.4 |
| Total Area | 2 | 19 | 9 | 52 | 78 | 38 | 156 | 409 | 517 | 324 | 209 | 110 | 286 | 44 | 12 | 26 | 16 | 24 | 235 | 222 | 273 | 3.6 |

### Percent Distribution

|     | 1 | 2 | 3 | 4 | 5 | 17 | 22 | 14 | 9 | 8 | 2 | 1 | 1 | 2 | 1 |
|-----|---|---|---|---|---|----|----|----|---|---|---|---|---|---|---|---|

### Notes

1. The above table illustrates the ranges of rentals being charged for a sample of privately initiated apartment structures visited during the apartment vacancy survey. Since no attempt has been made to adjust the total universe the figures shown are not necessarily representative of the private rental market as a whole.

2. The previous rent column refers to the October 78 survey. The percentage change is for the six month period.
### Actual Distribution of Apartment Units by Rental Range in Dollars

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### Percent Distribution

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### Notes

1. **No Units in Structures Sampled**
2. **Note 1:** The above table illustrates the ranges of rentals being charged for a sample of privately initiated apartment structures visited during the apartment vacant survey. Since no attempt was made to adjust to the total universe, the figures shown are not necessarily representative of the private rental market as a whole.
3. **Note 2:** The previous rent column refers to the October 78 survey. The percentage change is for the six month period.
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Books


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<tbody>
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<td>29</td>
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Correspondence

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VITA AUCTORIS

FAMILY
- Randy James Risk
- Son of Robert and Beverley Risk
- Born June 12, 1955, North Bay, Ontario
- Brother: Robert Brian

MARRIED
- August 9, 1980 to Constance Elaine Hellerman

EDUCATION
- Chippewa Secondary School, North Bay, 1974
- Bachelor of Arts, Nipissing University College of Laurentian University, North Bay, 1977
- Master of Arts, University of Windsor, Windsor, Ontario, 1980