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VALUING PARK ATTRIBUTES, MODERATION EFFECTS OF WALKABILITY AND SOCIAL CAPITAL: A MULTILEVEL APPROACH

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Valuing Park Attributes, Moderation Effects of Walkability And Social Capital: A Multilevel Approach

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By

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ABSTRACT

The goal of this research was to model the effects of park attributes, neighborhood walkability, and social capital on proximate home values. The results are expected to be useful for planners to design park-centric neighborhood revitalization plans, and for city governments to increase their revenues due to capitalization of park land on adjacent home values. The hedonic price model was used to determine household preferences for home features, park attributes, and neighborhood characteristics because within and outside home characteristics are untraded goods. Hedonic estimation was done using multilevel models because homes were nested in park neighborhoods. Park attributes were assessed using an observational tool - the Environmental Assessment of Parks and Recreational Spaces tool - developed by an interdisciplinary team in the University of Cincinnati. An exploratory factor analysis was done on park attributes and the factors were used to estimate multilevel models after controlling for home features and neighborhood income.

Three types of models were generated – the intercept only, random intercepts, and random intercepts and slopes. Generally, activity areas in parks in parks were negatively associated with home values and informal open spaces were positively related. Travel distance moderated the effect of direct distance on home values and households showed a negative preference for very low levels of associational activity in park neighborhoods. Finally, evidence was found for housing submarkets, which indicated the potential of park neighborhoods to be designated as target neighborhoods in neighborhood revitalization plans.

To my wife, Suchitra, for absolutely everything; and my children, Sumedha, Arushi, and Anannya, for accompanying me on this Odyssey

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Chapter I

INTRODUCTION

Revitalization of communities continues to be a key mission of the U.S. Department of Housing and Urban Development (2004) and local bodies are becoming aware of the potentialities of parks to revitalize neighborhoods and promote economic development. In 2007, the Cincinnati Park Board (CPB) prepared the draft Centennial Master Plan. This was the third Master Plan - the first was prepared in 1907 by George Kessler. One of the key principles in the Centennial Master Plan was to reposition parks as agents to revitalize neighborhoods (Cincinnati Park Board Centennial Master Plan: Key Principles 2007). To design park-centric neighborhood revitalization plans, planners need to know as much as possible about the demand and supply of goods in the park neighborhood. Planners have detailed information about the supply of goods (e.g. park attributes), but know little about the willingness of households to pay for specific-park attributes and neighborhood characteristics, which is surprising because increasing the demand for homes in park neighborhoods is one way to revitalize neighborhoods (Crompton 2001a; Leinberger and Berens 2001). Accordingly, the goal of this research was to determine the value placed by households on specific park attributes and park neighborhood characteristics.

The components of the park and the park neighborhood are non-marketed goods and the hedonic price model is one of the techniques to model household preferences (determine marginal implicit prices) for park attributes and neighborhood characteristics. However, homes are located only in one park neighborhood, that is, homes (level-1) are nested within park neighborhoods (level-2), which required a statistical technique that was able to model the nested effects present in the dataset. Figure 1.1 gives the nested nature of the dataset – homes contained in park neighborhoods.

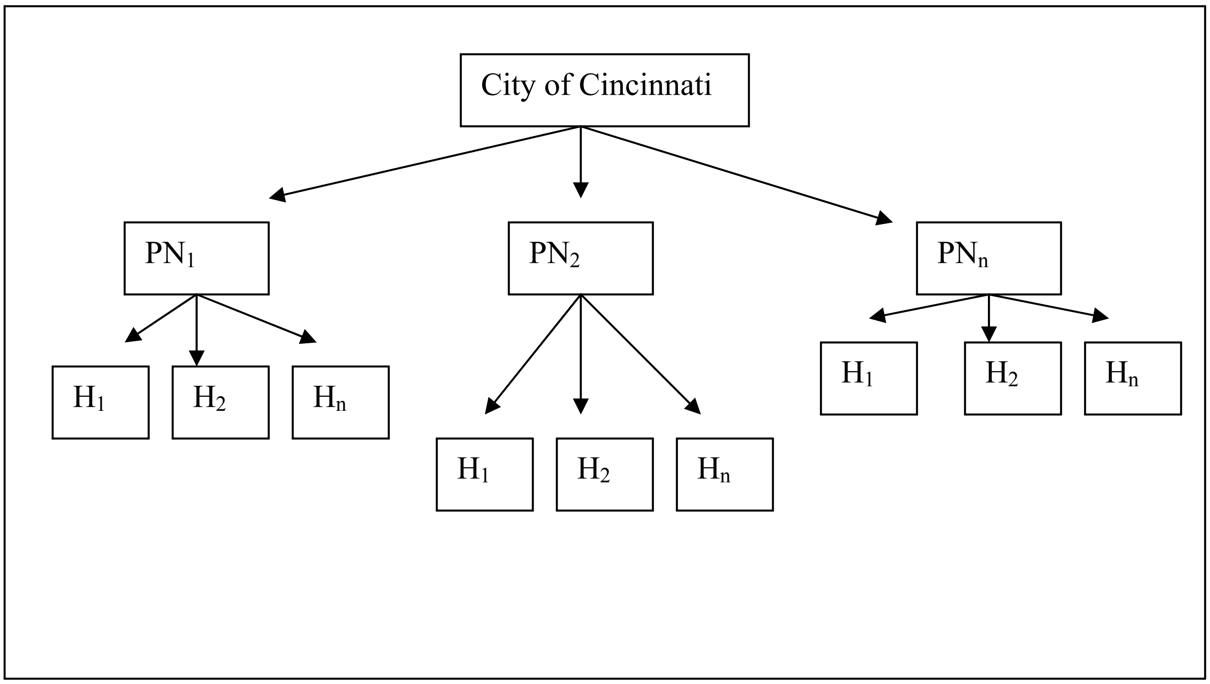

Figure 1.1. Homes nested in neighborhood parks
Note: PN- Park neighborhood; H- Homes

Traditionally, hedonic price models were made operational using multiple regression analysis, which assumed that the park effects were invariant among park neighborhoods. However, this dissertation research required both levels to be analyzed simultaneously because the outcomes of level-1 and level-2 are related. Multilevel techniques statistically connect level-1 and level-2 regressions, that is, regression coefficients computed at level-1 are regressed on level-1 dependent variables; therefore, hedonic estimation was done using multilevel techniques. In other words the effects of the heterogeneous park environments (contextual effects) and the spatially dependent homes within them (compositional effects) were modeled. Moreover, multilevel techniques also offered several other statistical and conceptual advantages over traditional multiple regression analyses and ANOVA approaches (Draper 1995; Masse et al. 2002; Luke 2004; Sibthorp et al. 2004; West, Welch and Galecki 2007).

As indicated earlier the objective of this research was to model components of the park neighborhood by statistically integrating within, and between, park neighborhood regression analyses, using multilevel techniques. A requirement of multilevel models is to estimate parsimonious models containing a minimum number of independent variables derived from theory and literature (Hox 2002; Tabachnick and Fidell 2007). Therefore, the research design had to satisfy two requirements - identify unique park effects, measured at level-2, and estimate parsimonious models.

There was little guidance from theory on the variables to be used in hedonic estimation (Sirmans, Macpherson and Zietz 2005; Sirmans et al. 2006). Park studies have included several variables in models depending on the research objectives. However, the requirement of parsimonious models precluded inclusion of numerous variables. One way to reduce the number of correlates of home values was to restrict the data to “spatially concentrated areas” (Thibodeau 2003), such as the park neighborhood, and restricted datasets were also used in earlier studies (Bolitzer and Netusil 2000; Miller 2001). Park neighborhood boundaries, in which parks were the most important influence on home values, were established from empirical evidence. Homes located close to parks are in greater demand because of the aesthetic experiences associated with park proximity and opportunities for park visitation. In turn, aesthetic experiences depend on park attributes (used interchangeably with features or elements) and park-home direct distances (as the crow flies); and park visitation is determined by park-home network distances (used interchangeably with travel distance). Most park studies have primarily investigated the association between direct distances and home values (Ward 1966; Hendon 1973; 1974; More, Stevens and Allen 1988; Bolitzer and Netusil 2000; Espey and Owasu-Edusei 2001; Lutzenhiser and Netusil 2001; Anderson and West 2006) and found that the positive park effects on home values decrease with increasing direct distances and become almost negligible at about 1,500 feet. In fact, the greatest park effect is experienced up to a distance of 600 to 800 feet (Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001); therefore, the park neighborhood was defined as an area contained within a radius of 1000 feet around the park.

Establishing boundaries to park neighborhoods permitted investigation of the characteristics of the park neighborhoods, in addition to examining the association between specific park attributes and home values. Accordingly, the values placed by households on park neighborhood characteristics, such as walkability and social capital, were also explored. Moreover, modeling demands for housing in a well defined area, such as the park neighborhood, permitted the examination of the presence of housing submarkets.

Generally, housing submarkets are defined by home structural attributes (e.g. single-family, town houses), specific preferences (e.g. historical homes), neighborhood characteristics (e.g. school district, park presence), and municipal boundaries (Goodman and Thibodeau 1998).

However, for practical purposes (e.g. mass appraisals) submarkets may be defined in a way that improves the predictive accuracy of hedonic price models (Bourassa, Hoesli and Ping 2003), and current studies (Bourassa, Hoesli and Ping 2001; Day 2003) have found that location and neighborhood characteristics, rather than home structural features, better define sub-markets. Therefore, similar homes within park neighborhoods, which are different from homes in other park neighborhoods, were expected to indicate the presence of housing submarkets.

Evidence obtained for the correspondence of park neighborhoods and housing submarkets is expected to lead to the design of park-centric neighborhood revitalization plans. Generally, neighborhood revitalization planning starts with the identification of a target neighborhood (U.S. Department of Housing and Urban Development 2004), and planners have followed traditional neighborhood boundaries to define target neighborhoods often ignoring the housing market. Admittedly, traditional neighborhood boundaries are more useful to predict and evaluate political and social outcomes, but if the policy objectives are related to housing supply and demand then the more appropriate unit to be designated as the target neighborhood is the spatially defined housing submarket (Bates 2006).

The conceptual model of the park plus the park neighborhood is given in figure 1.2, which shows the relationships and interactions between variables of interest in and around parks. Variables were measured at two levels – level-1 (home) and level-2 (neighborhood). Homes were nested in neighborhoods, shown by the small circle enclosed by the larger circle. Home values were affected by both level-1 and level-2 variables. Home structural features and neighborhood characteristics were statistically controlled and the effect of park attributes on home values was examined using multilevel models, which also facilitated the examination of relational characteristics (Lazarsfeld and Menzel 1969), such as the association between home values and the levels of social capital in the park neighborhood.

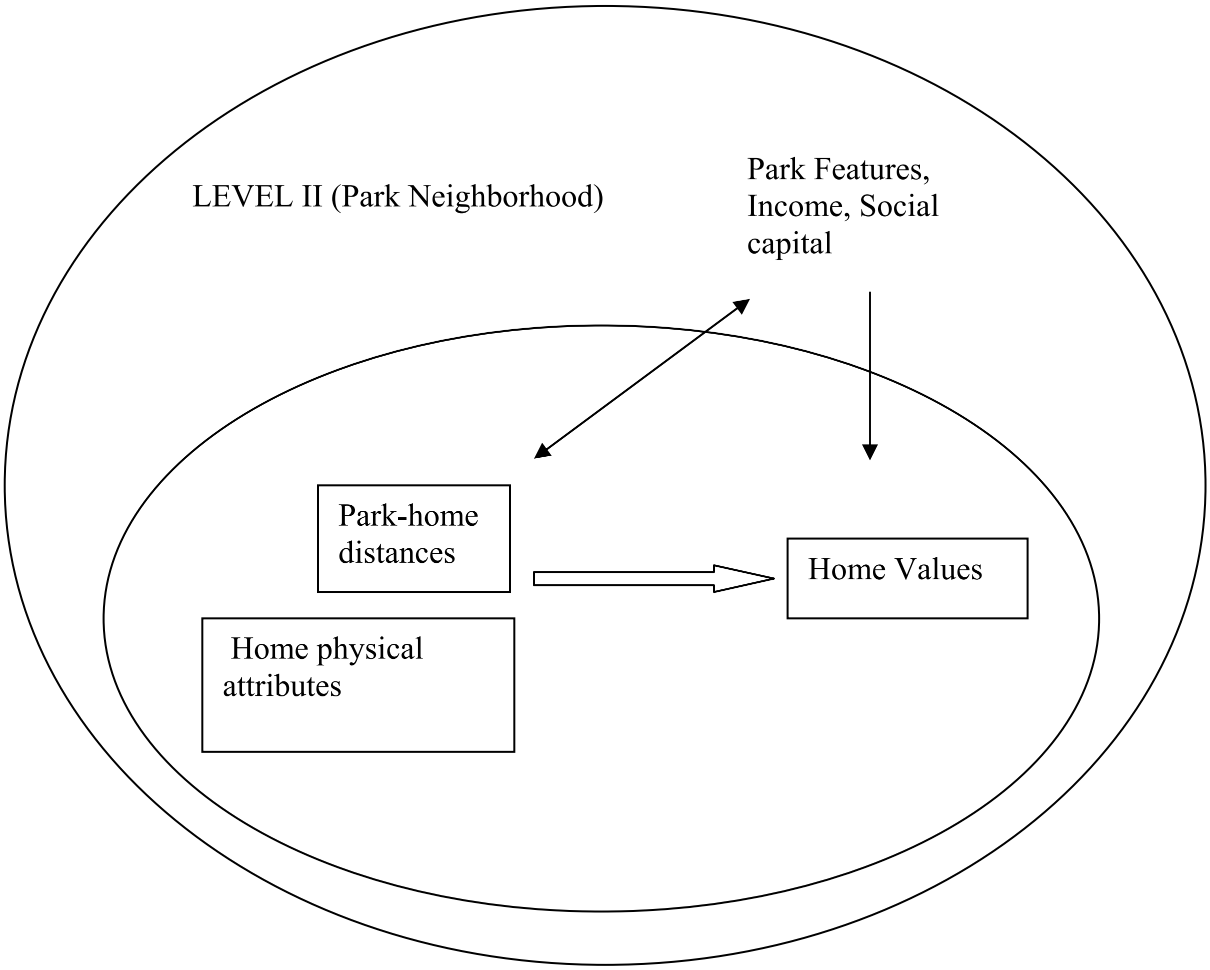

Figure 1.2. Conceptual park model with variables at multiple levels
Note: → effect of level II variables; ↔ effect of interactions between level I and level II variables; ⇨ effect of level I variables on home values the dependent variable

1.1. Research Objectives

Park studies have focused on examining the effect of qualitatively measured park attributes (features) on home values and have found that park attractiveness, aesthetics, size, greenery levels, children's play equipment, and active recreation areas influence home values (Ward 1966; Hendon 1973; 1974; More, Stevens and Allen 1988; Espey and Owasu-Edusei 2001). However, specific park attributes have remained undefined and households' preference for these park attributes was not estimated. Accordingly, the first objective was to examine the association between specific park attributes and home values.

As stated earlier, homes in a park neighborhood are under the dominant influence of the park. Homes in a park neighborhood are expected to be similar to one another and different from homes around other parks because homes in a park neighborhood have nearly similar levels of access to public services, and positive and negative externalities equally affect them (Thibodeau 2003). Differences across parks arise because parks have different sets of attributes and the park neighborhood characteristics differ, which lead to different inter-park average home values. To model these contextual variations in home values and make more accurate home values predictions, the park neighborhood was conceived to be a housing submarket. Accordingly, the second objective was to determine if park neighborhoods relate to different housing submarkets; specifically, if there were significant inter-park differences between the average home values and the slope of the relationship between home values and direct distances.

Furthermore, park studies have dissected the decay of park effects with increasing direct distance from the park (Wonder 1964; Kitchen and Hendon 1967; Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001). Some have also examined the change in home values with travel distance (Miller 2001) and the moderation effects (used interchangeably with interaction) of neighborhood level variables on direct distance (Anderson and West 2006). However, the interaction between direct and network distances is little studied; therefore, the third objective was to investigate the interaction of park-home direct distances with network distances. Finally, parks offer a place for children to play and adults to engage in physical activity, and households prefer park neighborhoods, which contain social capital, such as norms of adults looking after unattended children (Coleman 1990). Accordingly, the last objective was to determine the association between social capital and home values. Social capital constructs and variables were identified from social capital theorizing and social capital was conceived to be a neighborhood level construct.

1.2. Multilevel Model Specification

Estimating a parsimonious model specification was guided by the objectives of the research. Locational externalities were reduced by (1) excluding homes abutting parks (less than 100 feet), and (2) removing homes under the joint influence of two or more parks and the minimum number of home structural attributes were specified. The most common attributes used in hedonic studies were – lot size, finished area, age, number of bathrooms and number of bedrooms (Sirmans, Macpherson, and Zietz 2005); accordingly lot size, finished area, age, number of bathrooms were used in hedonic estimation. Additionally, the following two level-1 variables were also measured - direct and network distances.

Variables measured at level-2 were - neighborhood income, park attributes, and social capital indicators taken from the Social Capital Community Benchmark Survey (SCCBS) survey conducted by the Saguaro Seminar (2000). Home level variables (level-1) were taken from the Cincinnati Area Geographical Information System dataset (CAGIS). Park attributes were quantified using the Environmental Assessment of Parks and Recreational Spaces tool (EAPRS) and attributes, evaluated by observation, were subjected to factor analysis to generate composite park variables (called EAPRS factors.) Geographical Information Systems (GIS) was used to compute the direct and network distances from residential properties. The dependent variable, assessed home values, was log transformed and the final dataset consisted of 3,792 homes located around 26 parks.

1.3. Setting: Cincinnati

Cincinnati was selected as the study area for three reasons. First, the Cincinnati park system is in many respects typical of the park systems in the United States and the research findings are expected to be generalizable to other park systems. The population density in Cincinnati is located near the mean of the population densities of the largest 60 U.S cities. Moreover, the atypical features of the Cincinnati park system were also advantageous to this research - Cincinnati spent nearly $ 139 annually per resident, which was the 7th highest expenditure among all US cities; Cincinnati stood first in having the largest number of park units; and the greatest number of playgrounds per resident (Center for City Park Excellence: The

Trust for Public Land 2006).

Second, park lands in Cincinnati are managed by two different agencies – the Cincinnati Park Board (CPB) and the Cincinnati Recreation Commission (CRC). The mandate of CPB is to create parks that are directed towards leisurely, restful use (passive recreation), while the CRC develops facilities for sports and physical exercise (active recreation; Schuckman 2006); therefore, investigation of parks in Cincinnati provided an opportunity to separate the effects of active and passive recreation facilities. Finally, this research was a continuation of the park research being done in the School of Planning, University of Cincinnati (Sharma and Auffrey 2006; Sharma 2007).

1.4. Other Significant Contributions

In the face of shortage of resources parks have to become responsive to market demands in order to compete to be useful to the community (Garvin 2000). Local bodies have spent large resources on parks - the total estimated capital expenditure on local parks during the period 1964-65 and 1999-2000 exceeded $ 70 billion (Crompton and Kaczynski 2003). One way to make parks more oriented to market demands is to reposition parks as public goods that pay for themselves. Demand for proximate homes around parks is greater, especially by empty nesters, retirees, young professionals, and firms, which have greater freedom to choose their locations in a globalizing economy (Crompton, Love and More 1997; Barrette 2001). This increased demand for proximate homes leads to higher home values around parks, which is expected to translate in to higher tax revenues for the local bodies. Therefore, parks, which were earlier considered to be public goods to be provided free by the government, now pay for their construction and maintenance (Crompton 2001a; 2001b). In order to accurately assess the increase in home values due to park proximity, assessors require detailed information about the relationship between park attributes and home values. This research developed a multilevel model, which can be used by assessors to quantify the effects of specific park attributes on proximate home values.

This research also makes significant methodological contributions. The methodological framework followed in this research can be used to empirically verify theories that use the built environment as raw material for theory formation (e.g. New Urbanism), but have not been subjected to empirical testing (Fainstein 2000). Tools can be developed to evaluate the built environment and determine household preferences for different components of the built environment. This approach has already aroused research interest and one recent example is the valorization of three urban design types – traditional neighborhood development, enclave, and infill housing in Chicago (Ryan and Weber 2007).

Furthermore, multilevel techniques, in addition to numerous advantages over traditional analytic techniques, are useful to investigate nested phenomenon in Regional Development Planning. Variables measured at multiple levels with the smallest level contained in the higher levels results in a nested dataset. In Regional Development Planning, data are often measured at various levels – individual, homes, neighborhoods, cities, regions, and nations. Typically, the research design is unbalanced (e.g. different number of units in levels) and shows dependency (e.g. proximate households have similar income levels). Besides, a major issue of interest to Regional Development Planning researchers and practitioners is to decompose the variance attributable to determinants measured at multiple levels. Desegregation of variance in outcome variables is not possible in traditional analytic techniques (e.g. analysis of variance and regression analysis) because data is either aggregated or disaggregated. In contrast, multilevel techniques permit the simultaneous examination of relationships within levels (e.g. neighborhoods) and across levels.

More importantly, traditional analysis strategies assume fixed effects, that is, the phenomenon is invariant across levels, such as neighborhoods. However, in reality phenomenon encountered in Regional Development Planning vary randomly across neighborhoods. For example, baseline income levels and the effect of interventions are expected to vary across people and neighborhoods. One alternative is to use analysis of covariance, but this can be used only if slopes (relationship of outcome variable and an independent variable) are similar across neighborhoods. Additionally, if the independent variable partially explains the variance between-neighborhoods then the issue still remains unresolved (Masse et al. 2002; Sibthorp et al. 2004). Multilevel techniques allow slopes and intercepts to vary randomly between neighborhoods and to examine the contributions of each independent variable measured at different levels of analysis.

Finally, this research contributes to the Field houses vs. Meadows debate. The origin of the debate lies in the twin roles assigned to parks (Weir 1924; Garvin 2000) – to provide "green relief" (Meadows) from the noise and confusion of the city and to lead to the opening up places for "play" (Fieldhouses). The discourse over the relative importance of passive (green relief) and active (play) elements in parks is known as the Fieldhouses vs. Meadows debate and this research by determining the values placed by households on park attributes constituting Meadows and Fieldhouses, contributed to the ongoing discussion.

1.5. Limitations and Delimitations

Using assessed values instead of actual sale values was a limitation of the research. The primary reason to select the Auditor's assessed value over the actual sale value was that the single-family home price index was available only at the Metropolitan Statistical Area level, and therefore, did not account for the unique market conditions prevailing at the neighborhood level, which was important for this research. Moreover, hedonic studies have generally used only "arms length" sale transactions, which were likely to further reduce the sample size.

This study was delimited in several ways, which are expected to limit the ability to generalize the findings. The study was limited to parks located on plane levels and parks that did not have major locational externalities in their neighborhoods. Homes under the dominant and unique influence of the parks were sampled by creating a buffer (1000 feet) around parks and deleting homes under the joint influence of two or more parks. Moreover, to reduce the complex externalities operating near park edges homes abutting parks (100 feet) were also removed from the analysis.

1.6. Assumptions

This dissertation research was subject to four sets of assumptions. The first set consisted of the classical assumptions underlying multiple regression analysis, except the assumptions relating to independence of residuals and their constant variance (West, Welch and Galecki

2007). The second set of assumptions was connected to specifying parsimonious multilevel models. The assumption was that unmodeled independent variables, found in the error term, were uncorrelated with independent variables in the model. This research used a parsimonious model because the multilevel technique is more complex due to the presence of multi-levels of analysis and use of maximum likelihood techniques and too many predictors were likely to lead to model convergence and interpretation problems (Kreft and DeLeeuw 1998; Tabachnick and Fidell 2007, 786-87). Therefore, trade-off was made between large unstable models and unrealistic parsimonious models and a small model based on theory and empirical evidence was estimated.

The third group of assumptions was related to the hedonic price model. In the hedonic price model marginal implicit price is interpreted as the household's willingness to pay for an attribute. This required the assumption that the housing market was in equilibrium, that is, the householders instantaneously adjusted to the market led changes in prices of homes and were completely aware of all home attributes and prices. Even if this assumption is violated the estimation remains unbiased although errors of measurement in the home values affect the relationship between true property prices and within/outside home variables (Freeman 1993). Another assumption behind the interpretation of marginal implicit prices as the consumer willingness to pay was the availability of a full range of homes with varying attributes for buyers to choose from.

The fourth and final set of assumptions was connected to the measurement of network distances. Network distances were measured from the home to the closest point on the park perimeter. This may not be always true, often users have to travel greater distances to enter the parks. Moreover, network distances were measured from the center of the home polygon to the nearest point on the park boundary. The assumption was that at least one branch of the road network around parks led to the park.

1.7. Dissertation Organization

This dissertation consists of five chapters. The first chapter introduces the research followed by a literature review in the second chapter and the methods in the third chapter. The fourth chapter describes the results obtained and the fifth and final chapter discusses the results, draws conclusions, underscores the significance of the research and gives suggestions for future research.

CHAPTER II

LITERATURE REVIEW

Parks exert both positive and negative effects on adjacent home values, but the net effect is positive (Crompton 2001). Households prefer to live near parks because of the increased opportunities for aesthetic experiences and park visitation. In turn, aesthetic experiences are determined by park design and park-home direct distance and park visitation depends on park accessibility. However, park studies have primarily used direct distances to value the amenity effects of park proximity (Weicher and Zerbst 1973; Hammer, Coughlin, and Horn 1974; Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001; Anderson and West 2006), and only one study has modeled network distances (Miller 2001). Surprisingly, valuation of specific-park attributes and the interaction of direct and network distances have remained unexamined.

Accordingly, the goal of this research was to valorize park attributes and park neighborhood characteristics and determine their precise association with proximate home values. Hedonic estimation is one common technique to value park attributes and park neighborhood characteristics or estimate their marginal implicit prices; therefore, this chapter begins with a review of the conceptual foundations of the hedonic price model and its underlying assumptions. Typically, the hedonic price model was made operational using multiple regression analysis (Weicher and Zerbst 1973; Hammer, Coughlin, and Horn 1974; Bolitzer and Netusil

2000; Lutzenhiser and Netusil 2001; Miller 2001; Anderson and West 2006), but the objectives of this research required a modeling technique that separated level-1 from level-2 effects; therefore, multilevel techniques, not multiple regression analyses, were used to do hedonic estimation.

Precise definition of the context (park neighborhood) was required for the purpose of multilevel hedonic estimation. This forms the second part of the literature review. Park neighborhood was conceived to be the area around the park in which the park was the dominant externality affecting home values. Studies have shown that the park effect becomes negligible at around 1500 feet and the maximum effect is experienced up to a direct distance of 600 to 800 feet (Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001; Miller 2001); therefore, the park neighborhood was defined as the physical area within 1000 feet from the park boundary and consisted of different land uses, street networks, and the socio-economic characteristics. In this buffer the influence of the park was assumed to be dominant.

The association between open spaces and property values has been investigated in the case of golf courses (Do and Grunditski 1995), greenbelts (Correll, Lillydahl and Singell 1978; Nelson 1985), wetlands (Doss and Taff 1996; Mahan, Polasky and Adams 2000), agricultural and urban lands (Kitchen and Hendon 1967; Geoghegan, Lynch and Bucholtz. 2003), greenways (Nicholas and Crompton 2005), community gardens (Tranel and Handlin 2006), and forest preserves (Thorsnes 2002). However, the focus of this literature review was on studies that have examined the associations between home values and parks; therefore, the third part of this chapter reviewed park studies.

Using the framework developed by Lazarsfeld and Menzel (1969) to make generalizations about complex systems, multilevel models also permitted exploration of the effect of park neighborhood social capital on home values. Generally, park systems possess three types of properties - analytical, structural, and global. Analytical properties are derived from homes, structural properties are deduced from information about the interrelations between the households, and global properties are unique to the park neighborhood, not obtained from its members. In this study home attributes are the analytical variables, social capital is the structural variable, and park attributes are the global variables. Concepts and constructs derived from social capital theorizing were used as relational variables within the sociological framework. This is the fourth part of the literature review, which contains a discussion of the social capital frameworks developed by Bourdieu, Coleman, and Putnam. In this last part of the literature review chapter, different social capital concepts were evaluated and contemporary trends in social capital were identified.

2.1. Literature Review of Hedonic Price Models

Park attributes and neighborhood characteristics are untraded goods; therefore, other methods have to be used to estimate the marginal implicit prices that consumers are willing to pay for within and outside home characteristics. One such technique is hedonic estimation and hedonic price functions relate home and outside home attributes to the home price through the housing market. Subject to some assumptions this enables the estimation of marginal implicit prices of different home and outside attributes.

Intuitively, the concept of the hedonic price model is easily understood by comparing the park system to a grocery bundle. Grocery bundles contain different items. Similarly, each house is a unique bundle of bathrooms, bedrooms, and other amenities. Unlike grocery bundles the price of individual attributes is not directly observed. The hedonic price model estimates a price of these individual attributes by applying multiple regression analysis to a group of residential properties. The basic concept is that home buyers derive satisfaction (and therefore value) from various within and outside home characteristics and these can be priced. While consuming housing, home buyers will maximize utility subject to their budget constraint (Malpezzi, Ozanne and Thibodeau 1980).

Hedonic models are required because of the heterogeneous housing stock and heterogeneous consumer preferences (Malpezzi 2003). Home buyers possess unique preferences that make them value home characteristics differently, which are unknown *a-priori*, but are revealed by the observed behavior of individuals in the market. For example, one household may place more value on the number of bathrooms than bedrooms. Second, each home possesses a set of bundle of attributes and services (Knox 1994), which are unique to the house and are accordingly valued differently depending upon the structural characteristics, geographic location, and the neighborhood within which the home is nested. For instance, older homes are valued less and garages and heating have a greater value in colder climates. Hedonic price models are used to value these components or estimate their marginal implicit prices. Originally the hedonic price model was developed as an aspatial econometric model, later space was modeled by adding location, and finally the local context was added to generate the contextual hedonic price model. The aspatial, spatial, and the contextual hedonic estimation techniques are discussed next.

Background and Aspatial Hedonic Price Models

The name of Epicurus is most commonly associated with hedonic philosophy. Epicurus assumed that human feeling, not reason, was the most important factor to understand the world and that pleasure was good and pain bad (Taylor 2000, 101-139). This was ethical hedonism. However, hedonism in the hedonic model has psychological connotations rather than ethical, and refers to purposeful human behavior to improve their own welfare (Edwards and Gable 1991, 39).

The conceptual basis of the hedonic price model, as applied to home values, is the theory of rents. Productivity of land differs across locations and these locational productivity differences result in different land rents, and therefore, reflect different land values. Under conditions of competition and free entry, land rents will correspond to productivity differences. The price at which a piece of land sells in the market is the expected future rents; therefore, productivity differences will show up in land prices (Bye 1940; Freeman 1993). The productivity of land is assumed to be affected by externalities (e.g. air pollution, water quality, park presence), which in turn will show up in land prices. Accordingly, it is possible to use land values to measure the positive or negative effects of externalities.

Hedonic estimation techniques have been used in empirical studies for some time, but there is no consensus on the primogenitor (Sirmans, Macpherson and Zietz 2005). One of the first significant applications of the hedonic estimation was to study the effect of air pollution levels on home prices in the St Louis metropolitan area. In this study Ridker and Henning (1967) found that sulfation levels in the air were significantly associated with residential property values

– a decrease in sulfation of 0.25 mg/100cm^2/day was estimated to increase values of owner-occupied houses by between $ 83 and $ 245. The important finding that the air pollution coefficient could be used to predict property values, led to the possibility of using the regression coefficients to estimate the marginal implicit prices of environmental characteristics (Freeman 1993).

Lancaster and Rosen are commonly believed to have laid the theoretical foundations of the hedonic price model. Lancaster (1966) suggested that an individual gets satisfaction from a product's characteristics, for example, a home is more than a place to stay; an individual gets utility from different home features (e.g. size, number of rooms). Rosen (1974) developed the aspatial hedonic price model further by defining hedonic prices as the "implicit prices of attributes (that) are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them" (34).

Spatial Hedonic Price Model

The hedonic function was developed as an aspatial econometric model. Introducing space in to the econometric model and modeling only the demand side leads to a hedonic price model of the general form –

$$P_{hi} = P_h (S_i, N_i , L_i)$$

where, the price of the ith home, P_{hi}, is a function of the home structural attributes (S), neighborhood characteristics (N), and locational features (L) of the home. P_h is the hedonic price function and connects the two sides of the equation. This relationship (hedonic function) is linear if the features are additive, otherwise the equation is non-linear. Often the relationship is non-linear, for instance two six foot height rooms do not give the same satisfaction as a single twelve foot high room.

If the hedonic price function has been estimated for an urban area using multiple regression analysis, then the regression coefficients are interpreted as the marginal implicit price of that characteristic. Subject to holding all other variables constant this is the additional amount that a buyer has to pay to move to a bundle with a higher level of that characteristic. The buyer faces different within and outside home attributes, each with an implicit price, and scans all these attributes "until a point is reached where the marginal willingness to pay for an additional unit of that characteristic is just equal to the marginal implicit price" (Freeman 1993, 370-387). In the case of non-linear functions, the marginal implicit price is not a constant, but depends upon its level and on the level of other characteristics (Freeman 1993; Orford 1999).

Contextual Hedonic Price Models

Generally contextual variables have been ignored in past hedonic price studies, particularly in park studies and this research aims to fill this research gap. There are two types of contextual influences. One is the existence of housing submarkets (spatial heterogeneity), and second is spatial dependence – homes in one neighborhood are similar; and are different from homes in other neighborhoods. Spatial dependence leads to spatial autocorrelation because homes in one neighborhood are structurally similar so the home prices are correlated and prices of adjacent homes have an effect upon one another (Can 1990). Multilevel models by modeling spatial phenomenon permit identification of housing submarkets.

Housing Submarkets: Segmentation into housing submarkets may occur due to supply side or demand related factors. Further, housing submarkets may be defined by home structural attributes (single-family, town houses), specific preferences (historical homes), neighborhood characteristics (school district, park presence), and municipal boundaries (Goodman and Thibodeau 1998). The defining characteristic of a submarket is substitutability – defined as a pair of homes related in a way as the price increase in one leads to an increase in demand for the other. However, the objective of this research was not to define submarkets consisting of substitutable homes, but rather to examine submarkets in a way that allowed for more accurate estimates of home values, which in turn was expected to lead to better prediction and evaluation of outcomes related to neighborhood revitalization plans. To meet these practical objectives segmenting housing markets using hedonic prices is appropriate (Bourassa, Hoesli and Ping 2001; Bourassa, Hoesli and Ping 2003). Accordingly, this research used the contextual hedonic price model and conceived of segmentation to occur due to the dominant influence of the park in the neighborhood.

Such micro level approaches are finding support from a growing body of literature (Bourassa and Hoesli 1999; Bourassa et al 1999; Bourassa, Hoesli and Ping 2001; Bourassa, Hoesli and Ping 2003; Day 2003). In Australian and New Zealand cities results were improved if housing submarkets were included in the analysis (Bourassa and Hoesli 1999; Bourassa et al. 1999; Bourassa, Hoesli and Ping 2003). Moreover, these submarkets were distinguished by structural features of properties, neighborhood socio-economic characteristics, and locational variables. Contemporary studies (Bourassa, Hoesli and Ping 2001; Day 2003) have found that location and neighborhood characteristics, rather than home structural features, better define sub-markets, which also have practical utility.

Advantages of Multilevel Models: Park studies have combined variables measured at level-1 and level-2 (e.g. traffic, park attractiveness, size, income, density) into one regression equation ignoring the hierarchical nature of the dataset – residential properties nested within park neighborhoods. This leads to the "unit of analysis" problem. Traditionally, park studies have done hedonic estimation by generating multiple regression models by disaggregating data (Weicher and Zerbst 1973; Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001; Miller 2001; Anderson and West 2006).

Studies either aggregate or disaggregate data measured at multiple levels. In the disaggregated method all homes are assigned the same value on neighborhood variables and only homes level values are used as data in the regression model. In contrast, in the aggregated method all level-1 data is aggregated to a single neighborhood level, leading to loss of unique within-neighborhood information reduction in sample size (Heck and Thomas 2000), and making inferences about home values from neighborhood level data results in the well-known "ecological fallacy" (Robinson 1950).

Furthermore, the nested nature of data means that homes values around a park will be correlated with one another, which violates the assumption of independence of errors – a requirement in multiple regression analysis. Violation of this assumption results in lower standard errors and inflates Type I error rates resulting in misleading inferences (Barcikowski

1981). Accordingly, multilevel models offer conceptual and statistical advantages over multiple regression analysis and permit estimation of variances in the home values caused by structural, locational, and neighborhood variables, which are measured at different levels. Besides the problem of "spurious significance" failure to model both homes and parks simultaneously makes it impossible to investigate the extent to which home attributes and park neighborhood characteristics interact to effect home values (Steel and Goldstein 2007) The advantage of multilevel models is that they permit specifying and estimating relationships between independent variables observed at different levels. This research does not claim that multilevel techniques are being used the first time, but earlier studies (Orford 1999) had included parks as just one of the externalities.

Multilevel techniques have been used for some time, but computational challenges prevented widespread usage of the technique. Multilevel techniques are gaining wider acceptance following calls to increasingly use "state-of-the-art" multilevel techniques (Office of Behavioral and Social Sciences Research 2000). Usage of multilevel techniques has gained momentum, especially in public health (Subramanian, Kawachi and Kennedy 2001; Subramanian, Lochner and Kawachi 2003; Subramanian, Kim and Kawachi 2005) due to advances in specialized software programs (e.g. HLM, MLwiN) and inclusion of multilevel techniques in common packages (e.g. SPSS MIXED and SAS MIXED).

Multilevel models account for both spatial dependence and spatial heterogeneity. In the single level model compositional (home) and contextual (neighborhood) effects are mixed and contextual variable effects are included by expanding the fixed part (parameters of attribute and intercept) of the regression equation. The multilevel model analyzes the housing market at two levels - homes at level-1 and neighborhood variables at level-2. Unlike simple regression analysis that varies at a single level, the multilevel model varies at many levels, which is done by expanding the random part (error) of the model, rather than the fixed part. This expansion of the error part is called a multilevel model (Goldstein 1987; Jones and Bullen 1993; 1994).

Assumptions

The hedonic estimation technique is subject to four assumptions - (1) the housing market is at equilibrium (supply equals demand) and the home value reflects the present value and the future expectations of amenity levels, (2) a full range of houses with varying attributes is available to homeowners to choose from, (3) homeowners have perfect market knowledge and choose to maximize their utility subject only to a budget constraint, and (4) home characteristics exist objectively while consumers, based on their preferences, value homes containing different bundles subjectively. For instance, while a garage may be valuable to all buyers, each buyer will value the garage in different ways, that is, buyers will search for different bundles of attributes in homes (Rosen 1974; Maclennan 1982; Freeman 1993, 370-387).

Assumption violation occurs due to disequilibrium in the housing market and non-availability of complete range of homes for buyers to choose from. In the hedonic model marginal implicit prices are interpreted as the households' willingness to pay for an attribute. This requires the assumption that the housing market is in equilibrium - households instantaneously adjust to the market led changes in prices of homes and are completely aware of all home attributes and prices. This assumption is violated in the following circumstances. First, if self-assessed or appraised home values are used, they may inaccurately reflect actual prices. The errors of measurement in the home values will affect the relationship between true property prices and within/outside home variables; however, the estimation will remain unbiased. Second, if there is a lag in the market adjustment to the changed conditions of home demand and supply then the observed marginal implicit prices will not accurately measure the buyers' marginal willingness to pay. A change in marginal implicit prices will only lead to a corresponding buyer reaction if the potential utility gain is more that the costs (e.g. information, transaction). Therefore, there is a marginal willingness to pay range within which the marginal implicit prices can vary without a concomitant change in buyer behavior. Suppose the home prices change continuously in one direction ("rapidly"), then buyers will always exhibit a delayed response and the marginal willingness to pay will be overstated or underestimated depending upon price fall or rise. Finally a change in expectations of the future can affect home prices and marginal implicit prices independently of the, say, present park conditions. Generally divergence from equilibrium will result in random errors only in the estimates of the regression coefficients, but if the prices move consistently in one direction, or are expected to move in one direction, then biases are likely to occur (Freeman 1993).

Another assumption behind the interpretation of marginal implicit prices as the willingness to pay is the availability of a full range of homes with varying attributes for buyers to choose from, which is the same as the assumption that the hedonic price function is differentiable and continuous. First order utility maximization conditions are not satisfied if there are gaps in the range of available homes. This was shown in a study in Boston area found that high income households live in areas with high pollution levels because these locations have other more desirable features, which are unavailable in low pollution areas (Harrison and Rubinfield 1978). The aggregate model does not account for this, but this does not make the aggregate model completely unreliable. Awareness of this problem is important and a possible solution is prior examination of the disaggregated data to identify the absence of a full choice range for buyers (Freeman 1993).

2.2. Concept of Park Neighborhood

This research uses the contextual hedonic model. The context is defined as the park neighborhood. Neighborhoods are defined in different ways and fixing the boundaries of a neighborhood depends on the program objectives or the aims of the research. Generally, neighborhoods could be defined as social units or spatial entities or networks of relationships. For example, neighborhoods can be as small as the two sides of a street (face-block) or a residential neighborhood or an institutional neighborhood (Chaskin 1995). Physical boundaries of neighborhoods are the mental maps of the residents in which physical elements (Chaskin 1995; Connerly 1996), such as parks play an important role. Homeowners around parks consider the park as the defining unit of their space; therefore, the area of park influence was considered to be an appropriate unit to be designated as a neighborhood for the purposes of this research. Using the concepts of park influence area from Hendon (1974), the park influence area was defined as the distance that the park affects property values.

Further evidence was available from non-park hedonic literature. Pace and Gilley (1997) modeled neighborhood level effects, which were earlier ignored by Harrison and Rubin (1978) in their study of the effects of pollution on the home values in Boston. They found that the "small-scale" variations captured by neighborhood differences are important in predicting home values. This also reduced the error from unobservable local variables.

Park studies, which have examined the association between residential property values and home-park distance have found that park effects become negligible at about 1500 feet and the maximum effect is experienced up to a direct distance of 600 to 800 feet (Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001; Miller 2001). Therefore, park effect was assumed to be the dominant influence up to a distance of 1000 feet, and the park neighborhood was defined as a buffer up to 1000 feet from the park boundary. This buffer consisted of different land uses and street networks.

The park's service area is another way of defining the park neighborhood. The service area of the park is the area from which 80 to 90 percent of the park users come (Hendon 1974). Public health and planning and transport literature show that the service area of a park is greater than the influence area, which is expected, because the travel distance is always greater than the direct distance. Planning and transport researchers have used one-quarter mile as the standard distance people are willing to walk to do their daily chores, such as visiting grocery stores and transit points (Untermann 1984). This is an approximate length for a five minute walk. Public health literature also suggests that park visitation is increased if homes are located within 10 minutes walking distance from the park (Powell, Martin, and Chowdhury 2003). Therefore, the park neighborhood, defined as a buffer with a radius of 1000 feet, is expected to cover the homes that are within the dominant influence of parks and located within walking distances.

Park neighborhoods are appropriate to be classified as target neighborhoods in revitalization plans. Comprehensive revitalization plans focus on neighborhoods, which are located within walking distance of neighborhood center (U.S. Department of Housing and Urban Development 2004). Moreover, if the park neighborhood is also a housing submarket, then planners will be better able to predict and evaluate the housing outcomes of revitalization plans.

2.3. Review of Park Literature

Park studies can be classified, based on the main research question addressed, into three categories. The first set of park studies has investigated the relationship between park attributes and home values (Ward 1966; Hendon 1972; 1973; 1974; More, Stevens and Allen 1988; Little 1990; Espey and Owasu-Edusei 2001; Pincetl et al. 2003); the second group has examined the decay of park effect with increasing distance from the park (Wonder 1965; Kitchen and Hendon 1967; Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001); and the last category has focused on the influence of the park neighborhood on home values (Herrick 1939; Weicher and Zerbst 1973; Hammer, Coughlin, and Horn 1974; Miller 2001; Anderson and West 2006). Evaluation of the park literature shows that has been little research to valorize park attributes or examine the moderating effects of network distances on park-home direct distances.

Frederick. L. Olmstead, made the first attempt to examine the increase in property values due to the construction of the Central Park, New York City. Olmstead compared the increase in values in three contiguous blocks (twelfth, nineteenth, and twenty-second wards) around Central Park with other wards in New York City. Assuming that property values appreciated in the three wards around the Central Park at the same rate as that in New York City, the assessed property values were expected to increase by $53 million (1873 prices). However, the observed increase was $236 million and the additional increase was attributed to the establishment of the Central Park (Fox 1990, 10-12). Similar increases in property assessed values were reported in the case of Warinanco Park, Elizabeth, New Jersey between 1922 and 1939. A study by the Union County Park Commission, New Jersey found that the increase in the assessed property values within a quarter-mile radius of the Warinanco Park was 631.7 percent as compared to an average of 256.7 percent increase for the entire city (Little 1968/69, 87).

Associations between Park Attributes and Home Values

In an early qualitative study, benefits to children, availability of recreation, and park aesthetics were identified as the factors that increased home values adjacent to parks (Ward 1966). In Spokane, Washington 36 residents and 30 real estate agents were interviewed to explore the effect of parks on surrounding properties. Residential properties were divided into three groups - properties adjacent to the park (section A), properties located between 1,000 and 1,500 feet (section B); and properties located between 2,000 and 2,500 feet (section C) from the park. All the real estate agents considered properties close to parks to be more attractive for buyers, and park effects were strongest on adjacent properties due to benefits to children, availability of recreation facilities, and aesthetic experiences associated with park proximity.

All the property owners in section A felt that parks had a positive effect on their properties; this support fell to 66 percent in section B and to 8.3 percent in section C. Section A home owners rated aesthetics (75 percent) to be the most important factor in their home purchase decision followed by recreation facilities for children (> 50 percent). Moreover, homeowners expressed strong preferences to stay close to the park. The main drawback of this study was the small sample size. However, the important finding was that geographical areas in parks had distinct effects on home values. Moreover, the study found that parks increased values of adjacent properties, which rapidly decayed with increasing distance from parks.

During the early 1970s Hendon (1972; 1973; 1974) conducted numerous studies to examine the effect of playgrounds, playfields, and parks on surrounding property values. These studies provide insights into the effect of activity areas and undeveloped portions in parks on home values. An important finding was that park size was associated with home values. This was later explicitly tested by Bolitzer and Netusil (2000).

In the first study Hendon (1973) tested the hypothesis that park-school combinations, as compared to schools only, had a positive effect on property values. The reasoning was that while parks had positive effects on proximate properties; schools depressed property values due to noise and traffic. Randomly, three schools and three park-school combinations were selected in Dallas, Texas. Land value and assessed property value were the dependent variables and the results of the correlation analysis are given in table 2.1.

Table 2.1 shows that the association between land value and distance in the case of one park-school combination is insignificant. This occurred due to the small park area (2.6 acres) as compared to the total school area (15 acres). The relationship between assessed home values and park-school combinations showed a positive effect in the case of the third park-school combination, indicating that the park-school combination had a negative effect on adjacent property values. This was probably due to the relatively undeveloped park area in the third park-school combination; therefore, undeveloped areas in parks exert a negative effect on home values, that is, park presence itself is not enough, but park development and design are also important.

Table 2.1. Relationship of home land values and assessed values with distance from schools and park-school combinations in Dallas, Texas

Open space type	Land value and distance		Total assessed value and distance	
	Significance at .01level	Sign of correlation coefficient	Significance at .01level	Sign of correlation coefficient
Park - School 1	Yes	Negative	Yes	Negative
Park - School 2	No	Negative	Yes	Negative
Park - School 3	Yes	Negative	Yes	Positive
School 1	Yes	Positive	Yes	Positive
School 2	Yes	Positive	No	Positive
School 3	Yes	Negative	No	Negative

The study also found that park effects were associated with park size. Park size was a proxy for park attributes because smaller parks generally have fewer facilities (Mertes and Hall 1995); therefore, smaller parks were expected to have a smaller effect size, resulting in non significant results. Later studies, which specifically modeled park size found a significant association of park size with home values (Bolitzer and Netusil 2000).

Besides the park size, the park shape also affects property values. Linear shape enhances park effects (Little 1990). Little (1990) compared the perimeter of a circular park and a linear one, and found that the effective area, called the “apparent area” was different for linear and circular parks. The apparent area of a linear park was 5.65 times more than a circular park. In dollar terms the expenditure is more than five times to obtain the same “edge effect” in a circular park as compared to a linear park.

In another study Hendon (1974) examined the effect of three parks (Saner, Moore, and Exline) on proximate property values in Dallas, Texas. In order to identify unique effects of a park, Hendon (1974) deleted parks, which were under the joint influence of the parks and of other externalities (e.g. schools, commercial systems, transport systems). Of the13 parks only three parks were selected and these parks contained a mixture of playgrounds (Moore) and playfields (Saner and Exline). Further, two parks, Moore and Exline were located in primarily African-American areas and the study was one the early attempts to test the effect of racial composition on home values.

Table 2.2.Linear correlation analysis of total assessed value of properties to distance from nearest park in Dallas, Texas

Type of park	Neighborhood composition	Property-park mean distance (feet)	Number of properties	Correlation coefficient between total assessed value and distance
Hattie Rankin-Moore playground	African-American	4163	328	0.068
Beckley Saner playfield	White	2341	402	-0.138**
Exline playfield	African-American	2773	291	0.139**

Note: significance levels *.05, **.01

The results of the simple linear correlation analysis are given in table 2.2 and show that parks exert both a positive and negative effect on properties situated within 500 feet of the park, and the effect of parks on value of properties, located in predominantly African-American neighborhoods was negative. Non-significant results were obtained in Moore playground because homes were located at greater distances from the facility (mean distance = 4163 feet) and current literature shows that park effects decay and becomes negligible at about one-fourth mile (Bolitzer and Netusil 2000; Miller 2001).

This study was significant in several ways. First, the study investigated the concept of park service area and the service area, which was used to develop the notion of park neighborhood in this dissertation. The distance that the park affects property values was the influence area of the park and the park service area is defined as the area which attracts 80 to 90 percent of park users. Moreover, at greater distances identifying unique park effects becomes difficult because other influences (e.g. schools, interstates, retail) begin to have a greater effect on home values. Second, this study found that park design, aesthetics, and maintenance have an effect on surrounding property values. Third, this study showed that neighborhood variables (level-2), such as racial mix were also important and affects home values.

Interest in the home value as a dependent variable increased due to the extensive use of multiple regression techniques to make the hedonic price model operational. Several park studies were done in Worcester, Massachusetts in the 1980s (More, Stevens and Allen 1982; Allen, Stevens and More 1985; More, Stevens and Allen 1988), and More, Stevens and Allen (1988) used hedonic estimation to examine the effect of four parks on home values in Worcester, Massachusetts. This study is noteworthy because it was the first time that park attributes were explicitly investigated and the hypothesis that parks possess different attributes and each attribute makes has a distinct effect on home values was tested.

Four parks were investigated. The first park was the 76 acre Elm Park-Beaverbrook Park complex, which was a highly developed park with a water body, playgrounds, and undeveloped woodlands surrounding a high school. Beaverbrook was located only some blocks away and contained facilities for active recreation (e.g. tennis courts, swimming pool, playgrounds). Second, was the 50 acre Hadwen Park, which was a wooded area overlooking a lake. Moreover, the park also contained ball game grounds (e.g. ball diamond, tennis court). The third open space was the 15 acre Greenwood Park, which was primarily developed for active recreation. Finally, Lake Park was an undeveloped area of 78 acres, which also had facilities for active recreation (e.g. ball diamond, basketball) on the south and an ice skating rink on the north. Homes located within 4,000 feet from the park were sampled and the dependent variable was the home sale value. The independent variables included home physical features, location and park characteristics and direct and network park-home distances.

Homes adjacent to parks sold for $2,675 (adjusted to 1982 dollars) more on average than similar houses located 200 feet away, and this positive effect of parks was lost at about 2,000 feet. The study found evidence for the distinct effect of park attributes on home values, but failed to valorize the effect of specific park attributes on home values. For example, the study generally found that intensive activity areas in parks had a negative effect on home values. However, different types of activity areas were combined. Later studies (Sharma 2007) have found that the effect on home values is negative in the case of ball game grounds and positive for children's playsets. Most probably, non-availability of tools to evaluate different park attributes led to the non quantification of specific park attributes.

Another relevant finding of this study was that park design and maintenance effect home values. A major shortcoming of the study was the small sample size and mixing up of parks meant to promote active and passive recreation. For example, Greenwood Park was different because it was primarily developed for active recreation. Additionally, only large sized parks were used and these parks contained similar elements, making evaluation of variation in features among different parks difficult. Finally, homes under the joint influence of two parks were not separated; therefore, the unique park effects could not be isolated.

Continuing the investigation of park attributes, Espey and Owasu-Edusei (2001) examined the effect of park proximity, neighborhood characteristics, and park size on the sale values of 4,153 homes, between 1990 and 1999, in Greenville, South Carolina. Home sale values were deflated using monthly consumer price indices. The independent variables were - a depreciation factor, number of bedrooms and bathrooms, square footage of the house, presence of garage and air-conditioning, lot size, and proxies for neighborhood characteristics. Effective home age, which was the depreciation factor, was assessed by using both the actual age and condition of home. Park proximity was determined using GIS and the semi-log functional form of the hedonic price model was used for analysis.

For the purpose of the study parks were grouped into four categories. The first category consisted of 12 small (0.36 to 2.01 acres) unattractive neighborhood parks having play equipment in sandy areas, small grassy areas with weeds, and bare spots. Four attractive small (0.4 to 1.61 acres) parks, with some playground equipment, formed the second category. The third category consisted of six medium sized (4.84 to 25.28 acres) attractive parks, which had ball game grounds, walking trails, and natural areas. The last set consisted of two medium (2.19 to 3.89 acres) parks, with fewer facilities and no natural area.

In the first model, general impact of park proximity was estimated without including park size or attributes into the estimation. A positive effect on home values was found and homes located within 1500 feet of any park sold for 6.5 % more as compared to homes farther away. Surprisingly, small sized parks had a larger effect on home values as compared to medium sized parks - homes close to small neighborhood parks sold for 8.5 % more as compared to distant houses.

In the second model buffers were created at different distances around parks, separately for the four park categories. The objectives were (1) to examine the negative effects of park proximity on home values (e.g. negative impacts of noise is greater than positive value of access), and (2) to determine the maximum distance at which park effect was dominant and the variation of park effects up to this maximum limit.

Table 2.3 gives the sign and magnitude of effects produced by different park categories. Type I parks produced a negative effect (14 percent) up to 300 feet, a positive effect (14 percent) from 300 and 500 feet, and a small positive effect (7 percent) between 500 and 1500 feet. For small attractive parks (Type II) there was a significant positive effect (14 percent) up to 600 feet only. In the case of attractive medium sized parks (Type III) there was a significant positive effect (6 percent) between 200 and 1500 feet, but no significant effect up to 200 feet. Less attractive medium parks (Type IV) had a negative effect (50 percent) on homes within 600 feet and no significant effect beyond.

Table 2.3. Impact of park proximity on home values

Park type	Distance range (feet)	Number of homes in range	Effect on home values (%)
Small unattractive	<300	26	-14*
	300-500	70	15*
	500-1500	434	6.5*
Small attractive	<600	80	11*
	600-1500	289	0
Medium attractive	<200	28	0
	200-1500	289	6*
Medium unattractive	<600	5	-51*
	600-1200	79	0

Note: * statistically significant

The study did not precisely define park attractiveness and failed to provide details of the criteria used to designate parks as attractive and unattractive and classify parks as small or medium. A general comment says that median income of households, within 1,500 feet of small parks (Type I), was about 20 percent lower as compared to Greenville ($26,000 versus $34,000), indicating that lower income city residents obtain more benefits from neighborhood parks. Additionally, the research design did not account for the joint influence of two parks on homes and seemed to have combined variables measured at home and park neighborhood levels.

Another shortcoming of this study was that the wide variation in the sizes of medium sized parks. Generally, parks are classified, based on their size, into four categories – mini, neighborhood, community, and regional parks (Mertes and Hall 1995). The finding that small parks produce greater effects on home values may have arisen due to the arbitrary classification system followed in this study.

This study confirmed the existence of complex interaction of positive and negative effects on homes located adjacent to parks. Generally, attractive parks had a positive effect on home values particularly homes located close to parks. This positive effect extended farther if the size of the park is larger. Unattractive parks had a negative effect, especially on homes abutting parks. Additionally, the positive effects of park proximity were found to be related to park attributes.

Discussion – Studies have found that different geographical areas inside parks have different effects on home values. Activity areas have a negative effect on home values (Ward 1966; Hendon 1973; 1974). Parents rated recreation facilities for children, second to park aesthetics in terms of influencing their home buying decisions (Ward 1966). Examining park-school combinations Hendon (1973) found that large, developed parks reduced the negative effect of activity areas in schools. Later studies confirmed the positive and negative effects produced by parks (Hendon 1974).

Generally, greenery and landscaping made parks more attractive. Park aesthetics was the main reason that prompted home owners to locate near parks (Ward 1966). Moreover, park design, aesthetics, and maintenance had an effect on surrounding property values (Hendon 1974). This was confirmed by More, Stevens and Allen (1988) who found that park design and park maintenance affected home values. Well maintained (e.g. no weeds in open areas) parks having natural areas were positively associated with home values (Espey and Owasu-Edusei 2001).

Indirectly the positive effect of greenery on home values was also found by Pincetl et al. (2003) who investigated the effect of parks on sales of single family homes in a poor immigrant neighborhood in Vermont-Slauson, Los Angeles. The neighborhood green cover was converted to park equivalent acres and hedonic estimation was made using the sale values between 1999 and 2000 for 260 single family homes. Within a radius of 200 to 500 feet from a house an 11 percent increase in the amount of green cover, equivalent to a one-third acre park, increased the sales price of the house by approximately 1.5 percent.

Therefore, there is evidence that park attractiveness, aesthetics, size, greenery levels, children's play equipment, and active recreation areas influence home values. However, these have not been defined or measured precisely and their specific effect on home values is a research gap. This research used the EAPRS instrument to precisely evaluate the physical environment of parks and playgrounds. Moreover, parks established to explicitly promote active and passive recreation were expected to have differential effects on home values because people were likely to value proximity differently around these facilities. The separation of facilities to promote active and passive forms of recreation in Cincinnati provided an appropriate setting to investigate such effects.

Associations between Home-Park Distance and Home Values

An early study (Wonder 1965) showed that parks had a positive effect on properties in their immediate proximity and this effect decayed with distance. Two research designs were used to examine the decay of park effect in Clinton and San Antonia parks in Oakland, California. Clinton Park was used to evaluate the effect of parks on proximate properties as compared to properties farther away; while properties close to San Antonia Park were compared with control properties, not under the influence of a park. The control properties, in San Antonia Park were similar in all respects to the experimental units, including neighborhood characteristics.

Properties were divided into three categories depending on the distance from the parks. Tier I properties were closest to the parks, Tier II were in blocks two times as far, and Tier III properties were three times as distant. Systematic sampling of properties ensured that the dominant influence on home values was the park. Five hundred property owners were surveyed, and of the 55 who responded, 30 reported that parks had influenced their home purchase decision.

Correlation analysis showed that the value of properties in Tier I was higher as compared to Tier II ($1,000) in Clinton Park; and Tier III property values were lower as compared to Tier II. Similar results were obtained from the San Antonia Park - Tier I property values were higher, but failed to reach significance. In contrast, in the control neighborhood Tier III property values were significantly higher than Tier I and II properties. This was one of the earliest studies that attempted to use a matched pair design to control for home structural attributes and neighborhood characteristics. The results showed that home values were higher near parks and decay as park-home distance increases.

Kitchen and Hendon (1967) applied linear correlation analysis to test the hypothesis that the positive park effect on properties decays with increasing distance from the Davis Park in Lubbock, Texas. Properties located within two and half block radius only were sampled in order to reduce the influence of other externalities (e.g. commercial). Moreover, the properties under the joint influence of the park and an adjacent school were eliminated because the school was exerting a negative effect on adjoining properties. The 10 acre Davis Park contained landscaped open space, play equipment, and shelters and the sample consisted of 480 residential properties, sold between 1960 and 1965, ranging in value from $12,000 to $18,000. Both the sale and assessed values were used as the dependent variables.

Insignificant relationships were found between assessed values (1965-66) and park distance (0.0049). Non-significance was also found between sale values and park-home distances (0.0541). However, property land values and park distances showed a significant negative correlation (-0.17). Insignificant relationship between home values and park distance arose because the study failed to control for home structural features. The homogeneity of land led to significance even without controls. The importance of controlling for home structural attributes was an important finding in this study. Moreover, unique park effects on home values was found by removing properties under the joint influence of the park and other facilities and limiting the sample to properties located within a buffer, in which the park influence was dominant. The idea of sampling homes, which are under the dominant influence of the park, inspired the research design of this dissertation.

Park studies were showing that park effect decays with distance. To determine the precise reduction of park effect with distance two studies were conducted in Portland, Oregon (Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001). Regression analysis was used and neighborhood level variables were also included. Using the hedonic estimation Bolitzer and Netusil (2000) investigated the effect of distance and types of open space (193 public spaces, 2 private parks, 15 cemeteries, and 8 golf courses) on homes sale values. Parks were subsumed under the category public spaces, the majority of which were public parks. The mean size of the parks was 20 acres (maximum - 567.80 acres; minimum - 0.20 acres; mean - 20.73 acres; standard deviation - 50.78). Around parks, 9,318 single family homes were sampled (total for all open spaces = 16,402), which were sold between 1990 and 1992 and the sale values were adjusted to 1990 prices using the monthly median sales prices of single-family homes. Table 2.4 gives the details of the home characteristics.

Table 2.4. Home characteristics

Statistics	Real sale price ($)	Age (years)	Lot acreage	Distance to CBD (feet)	Distance to park (feet)
Mean	68,484	51.11	0.16	19,594	904
Standard-deviation	54,945	24.67	0.14	9,375	389

Two datasets were used in model estimation. The first dataset was the restricted one containing sale values, which were greater than the assessed values, and second unrestricted dataset contained all the home sale values. The linear and semi-log functional forms were used to generate regression models. Three models were estimated - (1) Model A - effect of any type of open space within 1,500 feet (0.28 miles or 457.2 meters) from homes, (2) Model B - effect of open space within 1,500 feet by type for different types of open spaces (7.5 blocks, each block being 200 feet); and (3) Model C – six dummy variables were created to investigate the effect of open space on homes located in the following distance intervals (in feet) – less than 100, 101 to 400, 401 to 700, 701 to 1000, 1001 to 1300, and 1301 to 1500. Home age, number of bathrooms, presence of a fireplace, lot size, square footage, radial distance to open space, traffic, and distance from the Central Business District were the independent variables. Park-home direct distance was estimated using GIS.

Both models - A1 (linear form) and A2 (semi-log form) - found that home values within 1,500 feet were significantly increased by park presence (R^2 (A1) = 0.6212 & (A2) = 0.6346). In model A1, the average increase in home value was $2,105 as compared to similar properties located beyond 1500 feet from the open spaces. For an average size park of 20 acres, homes sold for $2,670 more. Similar results were obtained from the semi-log specification and an average sized park increased home values by $ 1,247 for home locates within 1,500 feet. In both the functional forms open space size showed a significant positive association. Table 4.5 gives the results for the semi-log and linear model for all the variables.

Model B showed that golf courses ($ 3400 in B1; $3940 in B2) increased home prices more than parks ($ 2262 in B1: $845 in B2). The decay of park effect with distance was also examined in detail by creating six dummy variables in Model C. In both the functional forms, the effect of parks up to 100 feet was positive, but non-significant (R^2 (C1) = 0.6201 & (C2) = 0.6323). The largest significant positive effect was found between 401 and 700 feet in the linear model and 101 to 400 feet in the semi-log model. The positive effect of parks declined and became negligible at around 1,500 feet.

Only, the values of homes close to parks (less than 100 feet or one-half block) showed a non-significant association with park distance, which could be due to the small sample size (66) or due to negative externalities present in park proximity and which may have cancelled the positive park effects. Therefore, this study provided evidence for the operation of negative externalities close to parks.

Table 2.5. Comparison of results of linear and semi-log models

Variable	Linear model	Semi-log model
Park	+*	+*
Size	+*	+*
Fire	+*	+*
Age	-*	-*
Bathrooms	+*	+*
Lot acreage	+*	+*
Square feet	+*	+*
Average traffic	-*	-*
Heavy traffic	-*	-*
NE-CBD	-*	-*
SE-CBD	-*	- (non-significant)
SW-CBD	+*	+*
NW-CBD	+*	+*
N-CBD	-*	-*
<100 feet distance	(non-significant)	(non-significant)
101-400 feet	*	*
401-700 feet	**	*
701-1000 feet	*	*
1001-1300 feet	*	*
1301-1500 feet	**	***

Note: significance levels *.05, **.01 and ***.1

The study made two significant findings. First, the R^2 for the restricted dataset was higher than for the unrestricted one, that is, the variance accounted for was greater if home values greater than assessed values were used to do hedonic estimations. The result shows that restricting a dataset does not reduce the explanatory power of the model. Second, the study found that park effect decayed with distance, but failed to specify precise open space attributes in the regression equation. This was surprising considering the fact that the study also found that different types of open space have different effects on home values, but did not control for the open space features. Accordingly, the investigation of the effect of parks possessing different attributes on the decay of home values with increasing distance from the park remained a research gap. Moreover, parks of different sizes were combined in to one regression equation. The average size of park was 20 acres, and park sizes ranged from a maximum of 567.80 acres to a minimum of 0.20 acres. Larger parks possess different type, and sometimes greater number, of attributes. A stratified sampling based on park size would have possibly led to more insightful results and this was another major shortcoming of the study.

Using the same Portland data, Lutzenhiser and Netusil (2001) divided 201 open spaces into five categories – urban parks (number – 115 ;mean size-19.89 acres; standard deviation-36.71; minimum-0.38 acres; maximum-195.66 acres), natural area parks (number - 34; mean size-78.21 acres), specialty parks (number 29; mean size-7.21 acres), golf courses (number - 8), and cemeteries (number - 15). An urban park had "more than 50 % of the park manicured or landscaped and developed for nonnatural resource dependent recreation (e.g. ball fields)" and a natural area park was one with "more than 50 % of the park preserved in native and/or natural vegetation. Park use is balanced between preservation of hiking, wildlife viewing, boating, and camping)".

Home age, heavy and light traffic noise, fireplaces and number of bathrooms in the home, lot size, and total footage were the independent variables. Two models were estimated. In the first model, dummy variables were used for five types of open space for homes located within a buffer of 1500 feet and in the second model seven dummy variables were created for distances ranging from less than 200 feet to 1500 feet.

The largest effect was associated with natural area parks ($10,648) and a lesser effect was produced by urban parks ($1,214). The optimum size of a park, which would maximize the park effect, was also computed. Figure 2.1 gives the effect of open space size on home values. Specialty parks require the smallest area to maximize their effect on homes, while the largest area is required for natural area parks. A 148 acres urban park produced the maximum effect on single-family home values.

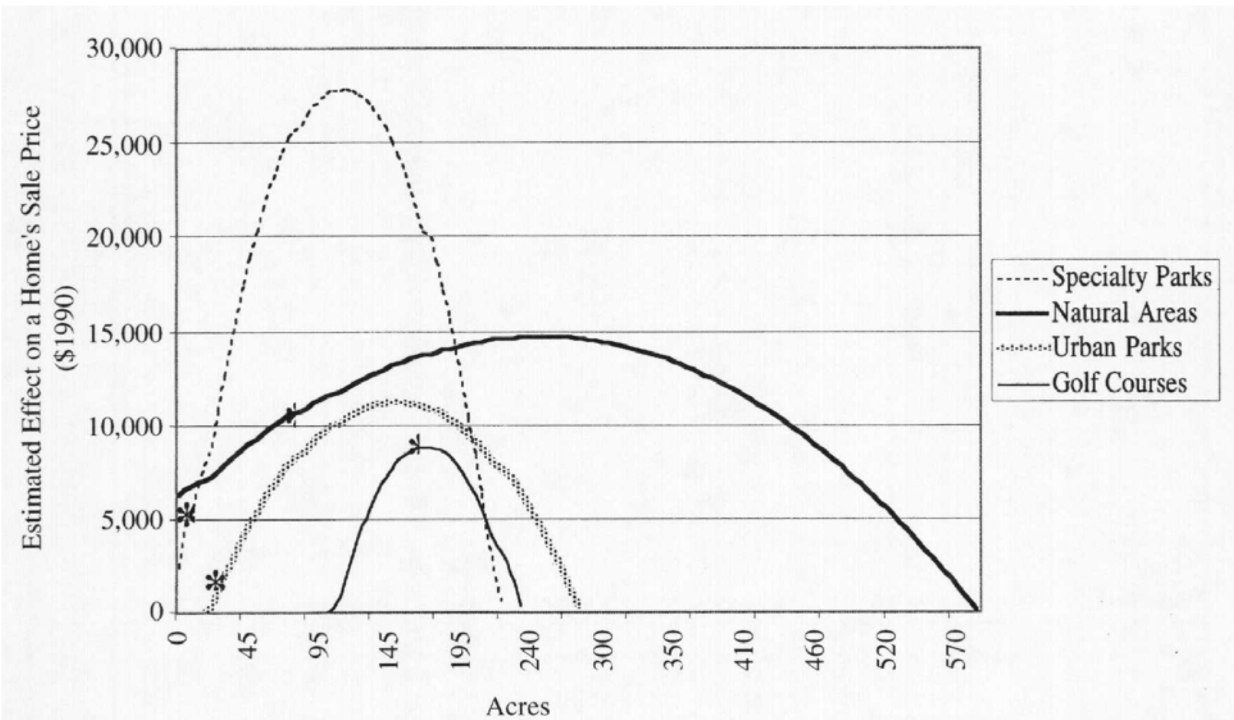

Figure 2.1. Open space acreage and home sale prices (adjusted to $1990)
Source: Lutzenhiser and Netusil (296, 2001)

The results of the second model for urban parks are given in table 2.6. Homes located within 600 feet and between 1,001 and 1,200 feet of the park were associated with significant positive effects. This study did not find any evidence of negative effects close to parks, although the positive effect was the least for urban parks among the five types of open spaces studied.

This study made two significant findings. First, that natural area parks produce the largest positive effects, which means that natural areas within urban parks are also likely to produce strong positive effects. Second, the study found a significant positive effect on home values located within 100 feet from the park, which was not observed in the earlier study. This provides some evidence that the negative effects were reduced by well designed parks.

Table 2.6. Distance variables evaluated at the mean open space for urban park

Distance (feet)	Value ($)
<200	1,926***
201-400	2,061*
401-600	1,193***
601-800	817
801-1,000	943
1,001-1,200	1,691*
1,200-1,500	342

Note: significance levels *.05, **.01 and ***.1

Discussion – The fact that natural area parks produced greater positive effects ($10,648) than urban parks ($1,214; Lutzenhiser and Netusil 2001) only reinforces the evidence obtained in the first part of the literature review that park attractiveness, aesthetics, size, greenery levels, children's play equipment, and active recreation areas effect home values. Early studies had observed the positive effect of parks on land values and on proximate properties and the decay of these park effects with increasing distance (Wonder 1964; Kitchen and Hendon 1967). Later studies constructed location curves to investigate the decay of park effect with distance.

Sophisticated studies in the past decade have dissected the location curves to precisely determine the decay of open spaces effects, in which parks were just one of the open spaces (Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001).

This dissertation conceived of park neighborhoods as areas around parks under the dominant influence of the park. In this areas park effect decays with increasing distance from the park. Submarkets are the "fault lines" for hedonic prices (Maclennan and Tu 1996); that is, marginal implicit prices for homes and decay of home values (slope of home values vs. direct distance) differ significantly across park neighborhoods. Therefore, the following two hypotheses follow -

H1 – Aesthetic experiences associated with parks increase proximate home values and noise and nuisance reduce them; therefore, it is hypothesized that specific park attributes will have a positive (e.g. open space, meadows) or a negative effect (e.g. playgrounds, picnic areas) on home values depending on the nature of experiences associated with them.

H2 – Park attributes and park neighborhoods affect proximate home values and their decay; therefore, it is hypothesized that the average home values and their decay (home value vs. direct distance slope) differs significantly across park neighborhoods.

Association between Park Neighborhood and Home Values

Arguably, statistical techniques were for the first used by Herrick (1939) to examine the effect of parks on real estate values in Washington D.C. Real estate assessed value was the dependent variable and park area and population density of cities were the two independent variables. The sample consisted of 85 largest U.S cities, which were based on population density, divided into five categories. The regression equation had the following form -

$$y = 32.5px + 1200p + 2000$$

where, y is the average assessed value of the real estate ($ per acre),

p is the population density, and

x is the park area in the city.

Within each category a positive association was found between the proportion of park land area and the real estate values. A separate regression equation was estimated for Washington D.C. Data from 1911 to 1937 was used and real estate value was again regressed on park area and population density to generate an equation that took the following form -

$$y = 0.0436px + 3.13p - 19.4$$

This equation was used to do a cost-benefit for the city of Washington D.C. for each year from 1911 to 1937. In these 27 years the net benefit was, tax increase ($ 68,833,314) – expenditure ($ 44,540,229) = $24,293,085. One percent conversion of city land to park area was expected to increase the real estate values by $ 43.60 per acre per person.

The purpose of the study was to determine the impact of parks on the net financial benefits to the city, but Herrick found that parks had a positive effect on both building and land values, although the effect was about three times more for buildings. This was one of the first attempts that showed that future studies should focus on homes, rather than land. A major shortcoming of this investigation was not accounting for multicollinearity (Ackerman and Goodrich 1940)

Using regression analysis to make the hedonic price operational in the 1970s, gave a powerful statistical tool to park researchers to separate home and neighborhood effects. Two related studies (Weicher and Zerbst 1973; Hammer, Coughlin, and Horn 1974) investigated the effect of the spatial orientation of homes on property values. The study by Weicher and Zerbst (1973) was a multiple park study and used five parks –Audubon, Kenlawn, Linden, Hauntz, and Westgate, in Columbus, Ohio. In contrast, Hammer, Coughlin, and Horn (1974) investigated a single park, the Pennypack Park, Philadelphia.

Weicher and Zerbst (1973) examined the effect of home spatial configuration, relative to parks, on property values. Three parks (Linden, Hauntz, and Westgate) faced homes with a street separating them from the park, while two parks (Audubon, Kenlawn) backed onto homes, separated only by a fence. Homes faced green areas in the parks except in two parks (Linden and Westgate), in which park buildings and recreation areas obstructed the park view. Three dummy variables were created for different spatial home configuration around parks - adjacent homes facing parks with a street separating them from the parks; adjacent homes backing onto parks; and adjacent homes facing high recreational use facilities.

The dataset consisted of single family home sales between 1965 and 1969 that occurred in park proximity (adjacent to and one block away). Homes had similar access to parks and the influence of other locational variables (e.g. distance from Central Business District) was controlled by selecting properties located close to parks. Home sale values were regressed against age of house, number of rooms, lot size, sale year, and distance to the park.

Table 2.7 gives the effect of home spatial orientation on home values. Park effects decayed with distance and houses facing parks sold between 7 and 23 percent more as compared to homes one block away from the park. The positive effect of parks on home sale values was felt only by homes facing parks. On an average, the sale value of homes facing parks (Westgate & Hauntz) was greater ($1,130). The other two spatial configurations sold for less - homes backing onto parks (Kenlawn & Audubon) sold for $169 less on average; and homes facing heavily used recreational areas (Linden) sold for $1,144 less on average.

Table 2.7. Effect of home spatial orientation around parks on property values

Park name	Home value –adjacent and facing park ($)	Home value -adjacent and backs to park ($)	Home value-adjacent and facing recreational area ($)
Westgate & Hauntz #1	1130		
Kenlawn & Audubon		-169.3	
Linden			-1144
Westgate & Hauntz #2	1609		-178.3
All park combined	3434	-1030	-1057

This study showed that property values were affected by both park-home distances and home spatial orientations. Additionally, this study also supports the inferences drawn earlier that high activity areas in park see a decline in sale values; most likely due to nuisance factors (e.g. noise and traffic). On the other hand homes facing attractive parks showed increase in values. The second significant contribution of this study was the finding that the effect of parks on single-family homes and apartments was different - apartments backing onto parks are less likely to feel the negative effects as compared to single family homes; implying that single family homes and apartments should be separately examined. One major shortcoming of the study was that only a few parks were used and the results could not be generalized.

The research design was also significant – focusing on properties, which were primarily affected by parks. In multilevel modeling a parsimonious model was estimated, which required that minimum number of locational variables to be included in the regression equation. This research design inspired the formation of buffers around parks to minimize for the influence of other locational externalities.

Hammer, Coughlin, and Horn (1974) examined the effect of the 1,294 acre Pennypack Park, Philadelphia, on 336 home sales after controlling for location variables. All the independent variable were dummy variables - 16 home attributes, 13 home sale variables, and four accessibility variables. The location variables consisted of park distances (network and radial) and home spatial orientation - on corner plots, abutting the park, and separated by a road. Using both linear and log form, this study found that home distance from park was significantly associated with home values ($R^2 = 0.82$). Homes located on corner plots and with a road separating them from the park showed a positive association with home values, but a negative effect was observed for homes with backyards abutting parks. The linear model explained the variation in sale values more efficiently than the log model. Using the linear model, location rent curves were created. The location rent was found to decay with distance - $1,171 at 40 feet from the park to $104 at 2,500 feet. Proximity effect on land value was also determined. Proximity accounted for 33% of land value at 40 feet from the park, 9% at 1000 feet, and 4.2% at 2,500 feet.

This study showed that the spatial orientation of homes with respect to the park effects property values and that the spatial effects existed only in close proximity to the park (maximum one block). The second major finding of this study was that roads separating homes and parks affect home values. This provides indirect evidence that the street network around parks is associated with home values.

This study also generated location curves and showed that the park effect decreased with increasing direct distance. However, a shortcoming of this study was that a single large park was used in the study and the location curves of multiple parks could not be explored. Moreover, the size of the parks was large and the effects associated with large regional parks were expected to be different from the proximity effect of smaller neighborhood parks.

Accessibility has multiple dimensions – geometric, social, and economic - and the geometric dimension has been the most investigated (Nicholls 2001). Park studies also have examined the effect of park location using the geometric approach, but detailed investigation of the network (travel) distance has been less studied. Miller (2001) did a detailed examination of the association between home values and travel distances in Dallas/Fort Worth metropolitan area. The natural log of the home sale value was the dependent variable and there were 29 independent variables consisting of home structural attributes, locational, and neighborhood characteristics. The final dataset contained 1,768 home sales transactions (1998 to 2000). Travel distances were measured using GIS from each property to a series of points on the park perimeter. The "difference between the actual travel and simple radial distance" was called detour. The detour was a proxy for street grid patterns and measured the indirectedness of the path to the park.

Table 2.8 gives the decay of park effect with travel distance. Nearly 75 percent of the amenity premium occurs within 600 feet from the park. The study found that proximate homes sold for 22% more as compared to homes located 0.5 miles away and the maximum impact of parks was felt within 600 feet of travel distance. Park effect rapidly decayed as distance from park increased and became insignificant at a distance of approximately 1,300 feet, the conventional five minute walking distance. The park's area of influence extends up to 800 feet. However, direct park-home distance showed a non-significant association with home values.

Table 2.8. Decay of park effect with distance

Distance from park (feet)	Percent premium (%)
100	22
300	13
500	8
700	4
1100	2

Compared to park size the effect of proximity was greater. Park size was positively associated with home values, one acre increase in park size led to 2.75% increase in home value, leading to the conclusion that numerous small parks, with a larger number of home located around them, increased neighborhood value more than a single large park. Dummy variables for the presence of activity amenities (e.g. soccer field, tennis courts) were insignificant. Relatively, high correlation with park acreage meant that park size was also capturing park attributes.

This study was significant for numerous reasons. First, this was one of the few studies that used the travel (network) distance and found that park effects were strong up to 800 feet. This is in accordance with contemporary evidence from planning literature (Boarnet 2006). Surprisingly, the direct park-home distance was not significantly associated with home values.

Second, this study attempted to include park attributes in the hedonic estimation. However, only ball game grounds were included and these characteristics showed non-significance. Most likely sampled parks did not have a range of attributes to detect significance (low power).

The study found that convoluted paths to the park reduced the value of park proximity and porosity of road network was significantly associated with home values. Roads along the park perimeter and larger number of sub-collectors reinforced park effects. Additional, useful insights were provided by the detour coefficient. The detour coefficient varied with park-home distance and was associated with the pattern of street networks around the park (e.g. homes at same distance but located on the diagonal vs. straight path of a gridiron plan). The study provided indications that indirect paths work against proximity and street and sidewalk porosity around parks effect home values, but did not investigate the moderating effects of network distance on park-home direct distances despite findings that indicated an interaction between the two.

This study restricted the dataset, which was also done by Bolitzer and Netusil (2000) earlier. The focus was on the neighborhood; therefore, parks with ball game grounds and swimming pools were excluded. Moreover, in order to isolate unique park effects, parks located near major streets and retail centers were not considered and incomplete transactions were removed. Finally, two category of homes were removed - homes located within 100 feet of the park to prevent short distance distortions; and the highest and lowest 10 percent sales values to reduce the range of values.

Confounding level-1 and level-2 effects and providing insufficient justification to use a linear detour coefficient were two major shortcomings of this study. In contrast to the Pedestrian

Route Directedness measure, (ratio of network distance to the direct distance), the linear detour coefficient, defined as the difference between the direct and network park-home distance, was used.

Anderson and West (2006) used hedonic estimation to examine the effects of proximity on homes sale values. Using neighborhood variables and examining their interaction with proximity made the study sophisticated. The dataset consisted of 24,862 single-family home transactions around multiple types of open spaces (1,825 neighborhood parks, 153 golf courses, 152 special parks, and 44 cemeteries) in the Minneapolis-St. Paul (Twin Cities) metropolitan area. Summary statistics are given in table 2.9.

Table 2.9. Mean values, standard deviations, and value ranges of selected independent variables

Variable	Mean	Standard deviation	Minimum	Maximum
Sale price ($)	142,322	98,300	1,000	4,300,000
Lot size (acres)	0.33	0.73	0.01	45
Finished area (square feet)	1863	890	99	35,000
Age (years)	38	28.63	1	148
Bathrooms (number)	2.10	0.90	1	9
Park-home distance (meters)	468.67	616.42	1	28,932
Park size (acres)	27.08	43.58	0.06	671.66
Density (persons per square mile)	4025.71	3187.65	18.90	29,104
CBD distance (meters)	14,514	8383	1181	38,945
Income (median in $ 1990)	43,132	13,992	4999	150,001

The dependent variable was the log of the sale price (1997) of single family homes in a block. The independent variables were - home-park distances, park size, lot size, home finished area, age, number of bathrooms and fireplaces. Neighborhood level covariates - density (persons per square mile), distance to CBD, median household income, crime (number of reported serious crimes per 1000 people), percent of population less than 18 years old, and percent of population aged years 65 and older – were controlled at the block group level.

Home-park distances and distance to CBD were computed using US Census land use data. Population density, median income and age composition were obtained from the 1990 U.S Census block group data and crime data was taken from the police department. Distance to parks was computed using GIS. To make interpretation easy neighborhood level covariates and park level variables were centered.

The elasticity of the sales price with respect to distance to park was computed. A negative value implied that the sales price and proximity were inversely related and the amenity had a positive effect on home values. Table 2.10 gives the change in sales price for every one percent change in independent variables.

Sales price of an average home increased by about 0.0035 percent for every one percent decrease in the distance to the nearest neighborhood park. The bottom half of table 4.10 gives the interaction effects. The negative signs in the interaction terms indicated that home values increase – in the case of denser (-0.006) and high income (-0.012) neighborhoods and neighborhoods having greater number of children (-0.0155); and the value of proximity to a park was diminished as distance to the CBD increased (+0.013). The result that park effect decreases with increase in park size (+0.0004) was contrary to earlier findings (Bolitzer and Netusil 2000).

Table 2.10. Change in sale price due to one percent increase in home structural variables

Home structural variable	Sign and percent change for every one percent change in home structural variable; and change in sales value with respect to park-home distance (home with average attributes) for interaction effects
Square footage	+ 0.50
Number of bathrooms	+ 0.08
Addition of fireplace	+0.05
Age of home	-0.13
Lot size	+0.09
Home-park distance	-0.003
Interaction terms	
Interaction of park size and home-park distance	+0.0004 (unexpected)
Interaction of density and home-park distance	-0.006
Interaction of income and home-park distance	-0.012
Interaction of children < 18 and home-park distance	-0.0155
Interaction of CBD distance and home-park distance	+0.013

Note: significance level is .01

The study had found that the sales price of an average home increased by about 0.0035 percent for every one percent decrease in the distance to the nearest neighborhood park. Decomposition of this elasticity is given in table 2.11. The negative sign shows that some households prefer to live farther away from parks, within a census block group, that is, some homeowners may desire to live farther away from parks while still enjoying the benefits of general proximity to parks.

Table 2.11. Characteristics of distributions of estimated elasticities of sales price with respect to park distance

Percentiles of distance from park	10	25	50	75	90
Elasticity	-0.0157	-0.0099	-0.0035	0.0029	0.0095
Mean	-0.0035				

One of the substantial contributions of this study was that the effect of the park-home distances is moderated by neighborhood characteristics (e.g. population density, income), which vary across urban areas. The proximity effect of neighborhood parks was enhanced three times if the neighborhood density increased by a factor of two; and four times if community income increased two times. In other words neighborhood characteristics have the potential to modify park-home proximity effects or simply that context matters. Accordingly, the study pointed to the presence of housing submarkets. The major shortcoming of this study was to combine different types of open spaces located in the inner city and suburbs, which may have led to contrary results, such as the inverse relationship between park size and park effect on home values.

Discussion – The first sub-set of park studies have examined the “hard” components of the neighborhood and their effect on home values. Weicher and Zerbst (1973) and Hammer, Coughlin, and Horn (1974) found an association between home spatial orientations and home values, including the presence of roads between homes and parks. Miller (2001) used travel distances to investigate park effects on home values. The detour coefficient, defined as the difference between the network distance and the direct distance, was found to be significantly associated with home values. Although, the effect of park-home direct distances on home values was found to be conditional on different values of the network distances (interaction effects), the interaction of the direct and network distances was not examined. Accordingly, the following hypothesis was formulated -

H3 – Park aesthetic experiences are dependent on park-home direct distances and park visitation is related to network distances; therefore, both direct and network distances affect home values, and it is hypothesized that the effect of park-home direct distances on home value (is moderated by) are conditional on the values of the network distances.

Investigation of the “soft” components (e.g. percent of adolescents and old, income, population density, crime rates) of the neighborhood is attracting recent research attention (Anderson and West 2006). Social capital is also one soft component of the neighborhood that is associated with economic outcomes (Woolcock and Narayan 2000; Woolcock 2001), but household preferences for social capital levels in park neighborhoods is little investigated. Furthermore, social capital is associated with neighborhood level revitalization outcomes, but the concept remains to be made operational to become useful to planners to design neighborhood revitalization plans (Rohe 2004). Accordingly, the next portion of this chapter reviews social capital theorizing to identify constructs and variables to be used in this research.

2.4. Park Neighborhood Social Capital and Home Values

Social capital as a metaphor was used nearly a century ago. The first recorded use of the concept of social capital is ascribed to L. J. Hanifan, in 1916, State Supervisor of Rural Schools, West Virginia. Later, Jane Jacobs and Glen Loury used the term to emphasize social ties. For

Hanifan (1916), social capital arose from the interactions among individuals, which led to individual and the community benefits. Jacobs (1969, 138) used the concept in the context of networks in city neighborhoods and their role in ensuring effective self-governance. Loury (1977) used social capital to explain the reduced access of black individuals to job networks (Loury 1977, 153-76).

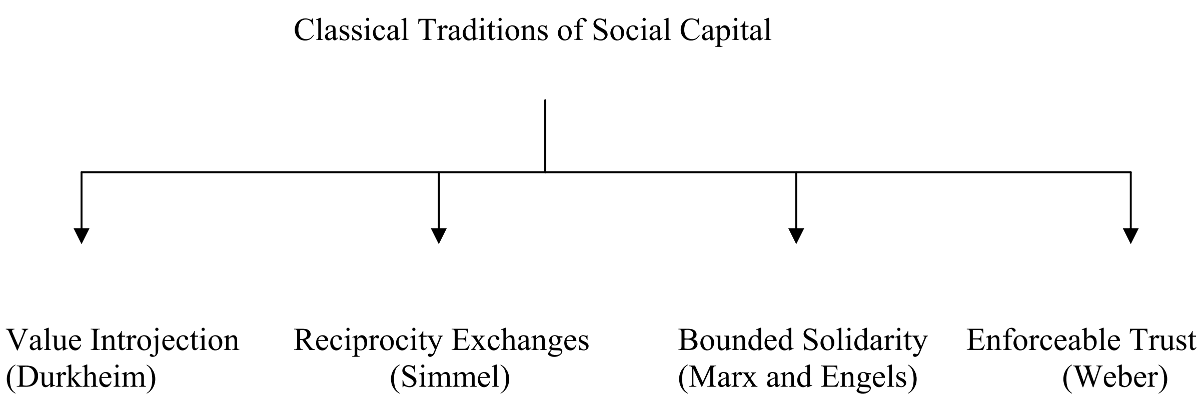

Figure 2.2. The origins of social capital based on classical traditions

The origins of social capital can be traced to four classical traditions (Portes and Sensenbrenner 1993), given in figure 4.2 which provide the conceptual foundations for the theorizing by Bourdieu, Coleman, and Putnam. Social capital is created in Value Introjection due to individuals acting according to values in the social structure, and not self-interest alone. In contrast, in Reciprocity Exchanges individuals pursue self-interest and obligations are accumulated as credit slips to be repaid later. Bounded Solidarity arises when a group faces a common issue and the individuals subsume their interest in the larger group interest. Social capital originates from a collective feeling of togetherness, not self-interest or reciprocity. Enforceable Trust arises as a result of individuals placing group interest above self-interest knowing that this is likely to pay off in the long run (Portes and Sensenbrenner 1993, 1322-27).

Accordingly, there is great diversity in the origins of social capital and this is reflected in the way social capital is conceived by principal theorists - Bourdieu, Coleman and Putnam. Table 2.12 gives the diverse positions held by the principal theorists on the origins, sources, and components of social capital.

Table 2.12.Diverse positions of principal theorists on important issues

Important issues	Bourdieu	Coleman	Putnam
Orientation	Value Introjection, Bounded solidarity: Institutional Marxist Sociology	Value Introjection, Reciprocity exchanges: Rational Choice in groups	Enforceable trust
Nature of social capital	Structural: Resources arising from social structure	Functional: Ties in social structure that produce advantage	Action that is assisted by social structure
Origins	Privileged position in society	Family and kinship ties	Community
Homogeneous or differentiated concept of social capital	Aggregate; negative for the under-privileged	Aggregate; does not deal with negative effects of social capital	Disaggregated: bonding and bridging social capital; acknowledges negative effects of social capital
Social capital as a public good: connected to trust and norms	Not a public good	Public good	Public good
Is the concept dynamic: accounts for loose and open social relations	Static	Partly dynamic	Dynamic
Level of analysis	Individual	Collective	Society
Exploration of gender issues	No	No	Cursory (Putnam 2000, 93-95)
Horizontal/Vertical networks	Horizontal	Horizontal	Horizontal
Closure or bridges in network		Closure	Initially closure; later bonding and bridging social capital
Quantifiable		No. Known only post-hoc	Yes

Bourdieu

During his exploration of inequality and hierarchy in society, Bourdieu (1986, 241-55) conducted the first methodical analysis of the concept of social capital. Social capital was defined as “the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition – or in other words, to membership in a group - which provides each of its members with the backing of the collectively owned capital”, a “credential” which “entitles them to credit, in the various senses of the word” (248-49). Social capital gives benefits to the possessor due to connections with the elite and requires efforts to transform fleeting relationships into more useful and beneficial relationships in the “neighborhood, the workplace, or even with kinship” (Bourdieu 1986, 249-50). The main shortcomings of Bourdieu’s approach were an overemphasis on kinship and social hierarchies and paying inadequate attention to social capital as a group resource.

Coleman

Coleman used social capital as a concept to explain cooperation among individuals, which was considered a deviation from the rational purposeful behavior of humans (Coleman’s 1988, 95-120; 1990, 300-21). Rational individuals intentionally create obligations because they are beneficial to the creator. Individuals help others at a time when the cost is not too high and the need by others is great. The calculation is that this assistance will be repaid, later, during times of a greater need of the individual. Thus a rational cost-benefit computation guides obligatory behavior.

Social capital is a resource that resides in the "structure of social relations" of a society, and assists the realization of interests that would, otherwise, be difficult to attain. Individuals, within the social structure use social capital to achieve goals; therefore, social capital is a type of resource available to individuals to pursue their best interests. Social organization has value if the individual can use the social structure to achieve ends.

Sources of Social Capital: There are three sources of social capital (Coleman 1988; 1990). The first source is the obligations, expectations and the trust that reside in the structure. If A helps B, then B is obligated to A to repay the assistance. In turn, this creates an expectation in A that B will repay the debt at a later date, that is, a "credit slip" is held by A. Social structures that contain more obligations possess more social capital. If A possesses a number of credit slips, A can always draw upon this resource when required. Moreover, the assurance that obligations will be repaid is determined by the trustworthiness of the social structure that obligations will be repaid. Therefore, social capital depends upon the number of credit slips held and the trust in the social environment, and different social structures are the result of different levels of trust contained in social structures and the number of credit slips held by individuals.

Some properties of social structures assist in the formation of social capital. One such property is closure of relationships within a social structure. A network closure occurs when the relationship is reciprocal, active, and is strengthened by mutual interactions, meaning that the relationship is not one-sided. The expansion of network closure permits resources from one relation to be shared by another, leading to the development of norms and trust within the social structure. The principle is that norms are effective if others in the social structure can see the impact of enforcement of norms. This only occurs if the impacts are known to all through network closure or mutual relationships. Similarly closure generates trust in social systems. Closure in a social structure, ensures that all actors know about non-fulfillment of obligations. This separates the trustworthy actors, from the untrustworthy, in the social structure (Coleman 1988).

The second source of social capital is the information contained in the social structure. Individuals, in order to act require information and if this is provided by social relationships then social capital is developed. Such relationships are different from the earlier form of social capital based on obligations - information in social networks does not lead to generation of credit slips. The third source of social capital is norms contained in a social structure. Norms, by rewards or sanctions, enforce or proscribe behavior.

The major shortcoming of Coleman's model was the over emphasis on the role of the family over other forms of social organizations (Field 2003, 26-28) and ignoring "weak ties" (Portes 1998). While dense ties may preserve existing outcomes, loose and distant ties that bridge are more useful when attempting new outcomes, such as searching for new jobs (Granovetter 1973; Lin 2001, 27). Moreover, Coleman mixed up the sources, consequences, and the social structure that provides the medium for the source and effects to become operational, ignoring the fact that there is a difference between membership of social groups and the resources an individual gets from such membership (Portes 1998, 4-5; Lin 2001, 27-28).

Putnam

Putnam (1993) formulated the concept of social capital during his study of the effectiveness of regional governments in Italy. In contrast to the South, communities in Northern Italy showed greater civic engagement that led to efficient institutional performance. These norms and networks were called social capital (16). Moreover, the norms of civic engagement had developed in the North due to historical traditions (179).

Putnam (164-71) defined social capital as: “features of social organization, such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions”. Therefore, social capital manifests itself in three forms - trust, networks, and reciprocity, and like other forms of capital was “productive”. Trust is an important element of social capital in impersonal large groups. Economic growth and institutional performance were seen in regions of Italy that had reservoirs of “social trust”. In societies trust enforces contracts, thus, performs the role of an external monitor.

Development of Social Capital – Figure 2.3 gives a simplified sequence of development of social capital (Rohe 2004). Participatory activities and association membership lead to formation of dense networks of civic engagement, norms of generalized trust, and generalized reciprocity. Generalized trust and cooperation occur between individuals even when they do not know one another.

Trust and cooperation interact - “trust lubricates cooperation” and “cooperation breeds trust”. Trust leads to cooperation by making the responses of actors predictable. In small groups “thick trust”, that is, trust based on personal knowledge of other actors in the group facilitates anticipation of the responses of group members. In large, impersonal groups personal trust is converted to social trust from "norms of reciprocity" (171-72).

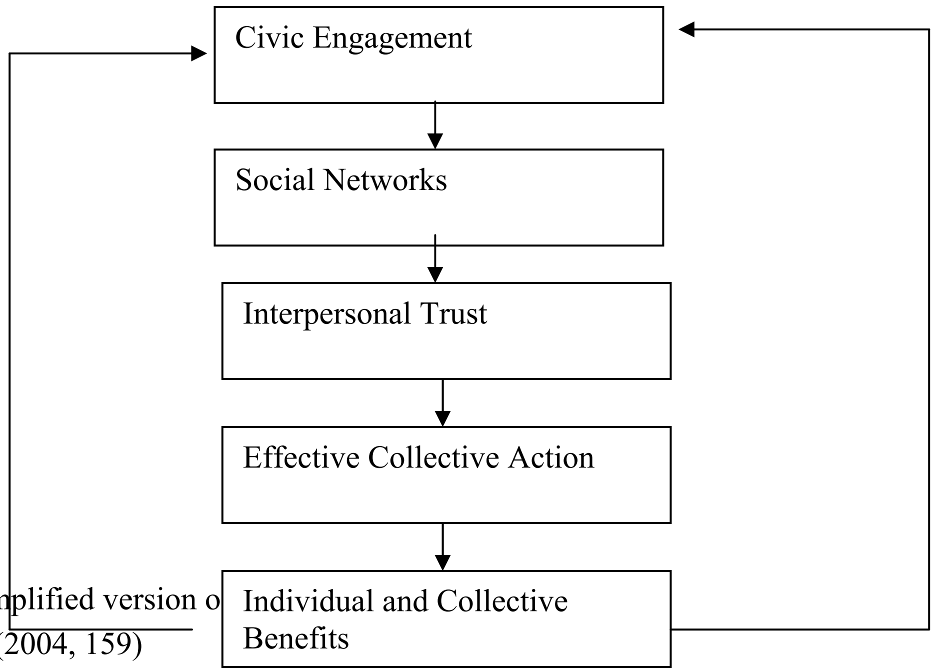

Figure 2.3. Simplified version o
Source: Rohe (2004, 159)

The norm of reciprocity prevents expedient behavior and "resolves problems of collective action". There are two types of reciprocity - specific, in which the exchange takes place immediately and the items exchanged are of equal value; and generalized reciprocity, in which the value of exchange is unequal and repayment is done later; therefore, generating a feeling of expectation (172). Generalized reciprocity is "more efficient than a distrustful society, for the same reason that money is more efficient than barter" (Putnam 2000, 21). In trusting societies individuals are confident that obligations will be repaid and expectations fulfilled, which promotes individual interactions. Over time such frequent exchanges lead to the development of the norm of generalized reciprocity. Therefore, social capital, in the form of trust and reciprocity, is found in "pre-existing social networks" (171-72).

Later Putnam (1995; 2000) modified the definition of social capital -"social capital refers to connections among individuals-social networks and the norms and trustworthiness that arise from them" (19). The change in the conceptualization is noteworthy – trust now arises from social networks and norms, such as reciprocity.

The main criticism against Putnam was that he only developed a framework and not "a complete theory of the origins, maintenance, transformation, and the effects of social capital" (Levi 1996, 52). Moreover, Putnam's argument was circular - social capital was both a cause and an effect. Social capital led to desirable outcomes such as economic development, and its presence was also known from these outcomes (Portes 1998, 19).

Discussion

There is no consensus on a single theory of social capital and social capital concepts, constructs, and variables are selected based on the approach of the investigator and the objectives of the study (Edwards, Foley, and Diani 2001). All the theorists accept social capital to be a metaphor, which gives competitive advantage to individuals and groups. However, the consensus disappears once the discussion enters the sources, components, and outcomes associated with social capital (Burt 2002, 148). The first issue is the form of social capital, which is expected to lead to positive effects on values of homes in park neighborhoods. The omnibus approach of the World Bank includes "institutions, relationships, and norms" (World Bank 2006). In contrast, the sociological perspective gives importance to social networks and greater complexity is introduced when cognitive elements are included in the social capital concept. In fact, some argue that that the use of the word capital is inappropriate because social networks are built by participants primarily for non-economic reasons - generating trust or reputation is not the same as building the physical investment (Arrow 2000, 3-5; Solow 2000). However, now numerous forms of capital are recognized - financial, physical, human, cultural, and social (Halpern 2005, 29-31; Light 2004; Lin 2001, 3-18; Woolcock 2001, 12).

Contemporary social capital theorizing is focusing on social networks and associated norms (Putnam 2004, 142; Woolcock 2004). Consensus also exists that there are two types of networks - bonding and bridging (Woolcock and Narayan 2000, 227; Putnam 2004, 143; Briggs 2004, 152-53; Vidal 2004, 165-66; Woolcock 2004, 186), which correspond to the "strong" and "weak" ties of Granovetter (1973) and "social support" and "social leverage" of Briggs (1997; 1998).

Gittell and Vidal (1998, 14-19) coined the terms bridging and bonding social capital. Bonding social capital promotes exclusive identities, gives precedence to the group over community, and promotes specific reciprocity. Bridging social capital is outward looking, promotes acquaintances with different and distant people, and leads to generalized reciprocity. Bonding and bridging capital are not interchangeable, though some groups may act along both these dimensions of social capital. Bonding and bridging ties are likely to develop if households in a park neighborhood engage in community affairs. This can happen by frequent participation and leadership in local group activities and involvement in non-faith based associations (e.g. neighborhood associations, parent associations). In addition to the relationships generated by formal social ties, informal interactions (e.g. inviting friends over to home, hanging out with friends) are also expected to lead to higher levels of social capital; therefore, this research tests the relationship between neighborhood networks and household preferences for homes.

Networks are a necessary, but not a sufficient condition for social capital to lead to beneficial outcomes for individuals. Positive outcomes do not automatically result from social interactions alone, but neighborhood ties lead to beneficial outcomes for residents only if trust develops as a result of such interactions (Rohe 2004). Therefore, in addition to social interactions in park neighborhoods household preferences for different levels of trust in park neighborhoods was also investigated.

Finally, social capital occurs at multiple levels; therefore, can be measured at the individual, neighborhood, city, region or national levels. The sociological perspective conceives of social capital to be an individual construct, and accordingly, measures it at the micro level (Portes 1998; Edwards, Foley and Diani 2001, 266-80; Woolcock 2005, 220-21). Health researchers measure social capital at the community level (Lochner, Kawachi and Kennedy 1999) and Fukuyama (2000) conceives of social capital to be a national level resource. Therefore, social capital occurs at multiple levels - individual, family, group and societal level (Briggs1997, 112) – and can be measured at multilevels. Again, the level at which social capital is measured depends on the approach of the investigator and the objectives of the study.
There are two dominant approaches to measure social capital - network analysis or Putnam's indicators. The focus of network analysis is on the individual (Portes 1998). However, social capital in this research was conceived to be a neighborhood level construct; therefore, Putnam's approach, which treats social capital to be a multilevel construct was best suited for this research.

Specifically, Putnam's indicators were used to evaluate household preferences for different trust levels and extent of bonding and bridging social capital in park neighborhoods. Accordingly, the following hypothesis was formulated –

H4 – Social networks and trust in park neighborhoods confer advantages on households; therefore, it is hypothesized that park neighborhoods with greater levels of social trust and associational activity have greater home values.

Chapter III

METHODS

This chapter describes the research design, setting of the study, variables used, procedures of data collection and preparation, diagnosis conducted, statistical analysis applied, and the methodological limitations. This research used a multilevel posttest research design; therefore, the first part of this chapter describes the nature of the dataset and the need for a multilevel research design. After discussing the advantages of the multilevel research design, the second part justifies the selection of Cincinnati parks as the study area. In the third part, I describe the elements and usage of the EAPRS tool followed by a discussion of the variables in the fourth part. The fifth part of this chapter deals with data collection and preparation. Data collection included evaluation of park attributes using the EAPRS tool, which was done between June and August 2007. The sixth part describes the residual diagnostics conducted and finally the seventh part describes details of models estimated, and the datasets used.

3.1. Research Design

This dissertation research used a quasi-experimental cross sectional research design to analyze the effects of parks on residential property values. The data structure was multilevel –

homes nested in parks; therefore, a multilevel research design was used. Semi-random sampling was done to select parks and homes located around these parks. Park and home level data collected in 2005-06 was used. However, park attributes were evaluated in 2007 and the assumption was that park features remain stable over short time periods.

Advantages of Multilevel Models

The review of park literature in Chapter II showed that the variance in home values around parks is an outcome of home level and neighborhood level variables. To model variables measured at multiple levels, the multilevel model offers technical and conceptual advantages over multiple regression analyses and ANOVA approaches (Draper 1995). While multiple regression analysis was unsuitable because of the problem of spurious significance and inferential fallacies, ANOVA also had certain disadvantages. In ANOVA a set of dummy variables is used to represent parks to which a home belongs. If there are N parks to be compared, then the park effects are captured by N-1 parameters. This study investigated 26 parks; therefore, a large number of parameters were likely to be estimated. In contrast, in multilevel models only one additional parameter, the between-park variance, was estimated irrespective of parks number. Moreover, ANOVA techniques do not allow inferences to be made beyond the parks in the sample. In this research the interest was in the population of parks from which our sample was drawn. The random variable in the random effects model in multilevel models permitted to treat the sample of parks as coming from a population of park units. Furthermore, multilevel models allowed exploration the extent to which inter-park (level-2) variation was explained by observing level-2 characteristics, which was the primary research question in this research. In ANOVA, the level-2 variables are confounded with level-2 effects, which do not permit examination of the extent to which level-2 variation can be explained by observed level-2 characteristics (Luke 2004; Steele and Goldstein 2007).

Multilevel Model Specification

Multilevel models require parsimonious specification with minimum number of independent variables derived from theory and literature (Hox 2002; Tabachnick and Fidell 2007). Multilevel data was modeled at two levels (home and park neighborhood). In multilevel modeling a large number of coefficients are computed and interactions estimated; therefore a trade-off was made between large unstable models and unrealistic parsimonious models. Large models are unreliable (small changes in model lead to large change in results), because of the increased possibility of correlation among predictors, including cross-level interactions. Too many predictors also lead to model convergence and interpretation problems, and generally literature suggests specification of small models based on theory or empirical evidence (Kreft and de Leeuw 1998; Hox 2002; Tabachnick and Fidell 2007, 786). Therefore, the challenge was to design an unbiased study with a minimum number of independent variables.

The minimum number of home structural attributes was used in model estimation. Sirmans, Macpherson, and Zietz (2005) reviewed approximately 125 hedonic studies and found that among the most frequently used home structural characteristics were - home age, finished area, lot size, garage, fireplaces, bedrooms, bathrooms, swimming pools, and basements. Among these the most common attributes were – lot size, finished area, age, number of bathrooms and number of bedroom – and these were used to estimate multilevel models. Bathrooms were preferred over bedrooms because bedrooms show up negative in some studies, but bathrooms never do so.

Park studies have also used restrictive datasets (Bolitzer and Netusil 2000; Miller 2001), and non-park studies also showed that one way to restrict the neighborhood determinants of home values was to sample residential properties in “spatially concentrated areas” (Thibodeau 2003). Accordingly, the twin objectives of identifying housing submarkets and estimating parsimonious models were met by conceiving of a park neighborhood.

Park studies have found that the park effect reduces with increasing distance from park and becomes negligible at around 1500 feet, and the maximum effect is only up to 600 – 1000 feet (Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001; Espey and Owasu-Edusei 2001; Miller 2001). This means that homes located within 1000 feet of the park were under the dominant influence of the park and some locational and neighborhood variables could be excluded, without introducing bias into the study.

Moreover, studies have found that homes located close to parks (100 feet) are influenced by other non-park related variables – spatial orientation of homes (Weicher and Zerbst 1973; Hammer, Coughlin, and Horn 1974) and negative park externalities operating in park proximity (Li and Brown 1980; Bolitzer and Netusil 2000; Espey and Owasu-Edusei 2001); therefore, homes within 100 feet of the park boundary were also excluded. Such a research design was also used by Miller (2001). Finally, to identify the unique park effects, homes that were under the joint influence of two or more parks were deleted from the analysis.

3.2. Setting and Environment

The study area was the City of Cincinnati, Hamilton County, Ohio (2006 est. pop. 331, 310; 49,898 acres; Cincinnati is the county seat of Hamilton County). Investigation of parks in Cincinnati builds on the ongoing research in the School of Planning, University of Cincinnati (Sharma and Auffrey 2006; Sharma 2007). In his Master's thesis, Sharma (2007) had found that home values were positively associated with neighborhood walkability and attractive children's play equipment; and negatively with field and court items. However, the Master's thesis had quantified only three park elements and combined level-1 and level-2 variables into one regression equation. This dissertation research, by evaluating all park elements and using multilevel modeling techniques, attempted to address the limitations present in the Master's thesis.

The Cincinnati park system is in many respects typical of the park systems in the United States. The population density in Cincinnati (6.6 per acre) is located near the mean (1/2 standard deviation) of the population densities of the largest 60 U.S cities ($\mu = 8.0$; $\sigma = 6.9$). Moreover, the atypical features of the Cincinnati park system were also advantageous to this research - Cincinnati spent nearly $ 139 annually per resident, which was the 7th highest expenditure among all US cities (μ = $89); Cincinnati stood first in having the largest number of park units (11 per 10,000 residents); and the greatest number of playgrounds per resident (4.8 per 10,000; Center for City Park Excellence: The Trust for Public Land 2006).

Moreover, in Cincinnati park lands are managed by two agencies - Cincinnati Park Board (CPB) and the Cincinnati Recreation Commission (CRC). These two organizations develop parks to achieve different recreation purposes – CPB concentrates on promoting passive recreation and the CRC on active recreations (Schuckman 2006). This provided a setting to investigate the differential effects of passive and active recreational facilities on home values. Such an administrative arrangement is also found in numerous other U.S cities (42 of 60; CCPE: The Trust for Public Land 2006); although the Parks and Recreation departments in the U.S are divided on four criteria – activities, geographic area, target groups, and facility type, and the most useful type is the bifurcation based on facility type (Wilder 1981).

3.3. Research Instruments

A survey of the built environment in parks was done in July and August 2007 using the EAPRS tool developed by an inter-disciplinary team in the University of Cincinnati (Saelens et al. 2006). The EAPRS instrument is a comprehensive tool to evaluate the physical environment of parks and playgrounds, which focuses on the functionality of park elements or the usability of the park element. The EAPRS tool has two dimensions – park elements and park qualities Table 3.1 gives a summary of the EARPS tool. Park elements consist of - trails and paths, use areas (e.g. open spaces, shelters), water areas, other amenities and facilities (e.g. vending machines, benches), and play equipment/fields/courts, which were rated on a dichotomous scale as present/absent and counted if possible. Components of elements (e.g. lighting on trail), called sub-elements, were assessed to be present/absent and were usually countable.

The second dimension evaluated during the field visits were the qualities associated with park elements (e.g. cleanliness, aesthetics), which were observable, but were often uncountable (e.g. condition of trails). Qualities were rated on Likert-type scales. For instance, if pathways were evaluated, the PEX scale was used to assess the condition (1=poor, 2=fair, 3=excellent); the NATE scale was used to evaluate cleanliness (1=not at all, 2=somewhat, 3=mostly to extremely); and the PER scale was used to appraise the coverage/shade (1=0-33%, 2=34-66%, 3=67-100%).

Generally, the inter-rater reliability is best for observational instruments, such as the EARPS tool. The inter-rater reliability of the individual item scores, for all items, was assessed in small (< 5 acres), moderate (5 – 50 acres), and large (> 50 acres) size parks, in three areas - urban (> 12 households per residential acre), urban periphery (3.0 to 11.99 households per residential acre), and suburban (< 2.99 households per residential acre). Items with dichotomous values (yes/no) were evaluated using the kappa statistic. The number in the high reliability category was - 65.6% of the 506 items. High reliability was found for presence/absence and specific quality items across park areas and features. However, cleanliness/aesthetic items had lower reliability (Saelens et al. 2006). In an e-mail to Chris Auffrey on October 09, 2007, Brian Saelens has reported an inter-rater reliability of 0.87 (Annexure 1).

Table 3.1. Summary of the EAPRS tool

Element	Rating	Scaling
Trails	Yes/No	PEX, NATE, PER
Paths	Yes/No	PEX, NATE, PER
General areas (open spaces, meadows, wooded areas)	Yes/No	SIZE, PEX, NATE, PROX
Water areas (ponds, lakes, streams, creeks, pools, fountains, beach areas)	Yes/No	NATE, PEX, PROX
Eating/Drinking features (drinking water fountains, grill/fire pits, picnic area, vending)	Yes/No	PEX, NATE, PROX
Facilities (restrooms, shelters/pavilions, gazebos, stages)	Yes/No	NATE, PEX, PROX,
Educational/historical features (historic markers/ monuments)	Yes/No	NATE, PEX, NOAL
Sitting or resting features (non-trail – benches, tables, seat walls, bleachers)	Yes/No	PEX, NOAL, NATE, PROX
Landscaping (flowers, shrubs, beds)	Yes/No	NATE, PEX
General aesthetics (outside view, sculpture/art, area surrounding park, trash cans, wildlife areas)	Yes/No	NATE, PEX, PROX
Access related features (entrances, bike racks, parking lots, sidewalks adjacent to park, roadways through park)	Number, Yes/No	NATE, PROX, NOAL, PEX
Directives and information-related features	Yes/No	NATE, PEX,
Safety-related features (telephones)	Yes/No	NATE, PROX
Play set or structure features (general play set, ground surface) and other play components	Yes/No	NATE, PROX, PEX
Athletic and other recreation areas	Yes/No	NATE, PROX, NOAL, PEX

Note: PEX–1=poor, 2=fair, 3=excellent; NATE-1=not at all, 2=somewhat, 3=mostly to extremely; NOAL-1=none at all, 2=some, 3=a lot or all; PER-1=0-33%, 2=34-66%, 3=67-100%; PROX-1=<25 ft, 2=25-50 ft, 3=51-100 ft, 4=10-200 ft, 5=>200 ft

One limitation of the EAPRS was that the ratings were biased towards optimal functionality, which may not happen in actual practice (e.g. rating depends on the number of restrooms on a trail- a restroom would be rated even if there was a single restroom on a six mile trail). The second limitation noted by Saelens at al (2006) was that the tool evaluates the usability of an element, but does not actually observe the usage of the element by a user. In fact, this is actually an advantage for this research because the hedonic price model estimates the willingness of the home buyer to pay a marginal implicit price for an attribute and home buyers look at the usability of park attributes.

Unlike EAPRS, the Bedimo-Rung Assessment Tool (BRAT; Bedimo-Rung at al. 2006) is comprehensive instrument to evaluate park features that are related to physical activity and consists of five evaluative components – direct observation (BRAT-DO), informant interviews, aerial photography, GIS, and archival data collection. Only the first part (BRAT-DO), which evaluates 181 physical park characteristics, was relevant to this research. The BRAT-DO evaluates five park conditions – access, condition, esthetics, features, and safety; in the following geographical areas – target areas (mutually exclusive areas of parks determined by observers; 85), street items (13), court items (26), green space items (4), path items (11), playground items (21), and sports field items (21). The evaluation process consists of four steps– observing the presence/absence of elements (e.g. structure on a playing field), completing a five point Likert-type scale (e.g. how much graffiti), selecting from multiple choices (e.g. type of surface under play equipment), and narrating facts (e.g. speed limit).

Inter-rater reliability was tested by calculating percent agreement among observers. Fifteen teams of observers in two large regional parks (400 and 200 acres) evaluated park features giving a total of 15 pairs of observations for each feature. The inter-rater reliability for different domains was – access = 88.2%; condition = 85.1%; aesthetics = 83.7%; features = 91.9%; and safety = 85.6%. All the domains exhibited high overall agreement (86.9%) and the least was for aesthetics. The geographic areas also exhibited an overall 87.5% agreement. The BRAT-DO also suffers from several drawbacks – (1) inter-observer agreement method, as compared to index of agreement (Cohen's kappa), did not account for agreement due to chance; therefore, may have overestimated the true agreement, (2) estimation of items, such as amount of shade showed poor results, (3) the association of the variables with theoretical domains was derived from a conceptual model, which is yet to be tested, and (4) the instrument was tested for large regional parks, not neighborhood level parks.

Both the tools, EAPRS and BRAT, show high inter-rater reliability for park physical features except for aesthetics and physical conditions. The EAPRS instrument was preferred in this research because of the following reasons - (1) the EAPRS tool focuses on evaluation of park physical attributes, while the BRAT is more comprehensive, (2) the BRAT is still in the process of development – the scales are yet to be developed, (3) the EAPRS instrument is more reliable for smaller sized parks, which is more relevant for this research, and (4) the EAPRS tool was developed locally and was used in my Master's research.

3.4. Research Variables

Hedonic models have used both the home sale values and the assessed values as the dependent variable. This study uses the assessed values taken from the Hamilton County

Auditor's website. The primary reason to select the Auditor's assessed value over the actual sale value was that the single-family home price index was available only at the Metropolitan Statistical Area (MSA) level, and therefore, did not account for the unique market conditions prevailing at the neighborhood level, which was required to investigate housing submarkets and determine precise park effects on home values. The following sub-section shows that using assessed values are unlikely to make the study biased.

The research design was cross sectional; therefore, actual home sale values had to be standardized to the current year (2005) by using home price indices. Generally, two indices are available – (1) the standardized home price index (HPI) published by Office of Federal Housing Enterprise Oversight (OFHEO), which tracks single-family house prices, and (2) the home indices available in the Consumer Price Index (2007). The HPI was a better home price index, because of the breadth of the sample of single-family homes covered; it provided more information than is available in other house price indexes. In fact, this was also confirmed in a personal e-mail communication received from Professor Norman Miller, University of Cincinnati Business School (Norman Miller, July 22, 2007, e-mail message to author, Annexure 2).The HPI uses data from Fannie Mae or Freddie Mac to measure the average price changes in repeat sales or refinancing on the same single-family properties since January 1975. The lowest geographical area was the MSA and data for some MSAs was also available at the Metropolitan Division level, but for Cincinnati information was available at the MSA level only (Consumer Price Index 2007; Office of Federal Housing Enterprise Oversight 2007).

The main drawback was that the HPI index was only available at the MSA level, and therefore, did not account for the unique market conditions prevailing at the neighborhood level, which was a critical requirement for this research. On the other hand, the Hamilton County Auditor's assessed values took into account the unique conditions prevailing in the home submarkets in the neighborhood once every three years. Moreover, assessed values were available for a larger number of homes (3798 vs. 2757 around 26 parks). Finally, meta-studies have shown that no systematic errors are introduced by using assessor generated home values (Sirmans et al. 2006); therefore, assessed home values used in this research are expected to lead to random errors only.

Using assessed values was unlikely to introduce bias because of the high bivariate correlation (Pearson's = .907) found between the assessed values and home sale values (adjusted to 2005) for the 2757 available home sale values. Table 3.2 shows that means, standard deviations, and skewness of the adjusted sale values and the assessed market values. Larger values of the coefficient of variation for assessed market value (C_v = 1.042) as compared to adjusted sale values (C_v = 0.904) indicated that assessed values were capturing the unique neighborhood effects more accurately.

Figure 3.1 gives the scatter plot of the assessed values versus the sale values (adjusted to 2005 prices). The data labels show the age of the outliers. Most of the outliers pertain to older homes. This was expected due to way the index is set up – as the number of years from the base year increases the index adds a disproportionate amount to the actual sale value.

Table 3.2. Means, standard deviations, and Pearson's correlation coefficient for assessed

market values and adjusted sale values (2005)

Sale value	Mean	Standard deviation
Assessed value ($)	129,895	135,368
Adjusted sale value ($)	137,954	124,766
Pearson's Correlation (2-tailed) = .907** (N = 2755)		

Note: ** p < .01

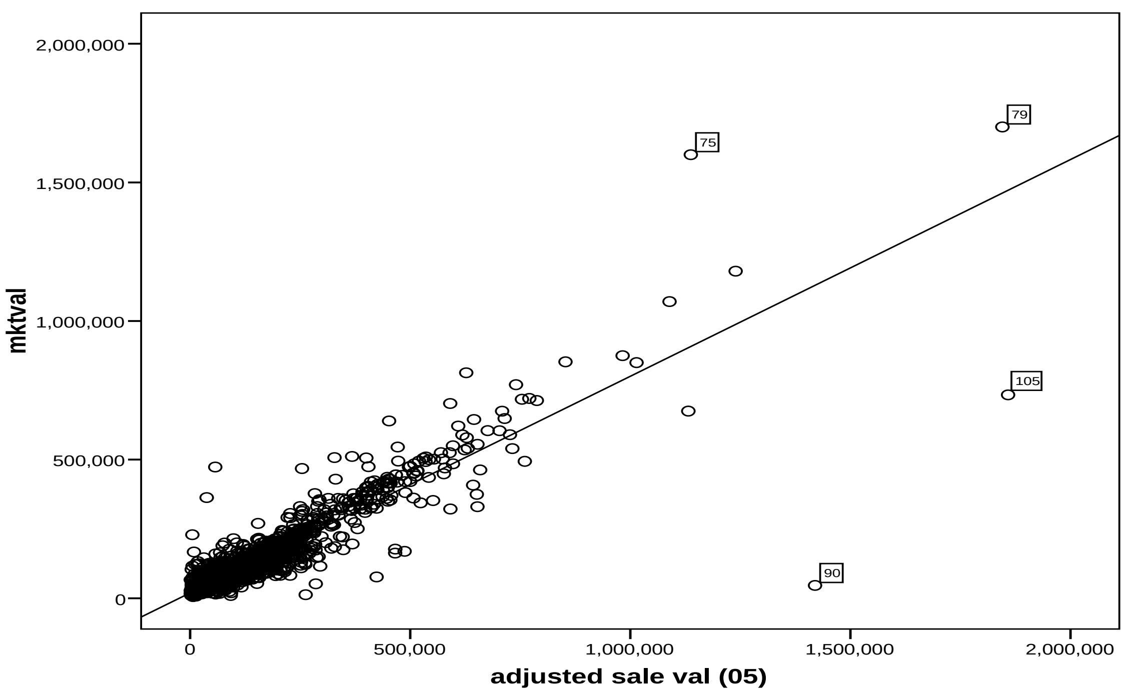

Figure 3.1. Scatter plot of assessed sale value versus market sale value adjusted to 2005

Independent Variables

A parsimonious multilevel model with minimum level-1 predictors was specified. Table 3.3 gives the details of the independent variables used and the levels of measurement. There are different ways of categorizing independent variables in the hedonic price model. The structural-locational-neighborhood (SLN) grouping system is the most common. Home structural attributes are the properties of the home and the parcel on which the home is situated. In turn, home structural variables can be categorized into two groups (Follain and Jimenez 1985) –living space (e.g. number of rooms, bathrooms, finished area) and structural quality (e.g. home age, fireplaces, and quality).

Table 3.3. Independent variables used and the level of measurement

Level of Hierarchy	Type of variable		
	Home structural	Locational	Neighborhood
Level -1	Finished home area, lot size, home age, and number of bathrooms	Park- home direct distance and network distance.	
Level -2 (park neighborhood)			Social capital indices, neighborhood income, and park attributes.

Table 3.4 shows the type of independent variables used in park studies. Nearly all park studies have used the following variables – lot size, finished area of homes, number of

rooms/bathrooms, and home age, which also account for the maximum variance in the model. Accordingly, three measures of living space – lot size, finished area, and number of bathrooms, and one of structural quality – home age were selected. Bathrooms were preferred over bedrooms because they a more unique representation of home characteristics - larger homes generally have more bedrooms, but the number of bathrooms is a matter of individual taste.

Locational attributes and neighborhood characteristics measure externalities. Locational attributes are level-1 characteristics and affect each property uniquely. In this research two locational attributes were used – park-home direct distance (as the crow flies or the aerial distance) and park-home network distance (actual travel path), which was used as a proxy for walkability. Unlike locational attributes, neighborhood characteristics affect all the properties in the area (Follain and Jimenez 1985; Dubin and Sung 1990). These are measured at level-2 and are the "micro-neighborhood" effects (Li and Brown 1980) or the park neighborhood effects in this research. Neighborhood income, park attributes evaluated using the EAPRS tool, and the social capital indicators developed by the Saguaro Seminar (2000) made up the neighborhood level variables in this study.

Table 3.4. Types of independent variables used in park studies

Author (date)	Dependent variable	Type of independent variable		
		Structural	Locational	Neighborhood and park related
Herrick (1939)	Assessed land and improvement values	Population density and park area in city		
Wonder (1965)	Assessed property value		Distance in terms of blocks	Socio-economic characteristics controlled
Kitchen and Hendon (1967)	Sales and assessed (land and total)		Properties within 21/2 blocks	Controlled by limiting sample to proximate properties
Hendon (1973)	Assessed land values and total value		Systematic sampling- properties selected in every other ring of properties to the point where parks were equidistance to other value determinants	Controlled by forming quadrants and selecting proximate properties
Hendon (1974)	Assessed land and property		Systematic sampling-rings around properties	Controlled by forming quadrants and selecting proximate properties
Weicher and Zerbst (1973)	Sale prices of homes	A, R,S, dummy variables for home distances	Single-family homes located adjacent and one block away from parks. Dummy variables for different spatial home configurations homes	Some controlled
Hammer, Coughlin, and Horn (1974)	Home sale values	Dummy – 16	Dummy – distance, home position- corner homes, abutting park, road separating houses from park -4	Some controlled

Table 3.4 (continued)

More, Stevens and Allen (1988)	Home sale values	A, L, R, B, S, F, G,C, Y	Home-park and home-CBD distance	Park district, property tax rate
Bolitzer and Netusil (2000)	(1) sale values (2) sale values greater than assessed values	A,B,F,L,S,	Home-park distance, distance to CBD	Traffic
Lutzenhiser and Netusil (2001)	Home sale values	A,S,L,B,F	Homes within 1,500 feet, distance to CBD	City district, Traffic
Espey and Owasu-Edusei (2001)	Home sale values	Not reported	Homes within 1,500 feet	Attractive and unattractive small and medium parks, home median income,
Miller (2001)	Home sale values	A, S, L, B, F, P,	Distances-park, radial-network (detour), school, freeway, airport, CBD	Park size, park visibility measured by percent road bordered by roads, average pass percentage in junior high school
Anderson and West (2006)	Log of home sales price	A, B, L, S, F, Y	Park-home distance, home-CBD distance	Park size, density, income, children under 18 and adults over 65

Note: A-home age, R-rooms, B=bathrooms, S-finished area, L-lot size, F-fireplaces, G-garages, C-home condition, Y-sale time, P-swimming pool

Walkability –Table 3.5 lists the accessibility measures used by researchers in several disciplines. Different accessibility indices measure common and some unique characteristics of the built environment (Dill 2004). The choice of an accessibility measure depends on the research design and the hypotheses to be tested. Here the purpose was to investigate the moderation effects of walkability on direct distance, and accessibility was conceived to be a measure of walkability - the ease of reaching the park by individual households or a "measure (of) the relative opportunity for interaction or contact with a _ _ _ park" (Gregory 1986; Nicholls

2001). Accordingly, the walkability measure is a household level variable, and only the Pedestrian Route Directedness (PRD) index meets the requirement. However, this study tests the interaction between the direct distance and walkability and the PRD denominator contains the direct distance; therefore, PRD was likely to lead to multicollinearity and difficult to interpret results. Accordingly, the park-home network distance, which was the most direct and simple measure to evaluate the ease of walking to the park was used.

Traditionally, planners have assumed that individuals are willing to walk one-fourth mile (1320 feet) to reach destinations (e.g. transit locations, shops; Untermann 1984). However, contemporary empirical evidence indicates that this distance may be overestimated and the actual preferred distance may be closer to on-eight mile (Krizek and Johnson 2006). Accordingly, the moderation effects of walkability was assessed by converted the network distance to an ordinal variable having three categories – park boundary to on-eight mile (1 = 100 – 660 feet); one-eight to one-fourth mile (2 = 660 – 1320 feet); and beyond one-fourth mile (3 > 1320 feet).

Table 3.5. Measures of walkability using built environment dimensions

S. No	Measure	Units	Connection to Walkability
1	Block length (mean)	Feet	Shorter blocks means more intersections, resulting in shorter distances and alternative routes
2	Block size (mean area/median perimeter)	Acres	Ambiguous
3	Block density[a]	# of census blocks per square mile	Proxy for connectivity – more blocks means smaller blocks and more intersections.
4	Intersection density[a]	# of intersections per unit area	More intersections indicates higher connectivity
5	Street density[a]	Number of linear miles of streets per unit area	More streets mean more connectivity.
6	Connected Intersection Ratio/ or Percent four-way intersections	# of street intersections / number of intersections plus cul-de-sacs (maximum value = 1.0)	Higher values, few cul-de-sacs, therefore higher level of connectivity
7	Link-Node Ratio	# of links/ # of nodes within the study area (perfect value = 2.5)	Ambiguous. Higher ratios mean more connectivity, but the additional routes created by the higher ratios may not be shorter and the ratio may not represent length of links
8	Percent Grid	Percent of area covered by grid street pattern, as measured by four-way intersections	Gridded network mean more connectivity
9	Pedestrian Route Directedness (PRD)	Ratio of network distance to radial distance between two points (best value = 1)	Direct routes represent more connected routes
10	Effective Walking Area	# of parcels within, say half mile, walking distance of a node / total # of parcels within half mile radius of the node (values range from 0 to 1)	More parcels within walking distance of a given point shows a more connected network
11	Network distance	1320 feet (1/4th mile)	Planners have used one-fourth mile as a standard as the distance individual are willing to walk

Note: [a]Highly correlated
Source: Adapted from Dill (2004)

Park attributes - This research used the EAPRS tool to evaluate park attributes. The objective of this research was to determine the effect of park characteristics on home values. Therefore, only nine elements in the EAPRS tool - *b, c, d, e, f, h, i, no*, and *p*, which were expected to influence home values were used. Children's play elements *n* and o were combined because the two elements were evaluating the same park attributes – one within the play set area and the other outside. Table 3.6 gives the details of the park elements, sub-elements, and park qualities used in the research.

An exploratory factor analysis was done separately for CPB and CRC parks on the nine EAPRS elements, using principal component extraction method and a varimax rotation (Meyers, Gamst and Guarino 2006). The Kaiser-Meyer-Olkin measure of sampling adequacy was inadequate (CPB = .249; CRC = .331); but Bartlett's test of sphericity was significant ($p < .001$) indicating, sufficient correlation between the variables to proceed with the analysis. The pattern of relationships in the correlation matrix only confirmed that factor analysis was required. Nearly all correlations were significant ($p < .001$) and none of the correlation coefficients were greater than 0.90. The determinants (CPB = .001; CRC = .014) were greater than .00001 indicating that multicollinearity was not a problem.

Using the Kaiser-Guttman retention criterion of eigenvalues greater than 1.0 a five factor solution for CPB parks and four factor solution for CRC properties emerged. Five factors for CPB parks accounted for 80.37 % of the total variance, and the four factor solution for CRC properties accounted for 77.76% of the total variance. Communalities were fairly high for each of the eight EARPS elements (CPB =87.3% to 95.8%; CRC = 61.7% to 95.9%) indicating that the factors explain higher proportion of variance in each element evaluated for CPB parks.

Table 3.6. Details of EAPRS tool elements, sub-elements, and park qualities used and components not used

S. No	Element used	Sub-element	Qualities assessed	Components not used with reasons
1.	Paths (*b*).	Existence and surface.	Condition, width, cleanliness, flatness, obstruction, shade.	Accessibility to internal park elements, because of opposite polarity of responses and lack of support in literature that internal distance between elements is associated with home values.
2.	General Space (*c*).	Open space, Meadows, General areas,	Average size, condition, cleanliness, flatness, and proximity to water areas.	Accessibility to internal park elements.
3.	Water areas (*d*)	Water areas (ponds, lakes, streams, creeks, fountains).	Average size (width and depth - streams/creeks; height - fountains), water quality, movement.	Swimming pools, because there was no variation in the pools in different parks.
4.	Eating/drinking features (*e*).	Drinking water fountains, grills/fire pits, picnic areas, vending.	Condition, taste/cleanliness, ground flatness, openness/visibility, supplied.	
5.	Facilities (*f*).	Shelters/pavilions/gazebos, entertainment venues/stages.	Size, cleanliness, condition.	
6.	Sitting or resting features (*h*).	Benches, Tables, Seat walls.	Condition, comfort, landscaping, cleanliness, shade.	

Table 3.6 (continued)

7.	Landscaping (*i*).	Flowers, shrubs/bushes, landscaping beds.	Variety, color, condition, cleanliness.	
8.	Play set/structures (n).	General play set, ground surface, things to hang from, slide down, climbing and standing features, swings,	Openness/visibility, coverage/shade, condition, cleanliness, levelness, colorfulness, size of features, height of ground.	N and O evaluate children's play sets and play equipment; therefore, these two attributes were combined (no).
9.	Other play components (*o*).	Sliding, swings, blacktop, spring toys, imaginary play structures, hanging sets.	Cleanliness, condition, colorfulness, size of features, height of ground,	
10.	Ball grounds (*p*).	Athletic fields and other recreation areas, courts.	Ground condition, cleanliness, drainage, surface condition, perimeter, striping/line condition.	

Table 3.7 gives the EAPRS elements that combined into factors when a varimax rotation was requested. Inferences about the combination of elements into factors were confirmed from an examination of inflexions in the Scree Plot. The names of five factors extracted for CPB parks and four factors for CRC facilities are given in Table 3.7. However, only four factors were used in the analysis of CPB parks. Based on the combination of elements the four factors were named

as follows – (1) General Services (*hf*) – contains facilities that service park users (e.g. restrooms, shelters), (2) Physical Activity Resources (*bp*)- consists of pathways and ball grounds that encourage physical activity, (3) Family Facilities (*eno*) – contains features, such as children's play equipment and picnic spots that attract families, and (4) Aesthetics (*cd*) – contributes to the overall attractiveness of the park(e.g. open spaces, meadows, wooded areas, ponds, streams). In CRC parks three factors were used in hedonic estimation – (1) Children's Activity and Supporting Features (*efhno*) – consists of attributes that attract children to parks and support complementary activity by adults, such as picnic spots, benches, and tables, (2) Moderate Activity Attributes (*bcd*) – contains pathways for adults to walk and open spaces to play passive sports, such as Frisbee, flying a kite, and tossing a ball, (3) Intensive Activity Attributes (*p*) – contains ball grounds (e.g. tennis and basketball courts) for vigorous physical activity. EAPRS element *i*, which represents shrubs, flowers placed or planted by design did not combine with any factor and was excluded from the analysis.

Table 3.7. Factor loadings for EAPRS element after rotation in CPB and CRC parks

Factor name from rotated matrix	Combination of EAPRS elements with factor loadings	
	CPB	CRC
General Services	h (.934)+ f (.880)	
Physical Activity Resources	b (.861) + p (.836)	
Family Facilities	e (.929) + no (.801)	
Aesthetics	c (.711) + d (.933)	
Landscaping	i (.972)	
Children's Activity and Supporting Features		e (.678)+ f (.757)+ h (.735)+ no (.834)
Moderate Activity Attributes		b (.770)+ c (.616)+ d (.848)
Landscaping		i (.977)
Intensive Activity Attributes		p (.968)

Social capital – The Saguaro Seminar (2000) surveyed nearly 30,000 respondents to evaluate levels of social capital in 41 selected communities across 29 states. This was called the Social Capital Community Benchmark Survey (SCCBS) and Cincinnati was one of the communities that participated in this nation-wide survey. A comprehensive social capital index consisting of 14 indicators was prepared as part of the SCCBS (Saguaro Seminar 2000). Restricted individual level data was obtained from the Roper Center after approval by the Institutional Review Board, University of Cincinnati (Annexure 3). The restricted dataset consisted of 39,061 responses. Of these, 129 responses came from census tracts of interest to this research. The modal value of these 129 responses was computed at the census tract level and used to estimate multilevel models.

Five indicators were taken from the SCCBS survey and used as independent variables. The five categorical variables were - social trust (general interpersonal trust, trust neighbors, trust co-workers, trust fellow congregants, trust store employees, trust local police), informal social interactions (having friends visit home, visiting with relatives, socializing with co-workers outside of work, hanging out with friends in public places, playing card and board games), organized group interactions (attend public meetings, attend club meetings, attend local community events), civic participation (voting, sign a petition, attend political meeting/rally, work on community project, demonstrate/protest/boycott or march), and number of formal group involvements (not faith based). Social trust, informal social interactions, and organized group interactions were measured on a three point Likert-type scale (1- low, 2- medium, 3- high). However, civic participation and formal group involvements were evaluated on a four point Likert-type scale (1 – very low, 2- low, 3- medium, 4- high).

One assumption made in this research was that social capital remained unchanged during 2000 and 2005-06. One way of validating the stability of neighborhood social capital between 2000 and 2005 was to use a proxy for social capital and examine the change in the proxy during this five year period. Homeowners have a greater economic stake in the neighborhood and are more likely to help others and develop relationships. Therefore, homeownership is an accurate proxy to measure levels of involvement in neighborhood networks. Studies in low-income neighborhoods have found that homeowners show an increased participation in neighborhood and block level meetings (Rohe and Basolo 1997) and homeownership was significantly associated with the bonding type of social capital (Brisson and Usher 2005). Using CAGIS datasets, homeownership ratios (owner occupied/ renter occupied) at the census tract level were computed. High bivariate correlation (Pearson's r > .99) demonstrated that the assumption that social capital remained unchanged between 2001 and 2005 -06 was realistic.

3.5. Data Collection and Preparation

Data was collected at level-1 (home) and level-2 (park neighborhood) from primary and secondary sources. Table 3.8 gives the name of the variables, their sources and level of measurement. The main data source was the CAGIS dataset for variables measured at level-1. The Hamilton County Auditor's database supplemented the CAGIS dataset, in case of missing values. The source for social capital data was the SCCBS dataset and park attributes were evaluated using the EAPRS tool.

Table 3.8. Variables, data sources, and level of measurement

Variable name	Level of measurement	Data source	Primary/secondary source
Assessed home market value	Home	CAGIS and Hamilton County Auditor	Secondary
Finished home area	Home	CAGIS and Hamilton County Auditor	Secondary
Lot size	Home	CAGIS and Hamilton County Auditor	Secondary
Home age	Home	CAGIS and Hamilton County Auditor	Secondary
Bathrooms	Home	CAGIS and Hamilton County Auditor	Secondary
Park-home direct distance	Home	CAGIS	Secondary
Walkability (Park-home network distance)	Home	CAGIS	Secondary
Social capital	Park neighborhood	SCCBS	Secondary
Park attributes	Park neighborhood	EAPRS	Primary

Types of Parks Studied

The first step in data collection and preparation was to identify parks that were to be investigated. Park selection was based on the functional categories developed by the National Recreation, Park and Open Space Association. The functional classification is given in table 3.9. In this research we are interested in the following types of parks – Mini, Neighborhood, and Community. Table 3.9 shows that the smallest unit is the Mini-park in the park hierarchy. Mini-parks are located close to service areas, with little buffer between the park and adjoining homes, and they cater to limited recreational needs. Typical facilities include – playground picnic tables with grills (not under shelter), half basketball courts, benches or bench swings, open play area, landscaped public use area and scenic overlook. Neighborhood Parks are the basic building blocks of park organization and are located within walking distance of the service area; providing a variety of facilities to different age groups. Generally, they contain - playground picnic shelters with grills, court games, picnic tables with grills (not under shelter), informal play field, benches, bench swings, volleyball courts, 50 % of the site is kept undeveloped to be used for trails/walking, and parking (7-10) spaces. The third type of park is the Community Park, which provides for the recreation needs of several neighborhoods. These parks also provide nontraditional types of recreation. Fifty percent of the park site is developed for passive recreation only. Normally, the following facilities are available in Community Parks – recreation center picnic tables with grills, basketball courts, benches, bench swings, tennis courts, nature trails, basketball courts/softball courts, restrooms, multi-purpose field parking, soccer fields, playgrounds, amphitheater, observation decks, and lakes (Mertes and Hall 1995).

Table 3.9. Functional classification of parks

Type of park	Description	Location criteria	Site criteria	Population served	EAPRS elements evaluated
Mini Park	Used to address limited, isolated or unique recreational needs.	Service area usually less than a 1/4 mile (0.4 km) along trails or low-volume residential streets.	Usually between 2,500 square feet and 1 acre (0.4 hectares); maximum 5 acres (2 ha).	500 to 2,500	*b, c, e, h, i, j, n.*
Neighborhood Park	The basic unit of a Park system. Serves the recreational and social focus of the neighborhood. Emphasis is on informal active and passive recreation.	Walking distance of a 1/4 to a 1/2 mile (0.4–0.8 km), uninterrupted by non-residential roads or other physical barriers.	Minimum of 5 acres (2 ha), 7 to 10 acres (2.8 to 4.1 ha) optimal.	2,000 to 10,000	*b, c, e, h, i, j, n, o, p.*
Community Park	Serves a broader purpose than a neighborhood park. Focus is on meeting community based recreation needs.	Usually serves 2 or more neighborhoods within a 1/2 to 3 mile (0.8–4.83 km) distance.	Between 30 and 50 acres (8.1 and 20.3 ha).	Variable	*b, c, e, h, i, j, n, o, p.*
Natural Resource Area	Land set aside for the preservation of significant natural resources, remnant landscapes, open space, and visual aesthetics/buffering.	Location determined primarily by resource availability and opportunity.	Variable	Variable	

Table 3.9 (continued)

Greenway	Ties park system components together to form a continuous park environment.	Location determined primarily by resource availability and opportunity.	Variable	Variable	
Sports Complex	Consolidates heavily programmed athletic fields and associated facilities to larger and fewer sites strategically located throughout the community.	Strategically located throughout community.	Usually a minimum of 25 acres (10.1 ha), with 40 to 80 (16.2 to 32.4 ha) being optimal.	Variable	
Special Use Facility	Covers a broad range of parks and recreation facilities oriented toward single-purpose use.	Variable	Variable	Variable	
Private Park/ Recreation Facility	Parks and recreation facilities that are privately owned yet contribute to the public park and recreation system.	Variable	Variable	Variable	

Source: Adapted from Mertes and Hall (1995, 94)

Park selection was based on existing park sizes in Cincinnati and service area of different types of parks. Neighborhood parks typically have service areas of one-fourth to one-half mile, uninterrupted by major roads and other physical barriers. In this research the park neighborhood was conceived as an area contained within 1000 feet from the park, which is the service area of a neighborhood park; therefore, neighborhood parks were included in the analysis. The lower limit was set at one acre and the upper limit of the neighborhood park was determined to be 25 acres because CRC parks are relatively larger than CPB parks. Accordingly, parks having an area between 1 and 25 acres (> 1 and including 25) constituted the dataset for this research.

Number of Parks Evaluated

There are 53 parks in Cincinnati sized between one acre and 25 acres. These were downloaded from the Cincinnati Park Board website and confirmed with the Park Board (Annexure 4). Complete details of the park location and addresses of 53 parks are given in Annexure 5. Twenty seven parks were excluded for the reasons given in table 3.10.

Table 3.10. List of parks not considered with reasons

S. No	Name of park	Size (acres)	Reasons for deletion
1	Bond Hill	5	Combined with an elementary school, difficult to separate effects.
2	Brown/Lane	2	Very close to Brown Run Golf course, difficult to separate effects.
3	Coy	2	Park and homes on multiple levels on a hill, close to University and largely renter occupied (students); and close to Fairfield Park.
4	Evanston	6	Very close to I-71 (nearly 210 feet).
5	Dunore	2	Not found as a separate entity in CAGIS dataset.
6	Fairview Playground	4	Near complete overlap with the larger Fairview park (28 acres), difficult to separate effects.
7	Ferry Street	3	No longer exists now.
8	Glenway	3	Surrounded by recreation facilities and other establishments (NW – Glenway Woods, SE – Mont St Mary's School, E – Our Lady of Grace School, N – Pub).
9	Hauck Gardens	8	CPB offices location and botanical garden, difficult to separate effects.
10	Hoffner	2	Located in a predominantly commercial area.
11	Inwood	20	Park contains multiple levels on a hill.
12	Jackson Hill	9	Park contains multiple levels on a hill.
13	Larz Anderson	9	Located on a hill close to Cincinnati Country Club.
14	Laurel	9	Located close to Laurel playground and nearly homes are multi-family constructed by the Cincinnati Metropolitan Housing Authority.
15	Laurel Playground	4	Located close to Laurel park and nearly homes are multi-family constructed by the Cincinnati Metropolitan Housing Authority.
16	Lincoln	10	Linked to Marion Center, difficult to separate effects.

Table 3.10 (continued)

17	Lytle	2	No Single-family homes in the buffer.
18	Mount Echo	16	Near complete overlap with Mount Echo Open Space, which is a large Natural Area, difficult to separate effects.
19	Pioneer Cemetery	2	Used as cemetery, not for recreation.
20	Seasongood Square	2	Close to parks – MLK Jr., Mitchell, and a school.
21	South Fairmount	4	Abutting a vehicle yard on the West and commercial area on the East.
22	St. Clair Triangles	3	Not existing on ground.
23	Taft Field	4	No single-family homes in the buffer.
24	Turkey Ridge	21	Not found as a separate entity in CAGIS dataset.
25	Victory Ballground	3	Merged with the Xavier University, difficult to separate effects.
26	Washington	6	Mainly consists of multifamily homes (12 single-family homes) and commercial area.
27	Woodward	10	Not used for recreation, no separate location on ground.

The main reasons for the deletion of 27 parks were – (1) not identifiable as a separate entity in the CAGIS dataset, (2) absence of single-family homes in the buffer, (3) near complete overlap of park buffer with other land uses making separation of effects difficult, (4) change of primary land use to non-recreational activities, (5) proximity to other large parks or natural preserves, making separation of park effects difficult, and (6) parks spread over multiple levels. The location of the remaining 26 parks is given in figure 3.2.

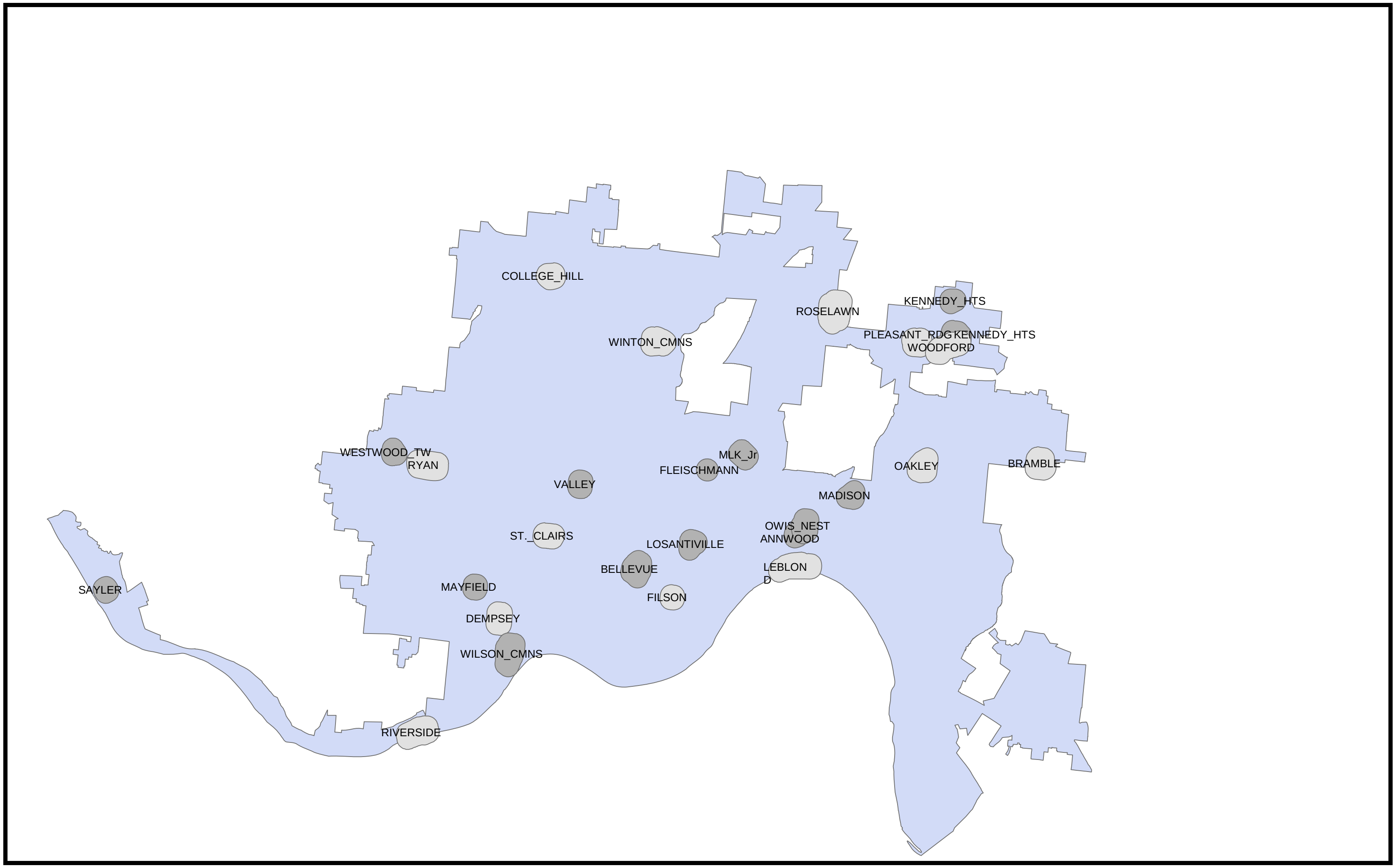

Figure 3.2. Location of 26 parks in Cincinnati City
Note: CPB (dark gray); CRC (light gray)

Number of Residential Properties in the Dataset

The purpose of this research was to determine the precise effect of parks and park neighborhoods on single-family home values. Therefore, only single-family homes (henceforth called homes) that are expected to be within the influence of a single park were identified and extracted in five steps –

(1) From CAGIS database all parks ranging between one and 25 acres (CAGIS>Misc data>City parks>all parks/union parks) were identified. Buffers were created around 26 parks using ArcGIS modeling (Ormsby et al., 2004). The model is given in figure 3.3 and consists of the input data – distance and park (Annwood), the buffer tool, and the output (AnnwoodB).

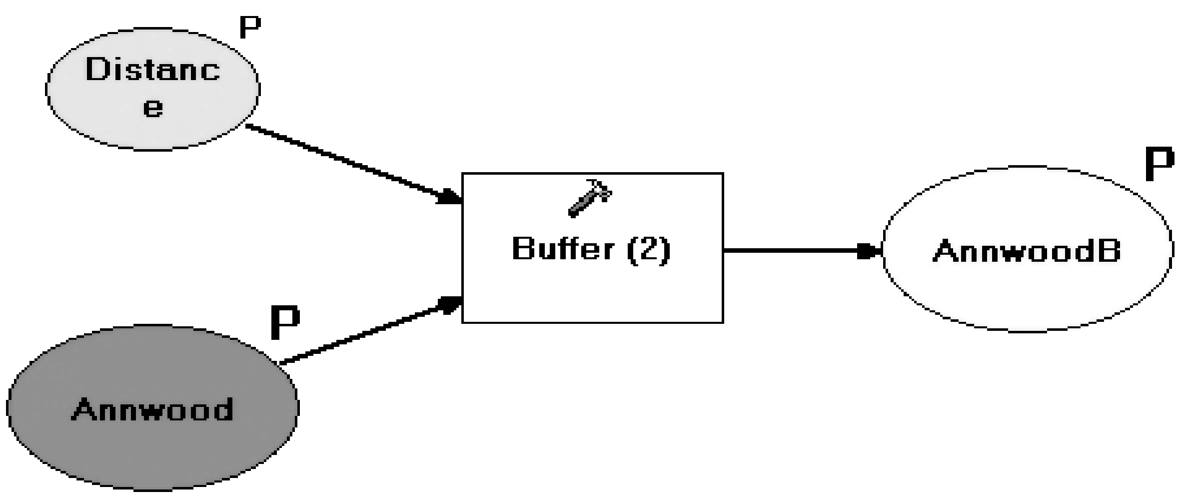

Figure 3.3. Buffer model showing interconnected processes
Source: CommunityViz

(2) For the 26 parks sale and assessment values, and home attributes were added (CAGIS>Property>parcels/parcent/parsales) using parcel as the common field to join the attribute tables. Again, census tracts, blocks, and block groups were joined using data from the US Census website. Finally, street networks (CAGIS>CinciStrNet) and junctions (CAGIS>HC_St_Network_Junctions) and occupancy in the years - 1996, 2000, and 2005 (CAGIS>Misc data>Censdata) - was added. Although CAGIS calls this dataset for 2006, the sale values were taken from the Hamilton County Auditor and are for the year 2005. In Ohio a triennial update of property assessments is mandated by law and the last assessment was done in 2005. During the interregnum only a few homes are re-assessed (e.g., new constructions). The models are given in figures 3.4 and 3.5.

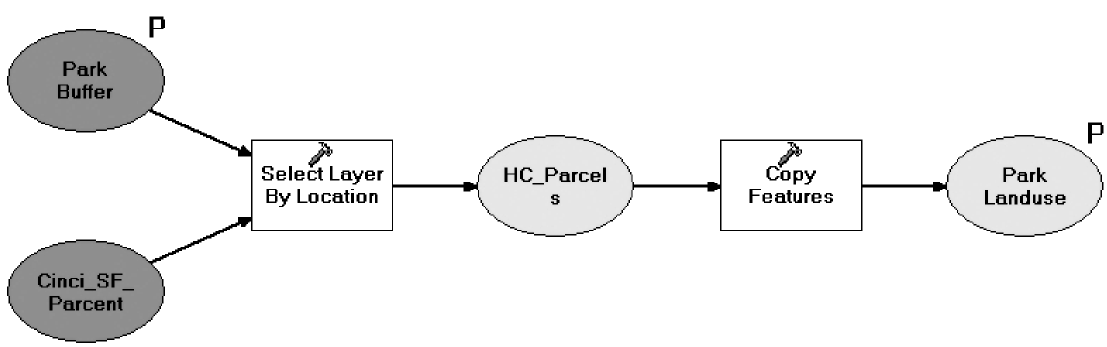

Figure 3.4. Model showing the addition of single-family homes in the buffer
Source: CommunityViz

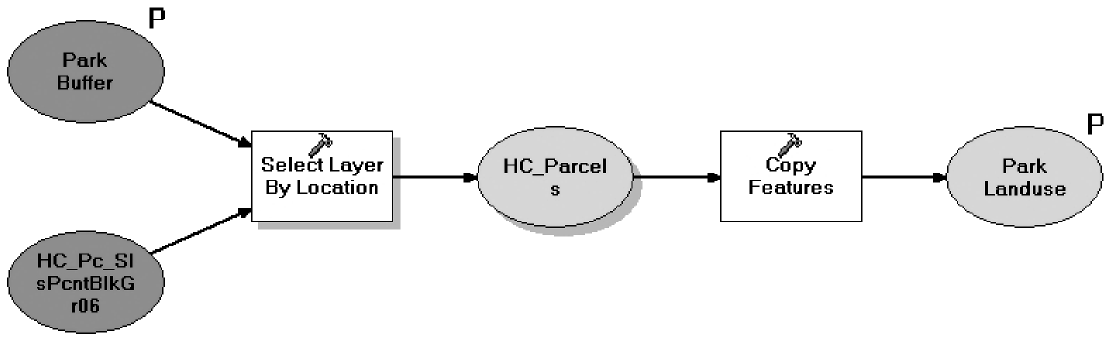

Figure 3.5. Model showing the addition of street network in the buffer
Source: CommunityViz

(3) Overlaps among park neighborhoods were deleted in three steps – first, by selecting features from park1 that intersect with buffer-1, second, by removing from currently selected features in park1 that intersect with buffer-2, and third, exporting the data. Seventeen hundred and two homes that were under the influence of two or more parks were deleted (8304 – 6602 = 1702). Complete details of parks with the number of homes in parks, before and after deletion of overlaps and the names of overlapping parks is given in table 3.11.

(4) The hedonic price model estimates the marginal implicit prices through the housing market; therefore, homes that were sold in the market were only included in the analysis. In the CAGIS dataset the earliest sale happened in 1972, therefore 4,065 sales that occurred between 1972 and 2005 were used in the analysis (number not sold and deleted = 2,537).

Table 3.11. Total number of single-family properties and the numbers deleted

S. No	Name of park	Size (acres)	Number of single-family properties in buffer	Number of single-family properties, after removing overlap with other parks	Names of overlapping parks within 1000 feet buffer
Park Recreation Board properties (Average size = 6.31 acres)					
1	Annwood	2	141	48	Scarborough Woods, Owls Nest, and unnamed park
2	Bellevue	15	334	210	Innwood, Jackson Hill, unnamed parks.
3	Fleischmann	4	89	89	Woodward.
4	Kennedy Heights	12	715	129	Woodford.
5	Losantiville Triangle	5	49	49	
6	Madison	4	324	323	Cincinnati Country Club.
7	Mayfield	2	391	371	Glenway.
8	MLK Jr.	6	97	97	Seasongood Square, Victory Park.
9	Owls Nest	10	424	335	Annwood.
10	Sayler Park	2	464	409	Lee Park.
11	Valley	3	75	75	Taft.
12	Westwood Town Hall	2	320	320	
13	Wilson Commons	15	369	248	Mt. Echo, Dempsey.
Park Recreation Committee park lands (Average size = 11.69 acres)					
14	Bramble	10	762	738	Little Duck Creek.
15	College Hill	5	200	198	Unknown
16	Dempsey	7	339	224	Glenway.
17	Filson	4	290	233	Jackson Hill, Johnston Park, unnamed parks.
18	Leblond	19	154	154	
19	Oakley	15	565	543	Hyde Park.
20	Pleasant Ridge	9	396	321	Woodford, Golf Manor.
21	Riverside	8	144	144	
22	Roselawn	19	141	141	
23	Ryan	23	422	422	
24	St. Clair Heights	18	356	291	South Fairmount.
25	Winton Commons	13	220	217	Emery.
26	Woodford	2	523	273	Pleasant Ridge, Woodford, Kennedy Heights.
Total			8,304	6,602	

(5) Park effects on homes located close to parks depend on numerous external factors. An early study in Texas (Hendon1974) found negative and positive effects on homes located close (< 500 feet) to parks. Park effect was moderated by the spatial orientation of homes located close to parks and facing active recreation areas (Weicher and Zerbst 1973; Hammer, Coughlin, and Horn 1974; More, Stevens and Allen 1988). One study found that up to 100 feet distance, park effects were insignificant (Bolitzer and Netusil 2000) or the effect was least for parks as compared to other types of open spaces (Lutzenhiser and Netusil 2001). Clues are available about the distance at which these park effects are dominant - less than a block (Weicher and Zerbst 1973) and specifically less than 100 feet (Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001). Therefore, there is evidence that park effects at close distances depend on factors which are extraneous to the research goals.

Accordingly, 222 homes located within 100 feet from the park boundary were excluded from the analysis, leaving a balance of 3,843 homes. The bar graph in figure 3.6 shows the number of home sold in the 26 parks between 1972 and 2005. Labels on each bar indicate the number of sales in that park neighborhood. Bramble recorded the largest number of sales, and Annwood the lowest.

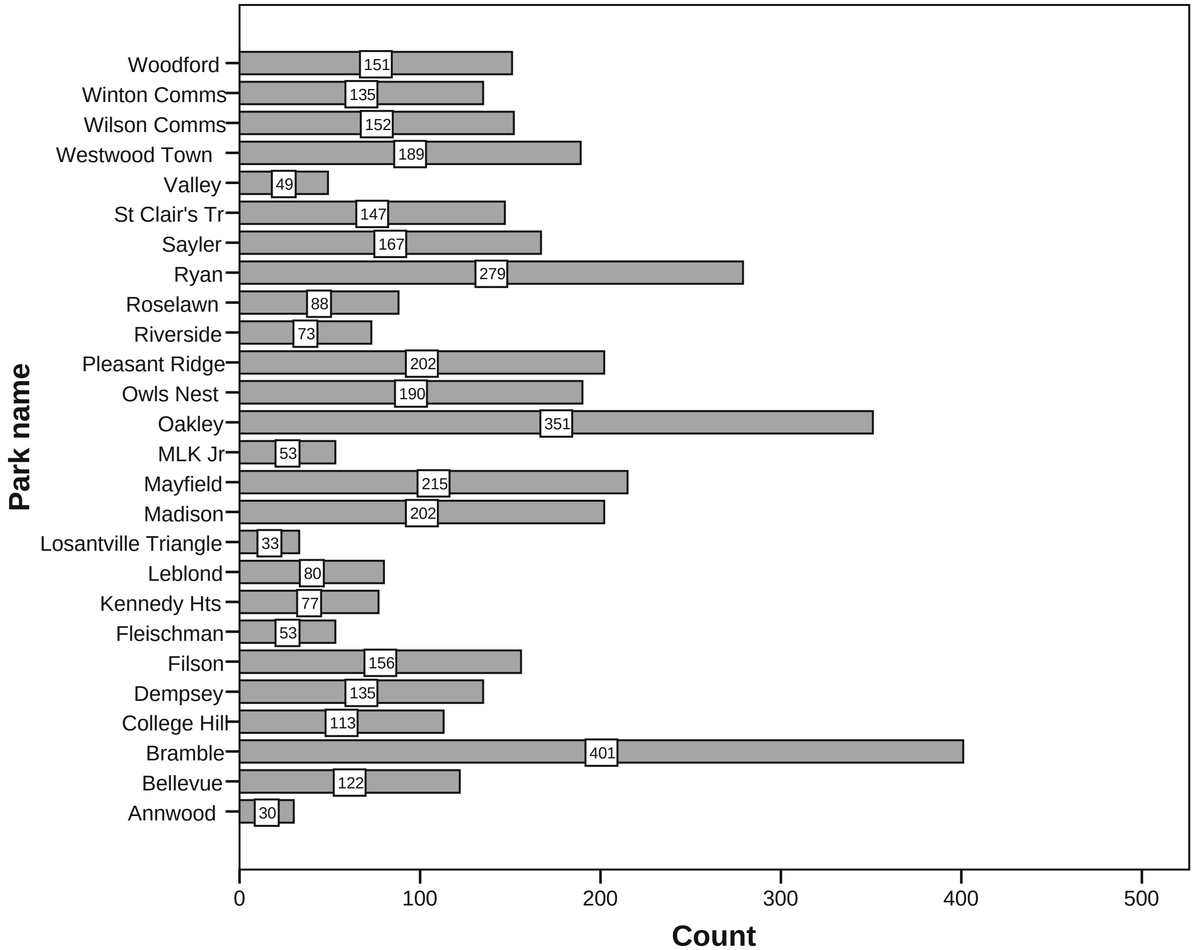

Figure 3.6. Park wise count of home sales during 1972 and 2005

Park-home Distances Measurement

Scenario 360 is a part of the CommunityViz extension, which was used to assess park-home distances – both direct and network. Scenario 360 permitted direct and network distances to be measured from home parcels to the nearest point on the park boundary, and the data was driven by the following formulae –

Aerial (direct) _Dist	*MinDistance ([Layer: Annwood])*
Network_Dist	*NetworkMinDistance ([Layer: Annwood]), [Attribute : HC_St_Network : Distance])*

The amenity value of the park is determined by the direct distance – homes closer to parks have higher values and the majority of park studies have used the direct distance from home to park. The Mindistance function computed the shortest straight-line distance from the edge of the home polygon (first layer) to the nearest edge on the park boundary (second layer), which is given in figure 3.7.

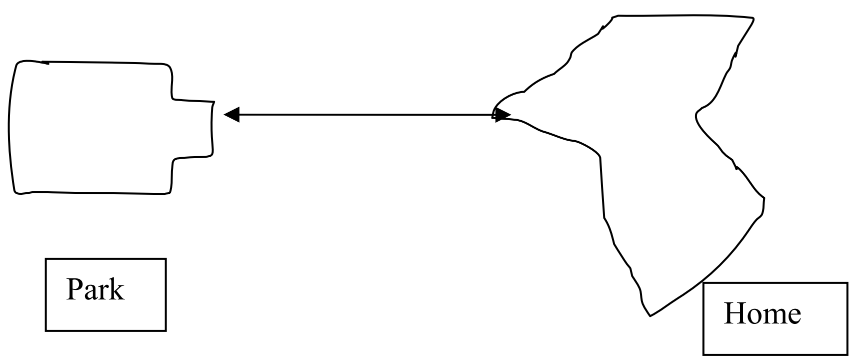

Figure 3.7. Computation method by MinDistance function
Source: Adapted from Help function of CommunityViz
Note: Not to scale

An assumption underlying the direct distance measurement was that park visitors were able to enter parks from nearest points from roads and do not always use the park entrances. Practically, park users would rather enter the park at the nearest point, provided the park perimeter does not have a fence or a wall to prevent visitors entry. During my field visits, I found that the majority of park did not have fences or walls along the boundary and people were entering the parks from numerous points along the perimeter. Such a computational procedure was also used by Miller (2001) to measure network distances.

The Network MinDistance computes the distance along the specified network layer from the center of the home polygon to the nearest point on the park boundary. In case the network does not intersect with the park boundary, distance is measured along the network from the nearest point on the network to the park, which is not included in the measurement. This is illustrated in figure 3.8. The fuzzy (double) line shows the nearest network distance from the home to the park. The double headed arrow shows the distance, which is not included in the measurement. There are two limitations to this measurement procedure. First, the park-home network distance was measured from the center of the home polygon and second, there may be some residual unmeasured portion left over (double headed arrow) in case the street network is not directly connected to the park. A visual examination of the street networks in CAGIS and Google Earth showed that in a majority of parks the streets were directly linked to proximate parks.

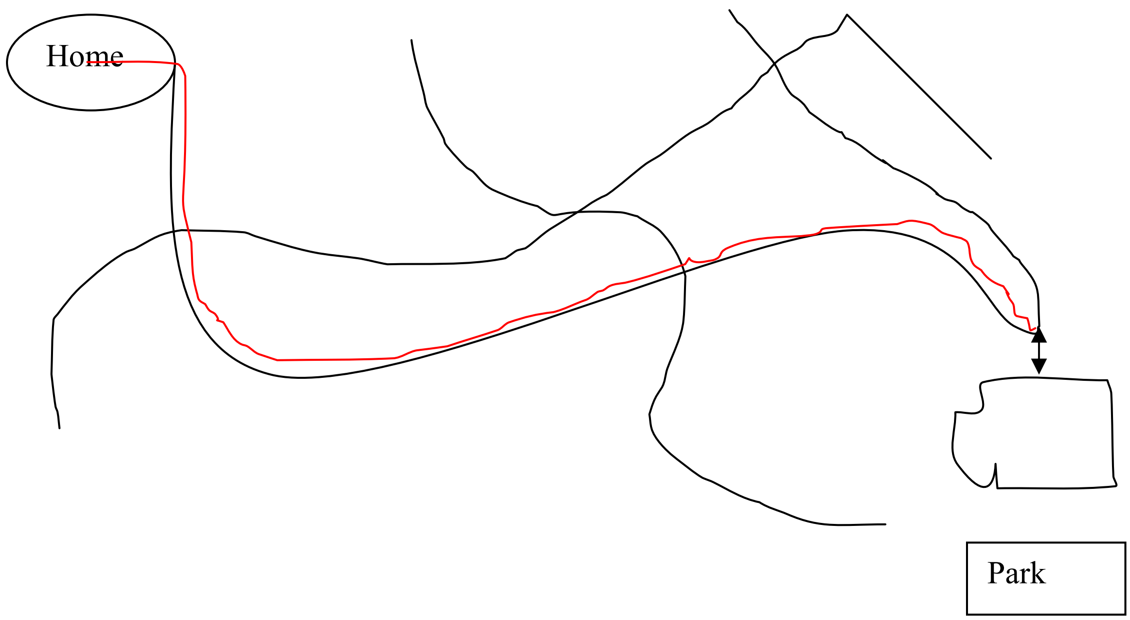

Figure 3.8. Computation method by NetworkMinDistance function
Source: Adapted from Help function of CommunityViz
Note: Not to scale

Neighborhood Social Capital and Park Attributes

Table 3.12 gives the list (CPB = 4; CRC = 3) of EAPRS factors used in multilevel model estimation. Neighborhood social capital and EAPRS scores were the ordinal variables in this study, which were amenable to limited arithmetical operations (Meyers, Gamst, and Guarino 2006, 23); therefore, EAPRS scores were added and the modal value was computed from the responses in the SCCBS. Neighborhood social capital was calculated as the modal value of the responses to five indicators of social capital - social trust, informal social interactions, organized group interactions, civic participation, and number of non-faith based formal group involvements.

Table 3.12. Park attributes composing factors in CPB and CRC properties

Elements constituting the factor	Park attributes in the factor	Factor name
Cincinnati Park Board		
b + p	Paths, Athletic fields, and Courts.	Physical Activity Resources.
c+ d	Open spaces, Meadows, Wooded areas, Ponds, Lakes, Streams, Creeks, Pools, and Fountains.	Aesthetics.
h +f	Restrooms, Shelters/Pavilions, Gazebos, Stages, Benches, Tables, Seat walls, and Bleachers.	General Services.
e +no	Drinking Water Fountains, Grill/Fire Pits, Picnic Area, Vending, General Play Set, and other Play Components.	Family Facilities.
Cincinnati Recreation Commission		
no + e + h+ f	Restrooms, Shelters/Pavilions, Gazebos, Stages, Benches, Tables, Seat walls, Bleachers, Drinking Water Fountains, Grill/Fire Pits, Picnic Area, Vending, General Play Set, and other Play Components	Children's Activity and Supporting Features.
b + c + d	Paths, Open spaces, Meadows, Wooded areas, Ponds, Lakes, Streams, Creeks, Pools, and Fountains.	Moderate Activity Attributes.
p	Ball game grounds	Intensive Activity Attributes.

3.6. Diagnostics and Final Dataset

Linear multilevel modeling is subject to the normality assumption, but the residuals may not be independent or have constant variance (West, Welch, and Galecki 2007). Therefore, the following assumptions were evaluated - checking the distributions for normality, identifying outliers, and absence of heteroscedasticity. Multicollinearity was checked for each model separately at the time of model estimation.

Residual diagnostics in multilevel models was a challenge because the model is more complex due to the presence of random effects and covariance structures and non-availability of standardized methods to do influence diagnostics (West, Welch, and Galecki 2007). However, standard multiple regression diagnostic methods are applicable to multilevel models also (Schabenberger 2004; Tabachnick and Fidell 2007), and accordingly, a mix of standard diagnostic methods and special techniques for multilevel models were used. Residuals were assessed for normality, constant variance, and outliers. Four types of models were estimated – unconditional (intercepts only), reference (level-1 independent variables only), and two types of nested models (level-1 and -2 independent variables of interest) – random intercepts and random slopes. Each model was expected to give a set of different residuals making step-wise analysis impractical. Therefore, the reasonable approach, suggested by Hox (2002), to investigate for gross violations of assumptions in the two residual terms in the intercept model containing all the park attributes was used.

Outliers

The dependent variable assessed value had a positive skewness, accordingly it was log transformed, which considerably reduced the skewness (0.355). Outlier detection was done in a series of steps. In *SPSS* conditional residuals were saved in the dataset by specifying the PRED, FIXPRED, and RESID in the SAVE subcommand. PRED saved the park-specific predicted values that incorporated both the estimated fixed effects and the empirical best linear unbiased predictors (EBLUPs) of the random park effects for each house. RESID saved the conditional residuals for each house, based on the estimated fixed effects and the EBULP of the random effects for each home value. FIXPRED gave the population-averaged predicted values, based on the estimated fixed-level parameters. In the first step 52 potential outliers (CPB – 22; CRC - 30) were identified from the boxplots of park-wise residuals and high influence values. Figures 3.9 and 3.10 give the boxplots park wise with extreme outliers labeled.

Next, these potential outliers were evaluated for their influence on the individual cases and the model as a whole. Influence statistics were obtained park-wise by using the SPLIT command as suggested for multilevel models (Tabachnick and Fidell 2007, 73&787), and the MAHALANOBIS, COOK'S distance and STANDARDIZED DFBeta values were saved using the REGRESSION command. The distance of a home value from the centroid (intersection of mean of all variables) of the home values of the remaining home values was measured by the Mahalanobis distance. Multivariate outliers lie at greater distances from the centroid. Cut-off limits were established based on the χ^2 distribution (CPB - χ^2 (11) = 31.264; CRC - χ^2 (10) = 29.588, $p < .001$). However, interpretation required care because the Mahalanobis distance depends on the patterns of variances and covariances among the variables in multilevel models (Tabachnick and Fidell 2007). Accordingly, other statistical measures of influence were used along with Mahalanobis distance to evaluate the potential outliers.

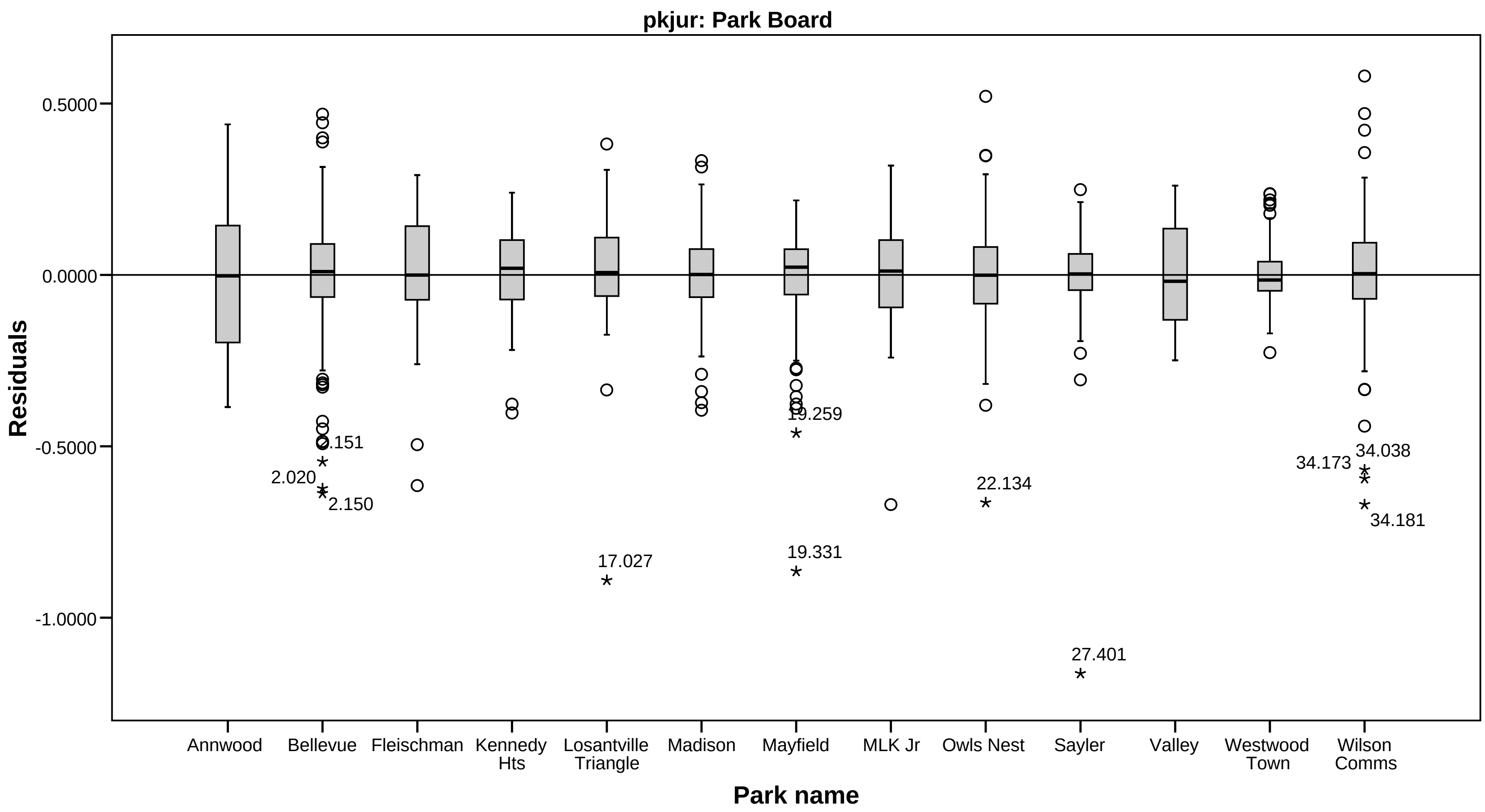

Figure 3.9. Boxplots of residuals in the CPB nested model

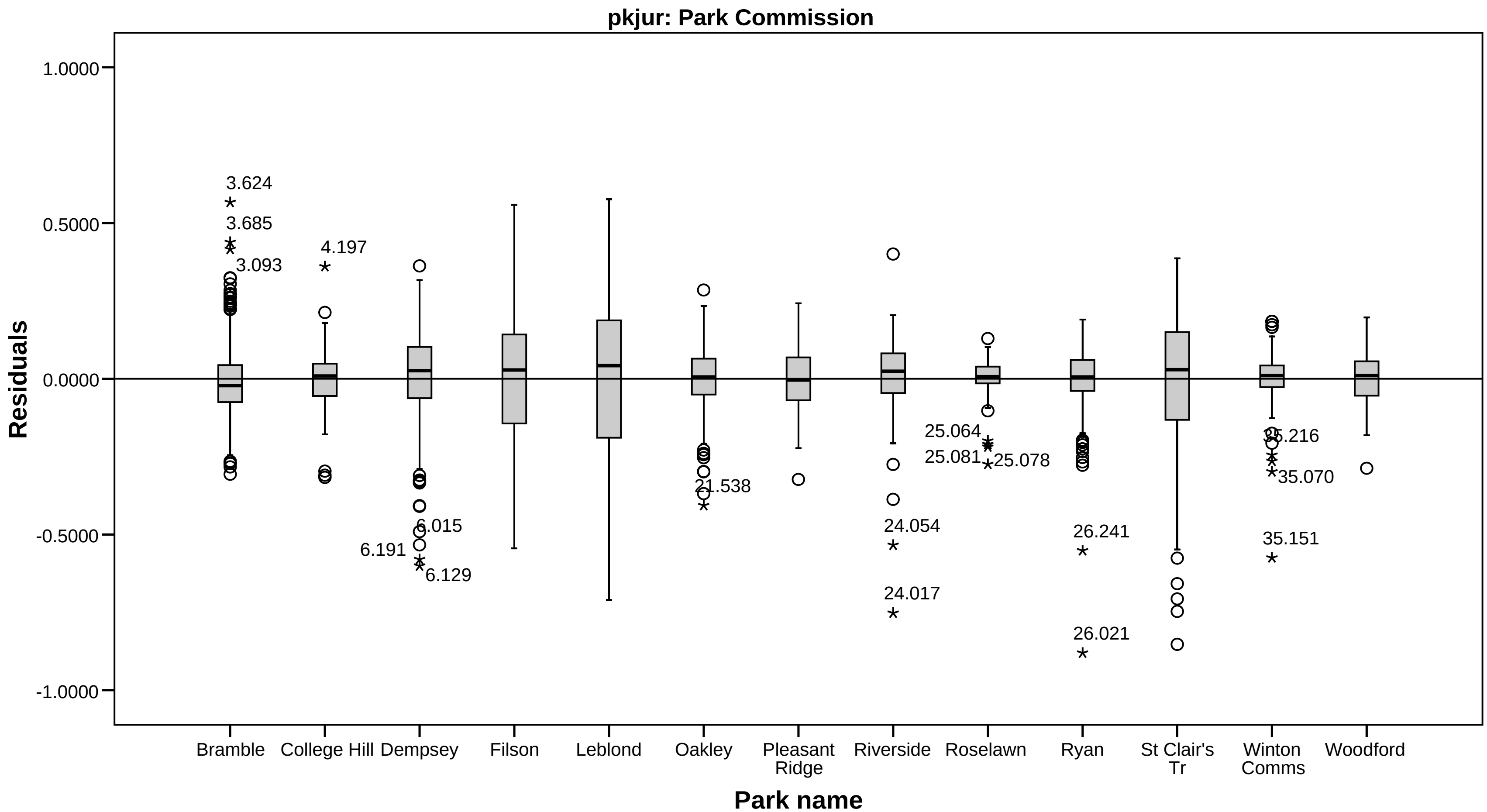

Figure 3.10. Boxplots of residuals in the CRC nested model

Cook's distance gave the influence of a single home on the overall model. All homes with values greater than one were evaluated as suggested by Cook and Weisberg (1982). The DFBeta is again a measure of influence, but gave the difference between parameter values when a case was excluded from the estimation. SPSS saves the variable-wise DFBeta values for all homes separately. DFBeta values above one were investigated in detail as suggested by Field (2000). Generally, homes were classified as outliers if the Mahalanobis distance was greater than the cut-off, Cook's D was above one, and the DFBeta values were above one for at least one variable. Table 3.13 gives the influence values of these 52 potential outliers.

Fifteen houses (CPB – 7; CRC - 8) were found to be actual outliers. In view of the small number of identified outliers (0.39 %) it was decided to delete these houses from the dataset leaving 3,828 houses for analysis. The following parks had more than one outlier home in the park neighborhood – Bellevue, Bramble, Dempsey, Leblond, Mayfield, Owls Nest, Riverside, Roselawn, Ryan, Sayler, St Clair's Heights, Wilson Commons and Winton Commons. The largest number of homes (three) was deleted from the park neighborhood of Winton Commons. Generally, larger homes (lot sizes and finished area) were identified as potential outliers and removed.

Furthermore, park wise analysis with SPSS REGRESSION was done to identify the combination of independent variables on which these 15 deleted outliers deviate from the remaining homes within the park. Each outlying home was evaluated in a separate SPSS REGRESSION run after a dummy variable was created using SPSS COMPUTE to separate the outlying home from the remaining homes in the park neighborhood (Tabachnick and Fidell 2007). Lot size was identified as the most influential variable separating outlier homes from the rest of the dataset. Annexure 6 contains a list of all the outlier homes investigated and the reasons for deletion or retention.

The final step was to determine how the scores of outlying homes on the variables that cause them to be outliers differ from the remaining homes in the dataset. SPSS LIST and DESCRIPTIVES procedures were used. The LIST procedure was run for each outlying home to show its values on all variables of interest, followed by DESCRIPTIVES to show the average values for the remaining park-wise data against which the outlying cases were compared. The comparison of park means scores with scores of the multivariate outliers are given in Annexure 7. The deleted homes had high scores on lot size and finished areas, often equal to the maximum in the park neighborhood. This means that generalizability of findings to large sized homes built on large lots (> 1 acre) will require caution.

Normality and Constant Variance

The boxplots of residuals by park separately for CPB and CRC parks (figures 3.9 and 3.10) showed that the residuals were nearly centered at zero and the distribution of the residuals was approximately across all the parks. However, some parks had relatively smaller number of homes; therefore, we cannot solely rely on the individual park boxplots to assess within-park variances (Luke 2004). Another common diagnostic plot is the scatter plot of residuals versus the predicted values, which is especially useful to assess heterodescedasticity. The plots of residuals against predicted values for CRC and CPB parks are in figures 3.11 and 3.12. The plotted points were approximately evenly divided above and below their values of zero, with no strong structure, and near oval shape of the scatterplot. This indicates linear relationship among variables, near normality, and no strong evidence of nonconstant variance in both the CPB and CRC parks (Hox 2002; Tabachnick and Fidell 2007). The outliers are also visible and some of the outliers are labeled, which were also tested during outlier analysis. Normality was confirmed by the normal shape of the histograms of the residuals of CPB and CRC parks, given in figures 3.13 and 3.14.

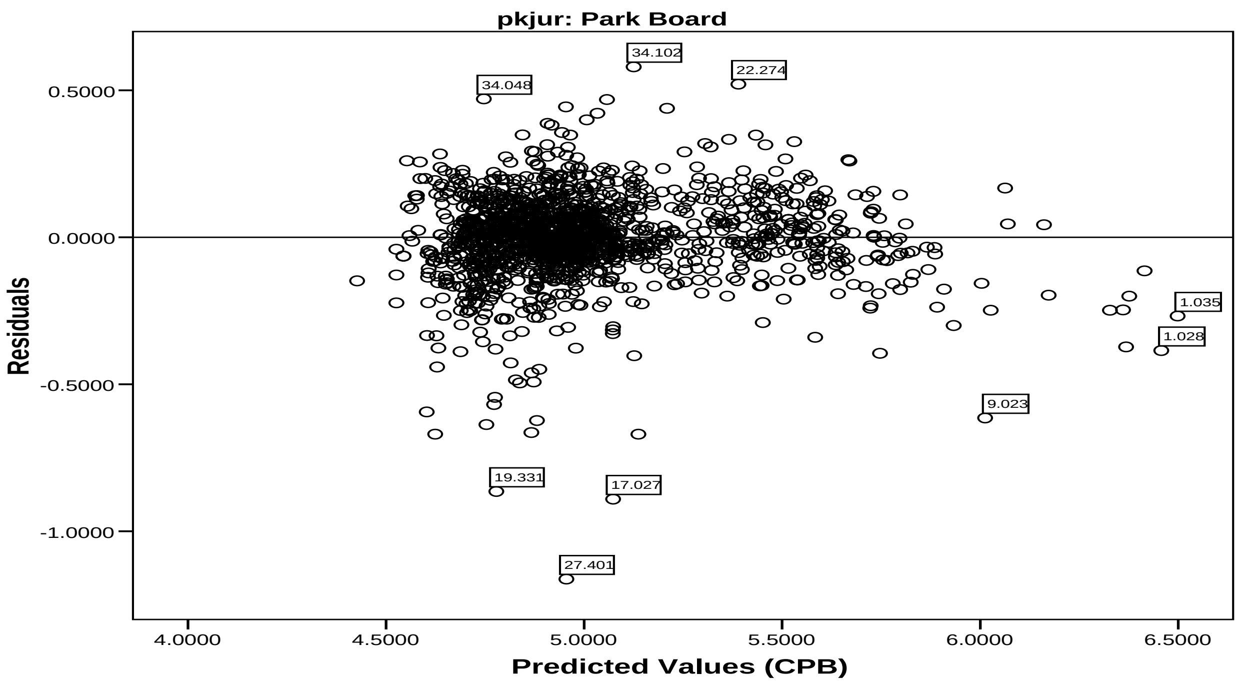

Figure 3.11. Scatterplots of conditional residuals vs. predicted values in CPB parks (nested)

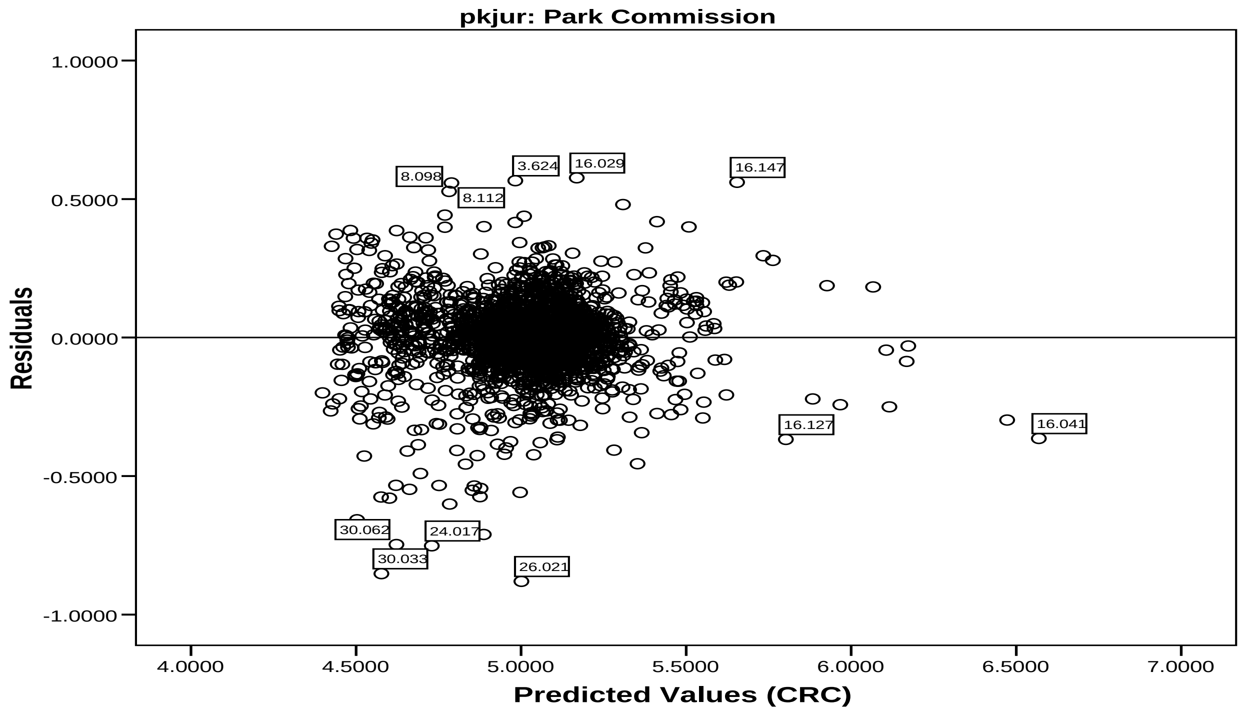

Figure 3.12. Scatterplots of conditional residuals vs. predicted values in CRC parks

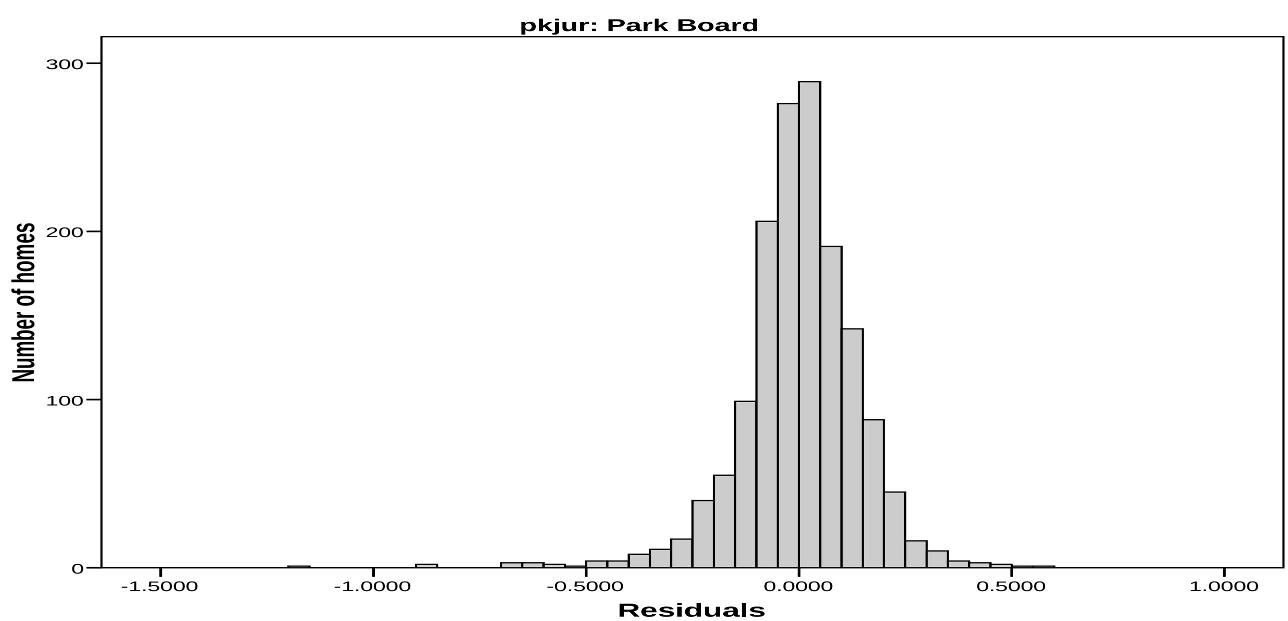

Figure 3.13. Histogram of residuals of CPB parks

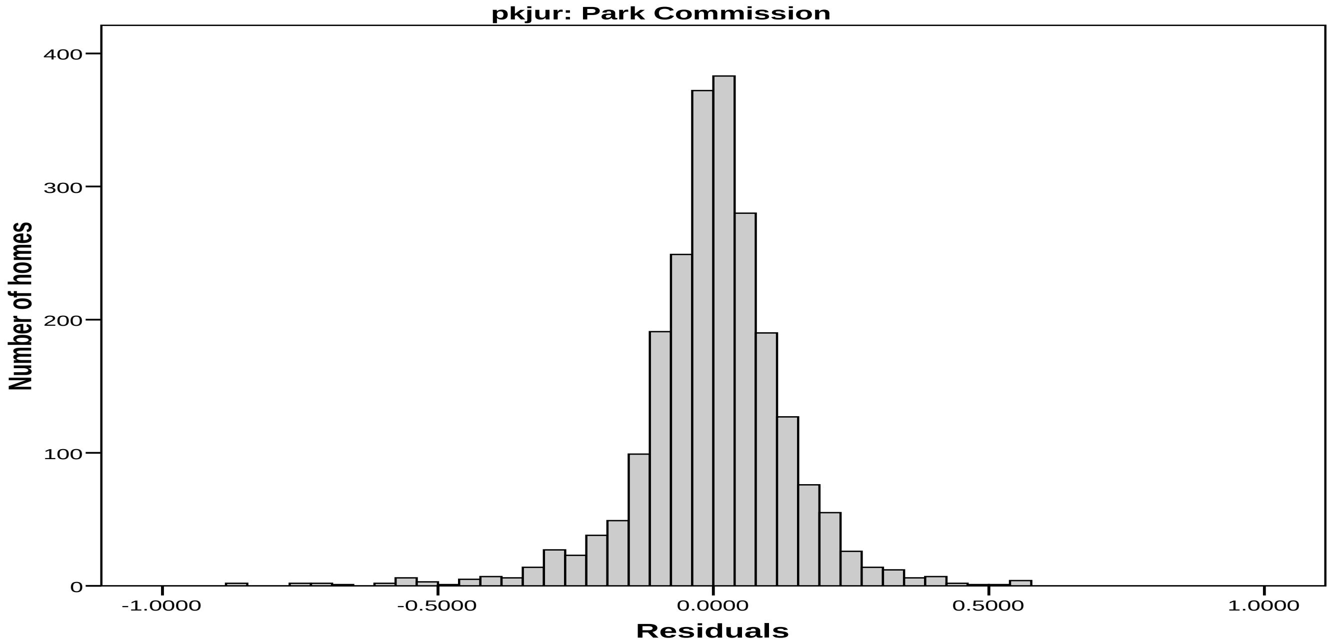

Figure 3.14. Histogram of residuals of CRC parks

Final Dataset

The hedonic function can assume different forms - linear, the quadratic, the log-log, the semi-log, the inverse log, the exponential, and the Box-Cox transformation. Only the log and the Box-Cox transformations permit the marginal implicit prices of home attributes to depend upon one another. The other forms assume independence of the implicit price of characteristics (Freeman 1993).

The Box-Cox transformation is given by:

$P_h^{\lambda} = (P_h^{\lambda} - 1)/\lambda$

If $\lambda = 1$, then this is the linear form, and as $\lambda \longrightarrow 0$, the Box-Cox assumes a semi-log form.

In this study I have used the linear form because the linear function gave more accurate results for parsimonious models. If all the home characteristics were included both the linear and quadratic forms of the Box-Cox versions give accurate results. In the multilevel design I am omitting variables; therefore, the linear function leads to more accurate estimation of coefficients because more number of coefficients have to be estimated in the quadratic form and omitting a variable is likely to result in bias in more number of coefficients (Cropper, Deck and McConnell 1988).

After deleting 34 missing values the final dataset consisted of 3,792 properties (CPB – 1,517; CRC – 2,275). The units for the variables were – log of home values, lot size (acres), finished home area (square meters), home age (years), bathrooms (numbers), neighborhood income ($/1000), and direct distance (meters). Finally, neighborhood income and all the level-1 variables were centered on their grand mean, that is, the raw score was changed to a deviation score by subtracting each score from its grand mean. Centering was preferred due to the goals of the analysis and technical reasons. Raw scores are useful in model estimation when the objective is to determine the variables that "explain" as much variation in the home values as possible, without any special interest in the level-2 variables (Kreft and de Leeuw1998). However, in this research we are generating parsimonious models with minimum level-1 variables to separate neighborhood (e.g. park attributes, walkability) from home effects; therefore, centered data was preferred.

Technically, centering makes interpretation meaningful, reduces multicollinearity (Hox 2002; Tabachnick and Fidell 2007), and is suggested in models having interaction terms (Aiken and West 1991). In multiple regression analysis the intercept is the value of the dependent variable when all the independent variables are zero. In this research, independent variables (e.g. park-home distance, neighborhood income) did not have a meaningful value of zero and centering made zero interpretable. The intercept after centering was interpreted as the expected home value with average score on the independent variables, that is, the expected variance for the average home.

Additionally, centering reduced the possibility of multicollinearity, computations were faster, fewer convergence problems were encountered, and the interpretation of the interaction became easier. The centered model was slightly different from the model estimated using raw data. Centering changed some parameter values, especially random parameters, but the models had the same fit, the same predicted values, and the same residuals (Kreft and de Leeuw1998).

3.7. Statistical Analysis

Five types of models (Models 1.0, 2.0, 3.1, 3.2, and 3.3) were estimated, four hypotheses (H1, H2, H3, and H4) were tested, and two datasets (CPB and CRC) were used for analysis. Figure 3.15 gives the plan of the statistical analysis done in the research.

The unconditional model (Model 1.0) did not have any independent variables. The home value was predicted by an intercept that varied across parks. The intraclass correlation (ICC) was computed from this model, which in turn determined the need for the multilevel analysis. The reference model (M2.0) contained all the home structural attributes and the park-home direct distance. This model was pitted against other models to answer the question – was the model improved by adding independent variables? The (-) 2Log Likelihood values of the reference model and nested models were compared, and significance tested using the χ^2 likelihood –ratio test. In general, models with lower (-) 2Log Likelihood values fit better. A model was nested (M3.1, 3.2, and 3.3) if the reference model could be derived from the nested model, that is, the reference model could be formed by removing parameters from the nested model (Hox 2002).

Multilevel models permit intercepts (mean home values) and slopes (home values and park-home direct distance relationships) to vary between parks; therefore, multilevel models are also called random coefficient regression models (Tabachnick and Fidell 2007). In turn this led to two kinds of nested models (M3.1 and 3.2). In the nested model 3.1 only intercepts were permitted to be random and in the nested model 3.2 both intercepts and slopes (home values vs. direct distances) were permitted to be random across parks. Model 3.3 was a random intercepts nested model with an interaction term, which was a product term formed by multiplying the direct distance with network distance.

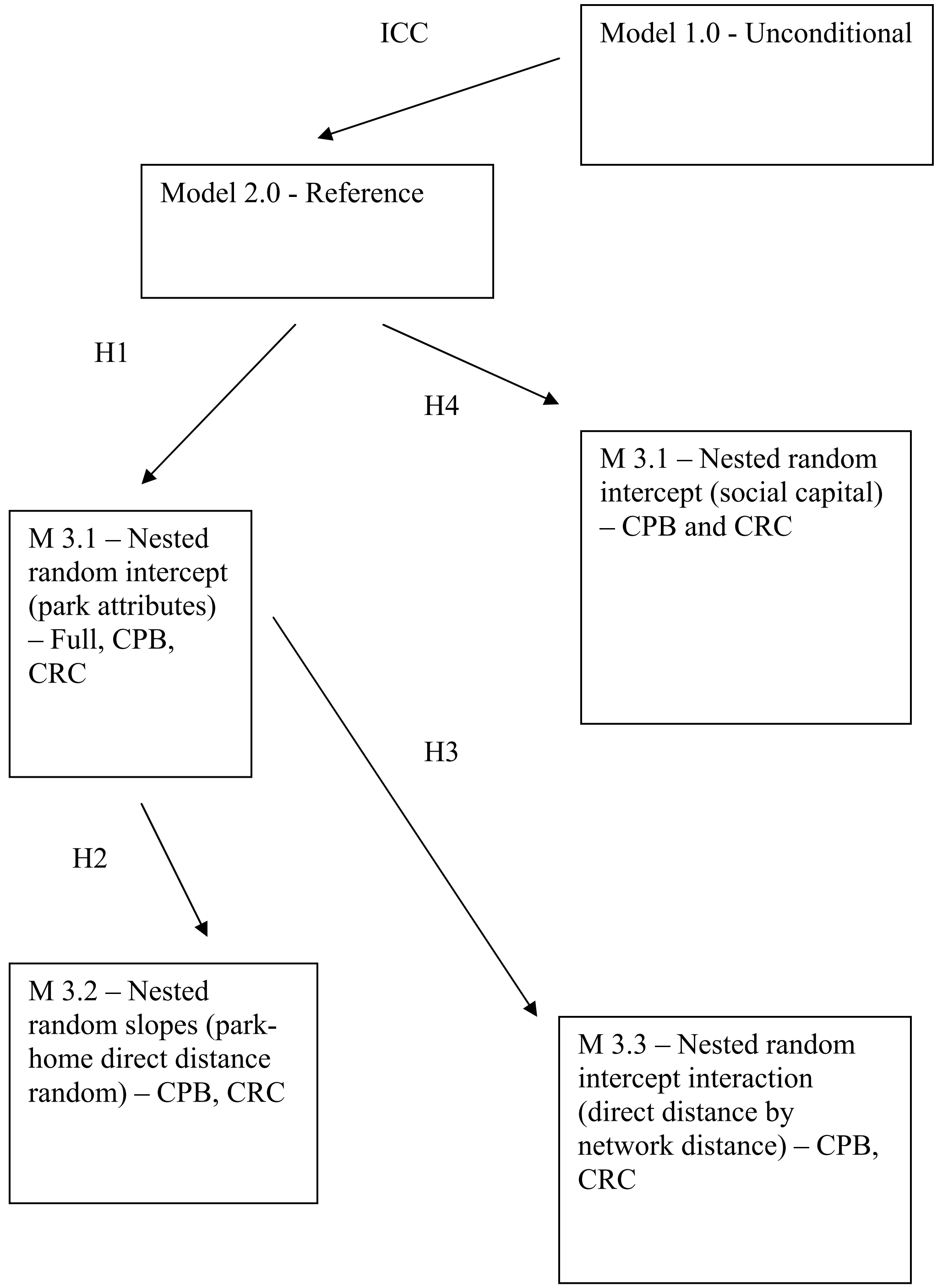

Figure 3.15. Model selection, related hypotheses, and analysis done

Multilevel Equations

In this part equations for the reference model with independent variables at level–1 and level-2 are derived (Heck and Thomas 2000, Luke 2004, and Tabachnick and Fidell 2007, 781-857).

Model 1.0 (Intercepts only Model without any Predictors) – This was the simplest model without any fixed terms except the overall intercept –

Level-1 equation (home) -

Home value$_{ij}$ (individual home value) = β_{0j} (intercept- mean- over j groups) + ϵ_{ij} (error of i^{th} home - deviation of a home value from the park neighborhood mean)

The value of β_{0j} was dependent on the park, therefore a parameter estimate (τ_{00}) was estimated with a standard error for the variance of the random effect, and the parameter value indicated the variance of home values between parks.

Level-2 equation (park): The park level used the home-level intercepts as the dependent variable and the prediction equation was -

β_{0j} (intercept for a park) = γ_{00} (average intercept over parks) + μ_{0j} (group error-deviation from average park intercept for j^{th} park)

For each park a separate equation could be written. Combining the two equations gave –

Home value$_{ij}$ (parks mean or average intercept) = γ_{00} (overall intercept or average intercept) + μ_{0j} (deviation in intercept for homes in j^{th} park) + ϵ_{ij} (deviation of i^{th} home in j^{th} park)

There were two random effects in the model –park intercepts and the residuals and one single fixed effect – overall intercept. Therefore, the total number of parameters in the model was three, the two random effects (μ_{0j} and ϵ_{ij}) and one fixed effect (γ_{00}).

Model 2.0 (only random intercepts) – This model included all level-1 home variables and shows the neighborhood effects after adjusting for home stock –

Level-1 equation (home) -

Home $value_{ij}$ = β_{0j} (park intercept varying over parks) + β_{1j} finished $area_{ij}$ (individual home value, not varying among parks) + β_{2j} age_{ij} + β_{3j} $bathrooms_{ij}$ + β_{4j} lot $size_{ij}$ + β_{5j} park-home direct $distance_{ij}$ + ϵ_{ij} (deviation of a home value from the park mean)

Level -2 equations (park) - Only the intercept is permitted to be random -

$\beta_{0j} = \gamma_{00} + \gamma_{01}$ neighborhood $income_j + \mu_{0j}$

Combining the two equations -

Home $value_{ij}$ = $\gamma_{00} + \gamma_{10}$ (finished $area_{ij}$) + γ_{20} (age_{ij}) + γ_{30} ($bathrooms_{ij}$) + γ_{40} (lot $size_{ij}$) + μ_{0j} + β_{5j} park-home direct $distance_{ij}$ + β_{6j} neighborhood $income_{ij}$ + ϵ_{ij}

This model had nine parameters- six fixed for independent variables, plus one for the fixed effect of intercept and two random effects for the intercept and the residual. Rearranging –

Home $value_{ij}$ = $\{\gamma_{00} + \gamma_{10}$ (finished $area_{ij}$) + γ_{20} (age_{ij}) + γ_{30} ($bedrooms_{ij}$) + γ_{40} (lot $size_{ij}$) + γ_{50} park-home direct $distance_{ij}$ + γ_{01} neighborhood $income_{ij}$ (fixed part)$\}$ + $\{\mu_{0j} + \epsilon_{ij}$ (random part)$\}$

Model 3.2 (random intercepts and slopes) - This model included all level-1 and level-2 variables and home value was predicted by a random intercept that varied across parks and a random slope for the relationship between home value and finished area that also varied across parks –

Level-1 equation (home) -

Home $value_{ij}$ = β_{0j} (park intercept varying over parks) + β_{1j} finished $area_{ij}$ (individual home value, not varying among parks) + β_{2j} age_{ij} + β_{3j} $bathrooms_{ij}$ + β_{4j} lot $size_{ij}$ + β_{5j} park-home direct $distance_{ij}$ + ϵ_{ij} (deviation of a home value from the park mean)

Level -2 equations (park) – random intercepts and slopes -

$\beta_{0j} = \gamma_{00} + \gamma_{01}$ neighborhood $income_j + \mu_{0j}$

$\beta_{1j} = \gamma_{10} + \mu_{1j}$

Combining the equations gave nine parameters in the model -five fixed and four random-

Home value$_{ij}$ = $\{\gamma_{00} + \gamma_{10}$ (finished area$_{ij}$) + γ_{20} (age$_{ij}$) + γ_{30} (bathrooms$_{ij}$) + γ_{40} (lot size$_{ij}$) + γ_{50} park-home direct distance$_{ij}$ + γ_{01} neighborhood income$_{ij}$ (fixed part)$\}$ + $\{\mu_{0j} + \mu_{1j} + \epsilon_{ij}$ (random part)$\}$

This model had ten parameters- six fixed for independent variables, plus one for the fixed effect of intercept and three random effects for the intercept, the residual, and the covariance between the slopes and the intercepts.

Estimating Methods

Maximum Likelihood (ML), Generalize Least Squares (GLS), Generalized Estimating Equations (GEE), and Bayesian method are some of the estimating method used in MLM. The ML principle was used because in large samples the ML method is robust against violations of assumptions and produces asymptotically efficient consistent estimates (Hox 2002). The estimates produced by the ML method maximize the probability (produce maximum likelihood of) of observing the data that is used in the model. Model estimation follows an iterative procedure – beginning with reasonable starting parameter values, which is improved in the succeeding steps to produce better estimates. Non-convergence occurs in small datasets or due to misspecified models or if the model has too many random (variance) components that are close to zero. If the change in the succeeding step is very small the program concludes that convergence is achieved.

Generally, the Full Maximum Likelihood (FML) and Restricted Maximum Likelihood (RML) techniques are used in parameter estimation. Table 3.15 summarizes the differences between RML and FML techniques. In FML both regression coefficients and variance components are used during estimation; in RML only the variance components are included (Kreft and DeLeeuw 1998). This dissertation research uses the FML method because (1) computations are generally easier, and (2) an overall χ^2 test based on likelihood can be used to compare the nested models against the reference model that differ in the fixed part, such as regression coefficients (Hox 2002).

Table 3.13. Comparison of FML and RML methods

Full Maximum Likelihood	Restricted Maximum Likelihood
Both regression coefficients and variance components included in likelihood function	Only variance components included in likelihood function and coefficients estimated in a second step
During estimation of variance components treats regression coefficients as fixed but unknown; does not account for the degrees of freedom lost while estimating the fixed effects; therefore biased- group level variance generally underestimated, although lower level variance accurate.	Variance components are estimated after removing fixed effects; therefore less bias
Advantages- Easier computation and regression coefficients are included in the likelihood function, therefore two models can be compared which differ in the fixed part- in RML only the random parts can be compared	Advantages-For balanced groups equal to ANOVA estimates and more realistic if groups are small

Source: Adapted by author (Hox 1998; Kreft and DeLeeuw 1998; Hox 2002)

3.8. Hypotheses Tested

Two types of datasets were used in the analysis – properties located around the CPB and CRC parks and the following hypotheses were tested -

H1 – Aesthetic experiences associated with parks increase proximate home values and noise and nuisance reduce them; therefore, it is hypothesized that specific park attributes will have a positive (e.g. open space, meadows, children's playsets) or a negative effect (e.g. playgrounds, picnic areas) on home values depending on the nature of experiences associated with them.

H2 – Park attributes effect proximate home values and their decay and park attributes and neighborhood characteristics differ among parks; therefore, it is hypothesized that the average home values and their decay (slope) differs significantly across park neighborhoods.

H3 – Park aesthetic experiences are dependent on park-home direct distances and park visitation is related to network distances; therefore, both direct and network distances affect home values, and it is hypothesized that the effect of park-home direct distance on home value is conditional on the values of the network distance.

H4 – Social networks and trust in park neighborhoods confer advantages to households' therefore, it is hypothesized that park neighborhoods with greater levels of social trust and associational activity have greater home values.

CHAPTER IV

RESULTS

Chapter IV presents the results of this study. The quantitative results presented in this chapter include descriptive and inductive statistics. ArcGIS v9.1 and CommunityViz were used for spatial analysis and SPSS v13.0 (later v15.0) was used to analyze data and the final results, which were also confirmed by running the analysis again with SAS v6.1. Five types of models (Models 1.0, 2.0, 3.1, 3.2, and 3.3) were estimated, four hypotheses (H1, H2, H3, and H4) were tested, and two datasets (CPB - 1517; CRC - 2275) were used for analysis. This chapter is organized into four parts – a methodological summary is followed by the presentation of data summary. Results of the analyses are presented in four parts corresponding to the four hypotheses given below. The last part summarizes the results chapter. The following hypotheses were tested -

H1 – Aesthetic experiences associated with parks increase proximate home values and noise and nuisance reduce them; therefore, it is hypothesized that specific park attributes will have a positive (e.g. open space, meadows, children's playsets) or a negative effect (e.g. playgrounds, picnic areas) on home values depending on the nature of experiences associated with them.

H2 – Park attributes effect proximate home values and their decay and park attributes and neighborhood characteristics differ among parks; therefore, it is hypothesized that the average home values and their decay (slope) differs significantly across park neighborhoods.

H3 – Park aesthetic experiences are dependent on park-home direct distances and park visitation is related to network distances; therefore, both direct and network distances affect home values, and it is hypothesized that the effect of park-home direct distance on home value is conditional on the values of the network distance.

H4 – Social networks and trust in park neighborhoods confer advantages to households' therefore, it is hypothesized that park neighborhoods with greater levels of social trust and associational activity have greater home values.

4.1. Methodological Summary

All parks between 1 and 25 acres were extracted from the CAGIS dataset. Twenty seven parks were not considered for analysis because of the following reasons – nonavailability in the CAGIS dataset, not having single-family homes in the 1000 feet buffer, located on hill sides at multiple levels, near complete overlap of park buffers or with other land uses or larger parks making separation of park effects difficult, and change of park use to non-recreational use. Within the park buffers the following types of data values were excluded – homes not sold in the last thirty years, homes under the joint influence of two or more parks, homes located within 100 feet from the park boundary, and homes which showed up as univariate and multivariate outliers. The final dataset consisted of 3,792 homes located around 26 parks in Cincinnati.

Home level variables (structural attributes, park-home distances) were taken from the CAGIS dataset and verified with the Hamilton County Auditor's data base. Park attributes were evaluated using the EAPRS tool. Social capital indicators were taken from the SCCBS survey done by the Saguaro Seminar. Using factor analysis, Composite Park variables were created separately for CPB parks (Physical Activity Resources, Aesthetics, General Services, and Family Facilities) and CRC managed facilities (Children's Activity Supporting Features, Moderate Activity Attributes, and Intensive Activity Attributes). Data screening consisted of – inspection of univariate descriptive statistics for accuracy of input, evaluation of missing data, checking pair wise plots for nonlinearity (SPSS plot), identifying and dealing with nonnormal variables, univariate outliers analysis (SPSS frequencies, descriptives, explore, and save option in linear regression), and residual diagnostics. All the level-1 variables, including neighborhood income, were centered on the grand mean of the variable. The dependent variable, home value, was log transformed. Table 4.1 gives the variable names, labels used in analysis, and the units of measurement.

Table 4.1. List of variables, labels and units of measurement

Variable label	*Level of measurement*	*Variable name*	*Units of measurement*
Assessed home market value	Level-1	lmktval	Log of assessed market value ($).
Lot size	Level-1	lotsiz	Acres
Finished home area	Level-1	finarea	Square meters
Home age	Level-1	homage	Home age (years)
Bathrooms	Level-1	bath	# bathrooms
Park-home direct distance	Level-1	dirdis	Park-home direct distance (meters)
Neighborhood income	Level-2	neighinc	Dollars /1000
Walkability - Park-home network distance	Level-1	netdis	Two categories -1 = 100-660 ft, 2 = 661 -1320 ft, and 3 > 1321 ft.
Social capital	Level-2	strstcat, schmzcat, orgincat, civparcat, grpinvcat	social trust (1-3), informal social interactions (1-3), organized group interactions (1 -3), civic participation (1-4), group involvements (1-4).
Park attributes	Level-2	CPB - Physical Activity Resources (bp), Aesthetics (cd), General Services (hf), and Family Facilities (eno); CRC – Children's Activity & Supporting Features (noephf), Moderate Activity Attributes (bcd), and Intensive Activity Features (p).	PEX– (1 -3); NATE- (1 -3); NOAL- (1 -3); PER- (1 -3); PROX- (1 - 5).

Multicollinearity was checked for the models separately during model estimation using the SPSS REGRESSION procedure and requesting for collinearity diagnostics for the CPB and CRC datasets. Using the norm that multicollinearity is indicated if the conditioning index is greater than 30 for a given dimension coupled with variance proportion greater than 0.50 for at least two different variables (Belsey et al. 1980) showed that multicollinearity was not a problem. The maximum conditioning index (CPB = 23.029) was obtained in the interaction model during the testing of the third hypothesis.

4.2. Data Summary

Home structural and locational attributes were measured at level-1, while the park neighborhood variables were measured at level-2. Models were generated to test the relation between home values and level-2 variables controlling for home structural features and neighborhood income. Moreover, models were estimated using the CPB and CRC datasets and descriptive statistics were first generated for these two datasets separately. Table 4.2 gives the mean, standard deviations, and the minimum and maximum values for all level-1 and level-2 variables. Compared to homes located around CRC parks, homes around CPB parks on an average have higher home values, are older and built on larger lots, have larger built area, and have greater number of bathrooms. However, the range of the lot size was greater in CRC parks (3.05 acres vs. 2.33 acres).

Table 4.2. Park jurisdiction-wise descriptive statistics of level-1 and level-2 variables

Variable/ Term	CPB (Parks = 13; N = 1517)				CRC (Parks = 13; N = 2275)			
	Mean	Std dev	Min	Max	Mean	Std dev	Min	Max
Level- 1								
mktval ($)	143,823	167,595	6,200	2,000,000	120,776	107,89	5,300	1,775,000
lotsiz (acres)	0.17	0.16	0.01	2.34	0.16	0.16	0.10	3.15
finarea (sq mts)	168.49	90.36	41.62	915.07	136.22	57.699	41.81	838.70
homage (yrs)	88.32	25.57	2	190	79.33	24.28	1	188
bath	1.597	0.81	0.50	7	1.37	0.58	0.50	7
dirdis (ft)	634.09	242.38	108.68	999.92	601.96	245.53	100.09	998.62
netdis (ft)	1884.36	864.31	208.03	5019.16	2293.93	1316.48	222.35	7,700.22
Level-2								
neighinc ($)	44,534.24	25,128.17	101	175,807	45,243.27	17,573.39	865	141,721
Physical Activity Resources	13.13	12.24	0	32				
Aesthetics	10.09	10.305	0	31				
General Services	17.33	13.81	0	43				
Family Facilities	30.04	26.51	0	79				
Children's Activity & Supporting Features					90.32	23.32	31	133
Moderate Activity Attributes					27.69	16.41	3	55
Intensive Activity Features					18.30	15.81	7	159
strstcat[a],	2.00	0.94	1	3	2.01	0.64	1	3
schmzcat[a]	1.92	0.61	1	3	2.18	0.79	1	3
orgincat[a]	2.44	0.72	1	3	2.04	0.74	1	3
civparcat[a]	3.03	0.88	2	4	2.52	0.95	1	4
grpinvcat[a]	2.88	0.88	2	4	2.52	0.94	1	4

Note: [a] N (CPB = 1098; CRC = 2137)

Factors generated for CPB parks had high mean values on Family Facilities and Supporting Services, and CRC facilities on Children's Activity & Supporting Features. Social capital indicators also showed interesting differences. General social trust levels were similar in the two park neighborhoods; but group involvement and civic participation were higher in CPB neighborhoods.

Park wise descriptive statistics are given in tables 4.3 and 4.4 separately for CPB and CRC parks. In the CPB parks the mean lot size was approximately 0.1 acres, the finished area was around 150 square meters, and the average number of bathrooms was 1.5. The average home age was nearly 90 years. However, variations were found among parks – Annwood (lot size = 0.83 acres; finished area = 728; bathrooms = 6.0). The average network distance was one-third mile. Within CPB parks large variations exist. The range of lot sizes varied from 2.09 acres (Annwood) to 0.17 acres (Bellevue); home finished area from 728 square meters (Annwood) to 211 square meters (Bellevue); number of bathrooms from 6.0 (Annwood) to 2.0.

The mean lot sizes, finished areas, number of bathrooms, and the home age in CRC parks were approximately equal to CPB parks. Large and small homes were found in CRC parks also – in Ryan the range of lot size is 3.09 acres, but the range of finished area is less at, 298 square meters. However, homes were located farther away, at one-half mile, in CRC parks. Therefore, evidence was found for inter and intra-park variation in the structural attributes of homes.

Table 4.3. Park-wise descriptive statistics for CPB managed facilities

Variable	Statistics	Park name (number of homes)												
		Ann (29)	Belle (122)	Fleisch (51)	Kennedy(77)	Losan Tr (31)	Mad (201)	May (212)	MLK (52)	Owls (188)	Sayler (166)	Vall (49)	West (188)	Wilson-n(151)
lotsiz (acres)	Mean	0.83	0.065	0.15	0.27	0.11	0.20	0.14	0.28	0.11	0.20	0.07	0.17	0.13
	SD	0.57	0.029	0.12	0.18	0.03	0.12	0.06	0.17	0.10	0.08	0.02	0.08	0.08
	Range	2.09	0.17	0.68	0.94	0.14	1.05	0.38	0.93	0.90	0.61	0.12	0.6	0.75
finarea (sq meter)	Mean	525	146	177	156	173	245	123	257	134	134	162	153	155
	SD	207	39	109	47	51	79	36	111	53	42	57	43	51
	Range	728	211	597	232	263	496	213	461	347	189	267	225	291
hom-age (years)	Mean	93	102	67	76	96	89	75	84	99	85	106	85	96
	SD	15	26	38	12	15	21	26	29	20	33	16	18	18
	Range	82	137	120	66	70	129	114	123	132	58	51	168	97
bath	Mean	3.52	1.45	1.93	1.45	1.56	2.27	1.28	2.48	1.36	1.32	1.62	1.45	1.34
	SD	1.38	0.58	0.95	0.54	0.72	0.92	0.44	1.27	0.64	0.47	0.54	0.52	0.49
	Range	6.00	2.50	4.50	2.00	2.50	5.00	2.50	4.50	6.00	2.00	2.00	2.00	2.00
dirdis (feet)	Mean	670	573	623	684	786	651	639	696	649	594	429	676	613
	SD	256	250	228	217	174	235	252	215	243	259	168	222	238
	Range	827	883	796	765	770	886	888	795	881	881	6325	887	875
netdis (feet)	Mean	1138	2,587	1,364	2449	1978	1,662	1975	2215	1,842	1482	1,088	1,479	2,642
	SD	331	602	411	1,466	553	590	774	1,092	609	577	269	555	1,015
	Range	1,241	3,027	1,716	3,885	1,792	2,639	3,267	4,304	2,597	2535	1,240	2,599	3,834

Note: Except lotsiz and bath all values rounded.

Table4.4. Park-wise descriptive statistics for CRC managed facilities

Variable	Statistics	Park name (number of homes)												
		Bram (400)	College(113)	Demp (133)	Filson (148)	Lebl (72)	Oakl (349)	Pleas (201)	Riv (72)	Rosel (88)	Ryan (278)	St. Cl (138)	Wint (132)	Wood (151)
lotsiz	Mean	0.13	0.23	0.11	0.07	0.29	0.12	0.16	0.26	0.15	0.23	0.11	0.19	0.19
	SD	0.05	0.27	0.04	0.045	0.32	0.05	0.06	0.28	0.04	0.29	0.07	0.15	0.07
	Range	0.51	2.0	0.28	0.33	1.55	0.35	0.54	1.24	0.39	3.09	0.36	1.27	0.45
fin-area	Mean	115	155	162	166	240	113	143	130	105	144	120	134	144
	SD	33	58	59	87	136	31	32	53	34	45	49	52	36
	Range	252	347	371	613	750	235	200	290	304	298	382	301	203
hom-age	Mean	69	82	94	113	65	80	81	90	62	70	96	81	66
	SD	15	23	22	29	46	13	14	19	7	19	33	23	17
	Range	104	142	127	180	136	82	130	92	52	139	179	152	99
bath	Mean	1.24	1.41	1.48	1.76	2.47	1.21	1.34	1.20	1.19	1.43	1.26	1.28	1.45
	SD	0.44	1.00	0.59	0.70	1.30	0.37	0.45	0.45	0.44	0.54	0.43	0.44	0.51
	Range	2.50	2.50	2.50	3.00	6.00	1.50	2.50	2.50	3.00	3.50	2.00	2.00	2.00
dirdis	Mean	623	585	625	587	535	649	577	517	755	589	476	624	581
	SD	255	231	258	207	286	221	240	189	147	262	252	254	239
	Range	897	884	870	871	842	896	849	783	512	897	870	889	862
netdis	Mean	2,268	1,665	1,542	1,083	2,516	2449	1,609	1162	4,390	3,272	1,607	1,994	3,535
	SD	906	842	370	479	1212	1108	494	390	819	1,488	506	1,172	1,839
	Range	3,947	4581	1,640	2,848	7142	5005	2,448	1,701	2,948	6,141	2,049	4,952	6,113

Note: Except lotsiz and bath all values rounded.

More importantly, differences were found in the parks managed by the CPB and CRC parks. Generally, homes in CPB park neighborhoods were located within one-third mile from parks, but home around CRC facilities were located farther away. Homes around three CRC parks -Roselawn, Ryan, and Woodford, were located beyond 3000 feet.

4.3. Results of Hypotheses

To test the first hypothesis three models were estimated - (1) the unconditional model without any independent variables (M1.0), which showed the compositional effects; (2) the reference model (M2.0) with home structural features (lot size, finished area, bathrooms, home age and park-home direct distance), which identified the contextual effects of location after adjusting for compositional effects of housing stock; and (3) the nested models (M3.0), which contained all the variables in Models 1 or 2. Two datasets (CPB – 13 parks, and CRC – 13 parks) were used to estimate the unconditional, reference, and nested models. Extracted factors were used as park variables. The χ^2 test statistic, computed from the -2ML log-likelihood ratios, was used to evaluate model improvement – unconditional vs. reference and nested vs. reference models. In general, models with lower (-) 2Log Likelihood values fit better. The intraclass correlation (ICC) was computed from this model, which in turn determined the need for the multilevel analysis.

The second hypothesis was tested by making the intercepts and slopes random. In the nested model 3.1 only intercepts were permitted to be random and in the nested model 3.2 both intercepts and slopes were made random across parks. The third hypothesis was tested through the interaction nested model (M 3.3), which was the random intercepts model with an interaction term, formed by multiplying the direct distance with network distance, while controlling for park attributes. The last hypothesis was tested using a random intercepts model (M3.1) with social capital indicators added as level-2 variables.

Hypothesis # 1

Research Question #1 – Using multilevel models to examine the effect of specific park attributes on home values?

Hypothesis # 1 – Aesthetic experiences associated with parks increase proximate home values and noise and nuisance reduce them; therefore, it is hypothesized that specific park attributes will have a positive (e.g. open space, meadows, children's playsets) or a negative effect (e.g. playgrounds, picnic areas) on home values depending on the nature of experiences associated with them.

Chi-Square Test - The intercept only, reference, and the nested models were evaluated using the Chi-Square (χ^2) likelihood-ratio test because all the effects of the more complex model were found in the simpler model, that is all the independent variables in the unconditional model were contained in the reference model and in turn the reference model predictors were found in the nested model (Hox 2002, 38; Tabachnick and Fidell 2007, 830). Table 4.5 gives the log-likelihood ratios, χ^2 statistic, and the significance levels for the three models. Compared to the unconditional model, adding home structural attributes and neighborhood income improved the models in both CPB (χ^2 (6) = 958.27, p <.001) and CRC (χ^2 (6) = 1364.61, p <.001) datasets. However, including park characteristics only improved the model in the CPB dataset (χ^2 (4) = 12.99, p <.025); therefore, only the CPB nested model predicted home values beyond what would be expected by chance.

Table 4.5. Comparison of - 2ML log-likelihood values of the unconditional, reference, and nested models containing park attributes

Model	Models compared – 2ML log-likelihood values			χ^2 difference test			
	Unconditional (df)	Reference (df)	Nested random intercept model (df)	Reference vs. Unconditional(df)	Significance levels	Nested vs Reference(df)	Significance levels
CPB	-631.01 (3)	-1589.28 (9)	-1602.83 (13)	958.27 (6)	.001	12.99 (4)	.025
CRC	-1235.00 (3)	-2599.61 (9)	-2604.12 (12)	1364.61 (6)	.001	4.51 (3)	.25

Intraclass Correlation - The complete results of the unconditional, reference, and random intercept models for CPB and CRC parks are given in tables 4.6 and 4.7. The intraclass correlation (ρ) was computed to investigate the need for a multilevel model and indicate the presence of housing submarkets. High values implied that the assumption of independent errors was violated and that the errors were correlated (Luke 2004, 27; Tabachnick and Fidell 2007, 822), meaning that there was variance in the park level means on home values around the grand mean. The intraclass correlation (ρ) was calculated as the ratio of the variance in home values between parks at level-2 to the variance in home values within parks. High intraclass correlation values (CPB = 72.38%; CRC = 56.57%) in the unconditional models indicated the presence of housing submarkets. The intraclass correlation values were higher for CPB parks (ρ = 72.38%) as compared to CRC properties (ρ = 56.57%).

Interpreting Fixed-Effect Parameter Estimates – Models 1.0, 2.0, and 3.1 have an intercept (γ_{00}) and independent variables (γ_{ij}) at level-1 and level-2. The intercepts in the unconditional model were the unweighted grand mean of home values for the 13 parks (mean of the 13 park means). In the reference model the home values were interpreted as the unweighted grand mean of home values when all level-1 independent values had average values, that is, the expected home value of an average sized home located at an average distance from the park in an average income neighborhood. The intercept in the nested model gave the grand mean of an average sized home value located in an average income neighborhood with park attribute scores = 0. The fact that it differed significantly from the average home value was of no research interest (Tabachnick and Fidell 2007).

In the reference models home lot size, finished area, number of bathrooms, direct distance, and neighborhood income were positively associated, and home age was negatively related to home values. Lot size in the CPB dataset and direct distances in the CPB and CRC datasets did not reach significance. The CPB nested model improved upon the reference model; therefore, this model was only interpreted. The relationship of Aesthetics and General Services with home values was positive and Physical Activity Resources and Family Facilities negative. Physical Activity Resources had the largest effect on home values and Family Facilities the minimum.

Table 4.6. CPB nested, reference, and unconditional models with EAPRS elements combined into factors compared to the reference and unconditional models

	Unconditional model(Model 1.0)		Reference model (Model 2.0)		Nested random intercept model(Model 3.1)	
Variable/Term	Unstandardized coefficient	SE	Unstandardized coefficient	SE	Unstandardized coefficient	SE
Fixed effects						
Intercept	5.039	.086	4.968	.041	5.041	.060
lotsiz			0.055	.034	0.053	.034
finarea			0.002**	.000	0.002**	.000
homage			-0.002**	.000	-0.002**	.000
bath			0.048**	.007	0.048**	.006
dirdis			-0.000	.000	-0.000	.000
neighinc			0.001**	.000	0.001**	.000
Physical Activity Resources (bp)					-0.007**	.002
Aesthetics (cd)					0.005*	.002
General Services (hf)					0.006*	.002
Family Facilities (eno)					-0.003**	.001
Random effects - variances						
Park level (intercept)[a]	0.097**	.038	0.021**	.008	0.007**	.003
Home level	0.037**	.001	0.019**	.001	0.019**	.001
-2 log-likelihood (df)	-631.01 (3)		-1589.28 (9)**		-1602.83 (13)*	

Note: significance levels *.05 and **.01

a – SPSS gives a two-tailed test against a more appropriate singe-tailed test; therefore, the p values have been divided by two

Table 4.7. CRC nested, reference, and unconditional models with EAPRS elements combined into factors compared to the reference and unconditional models

	Unconditional model (Model 1.0)		Reference model (Model 2.0)		Nested random intercept model (Model 3.1)	
Variable/Term	Unstandardized coefficient	SE	Unstandardized coefficient	SE	Unstandardized coefficient	SE
Fixed effects						
Intercept	4.984	.058	4.986	.040	4.77	.143
lotsiz			0.067**	.019	0.067**	.019
finarea			0.002**	.000	0.002**	.000
homage			-0.002**	.000	-0.002**	.000
bath			0.048**	.006	0.048**	.007
dirdis			-0.000	.000	-0.000	.000
neighinc			0.003**	.000	0.003**	.000
Children's Activity & Supporting Features (noephf)					0.001	.001
Moderate Activity Attributes (bcd)					0.003	.003
Intensive Activity Features (p)					0.000	.000
Random effects - variances						
Park level (intercept)[a]	0.043**	.017	0.021**	.008	0.017**	.007
Home level	0.033**	.001	0.018**	.001	0.018**	.001
-2 log-likelihood (df)	-1235.00 (3)		-2599.61(9)**		-2604.12 (12)	

Note: significance levels *.05 and **.01

a – SPSS gives a two-tailed test against a more appropriate singe-tailed test; therefore, the p values have been divided by two

Interpreting Random-Effect Parameter Estimates – Models 1.0, 2.0, and 3.1 had two random coefficients each (τ_{00} and ε_{ij}). Both the home level (ε_{ij}) and park level (τ_{00}) random effects were significant across all three models for CPB and CRC datasets. Park level random effect (intercept) was the variance in the means of home values for parks around the grand mean of home values, that is, the variance in the mean home values across parks was significant. Varying intercepts suggested the desirability of taking park differences into account (housing submarkets) when predicting home values. Home level random effect was the variance in home values for individual homes within park neighborhoods around the mean home value for the park, that is, home values differ even after accounting for differences among parks. This random effects part of the model was concerned with the variance components. Non-zero variance components showed un-modeled variability. The relative larger variance component in the unconditional model for the CPB dataset for park level variance (CPB =0.097 vs. CRC =0.043) showed the need to add more independent variables.

The inclusion of home structural attributes, park-home distance, and neighborhood income in the reference model led to a decline in home level and park level estimated variances. The reduction in the home level estimated variance was expected because price differences between individual houses are a result of differences in structural, location, and neighborhood attributes. The reduction in park level variances was greater in the case of the CPB dataset – the estimated variance changes from 72.4 percent in the unconditional model to 52.5 percent in the reference model; the corresponding change in the CRC dataset was from 56.6 percent to 53.9 percent. Adding home attributes and neighborhood income to the unconditional model made the estimated park effects in the CPB and CRC datasets approximately equal (τ_{00} = 0.021).

Adding park attributes to the CPB dataset to estimate the nested model further reduced the park level variance (τ_{00} = 0.021 to 0.007), without changing the home level variance estimates (ε_{ij} = 0.019). This was expected because inclusion of park attributes in the model was expected to only change the park level effects, not home level estimated variances. The nested model estimated using the CRC dataset could not be interpreted because the nested model did not significantly improve prediction as compared to the reference model ($2LL_{reference} - 2LL_{nested}$ = 4.51, df (3), $p > .25$).

Variance Explained - In multiple regression analysis the squared multiple correlation R^2, is interpreted as the proportion of variance modeled by the independent variables. In multilevel models the issue of variance explained is complex. First, variance has to be explained at multiple levels, and second, in a random slopes model variance explained ceases to have a unique definition and the estimated variances depend on the scale of the independent variables (Hox 2002).

Table 4.8. Variance explained by the reference and nested models

Park jurisdiction	Model type	Level	Percentage of variance explained
CPB	Reference	Level-1	35.14
	Nested	Level-1	35.14
	Nested	Level-2	92.78
CRC	Reference	Level-1	45.45

A simple method to compute the proportion of variance explained was to investigate the residual error, separately for levels, in a series of nested models using the FML principles (Bryk and Raudenbush1992; Hox 2002; Tabachnick and Fidell 2007). The base model for all comparisons was the unconditional model. The following general formula was used –

$$\frac{(\text{Home/Park level variance}_{\text{unconditional}} - \text{Home/Park level variance}_{\text{reference/nested}})}{(\text{Home/Park level variance}_{\text{unconditional}})}.$$

Table 4.8 gives the variance explained in the reference and nested models. Introducing home structural attributes and neighborhood income explained more variance in home around CRC facilities (45.45 percent) as compared to homes in CPB neighborhoods (35.14 percent) and adding park attributes to the CPB model explained 92.78 percent of the level-2 variance.

Hypothesis # 2

Research Question #2 – Using multilevel models to determine if there is a significant difference in the mean home values and in the slope of the relationship between assessed home values and park-home direct distances across parks after controlling for home features, neighborhood income, and park attributes.

Hypothesis # 2 – Park attributes effect proximate home values and their decay and park attributes and neighborhood characteristics differ among parks; therefore, it is hypothesized that the average home values and their decay (slope) differs significantly across park neighborhoods.

Model 3.1 and Model 3.2 contained the same set of independent variables, but the home value-direct distance slope was permitted to vary across parks in Model 3.2, that is, the model was specified with random intercepts and slopes. Accordingly, there were four random coefficients (τ_{00}, τ_{10}, τ_{11} and ε_{ij}).). Table 4.9 gives the fixed and the random estimates of the reference and nested models generated using the CRC and CPB datasets. Nested random models estimated using both the CPB and the CRC datasets predicted better than chance (CPB - $2LL_{intercept} - 2LL_{slope} = 20.05$, df (2), $p < .001$; CRC - $2LL_{intercept} - 2LL_{slope} = 50.88$, df (2), $p < .001$). Generally, the coefficients and standard errors were robust for home structural attributes, park-home distance, neighborhood characteristics, and park attributes of the model.

Interpreting Fixed-Effect Parameter Estimates – The intercepts (γ_{00}) in the nested random slopes and intercepts models were robust and were interpreted as the expected value of an average type of home located at an average distance from a park in an average income neighborhood. Permitting the slope to vary across parks did not affect the coefficients or their signs for home structural attributes, park-home direct distance, park attributes, and the neighborhood income. Lot size was significant only in the CRC dataset and direct distance remained non-significant in both the datasets, although the negative sign was expected.

The sign of the coefficients of the variables created from EAPRS scores remained unchanged in the CPB dataset. The association of Aesthetics and General Services with home values was positive and negative for Physical Activity Resources and Family Facilities. Physical Activity Resources continued to have the largest effect on home values and Family Facilities the minimum. However, Intensive Activity Features (*p* element) in the CRC dataset became significant after permitting the slopes to become random across parks. Moreover, park features that promote intensive physical activity were positively related to home values.

Table 4.9. Nested random intercept and random slope models for CPB and CRC parks

	CPB (Models 3.1 and 3.2)				CRC (Models 3.1 and 3.2)			
Variable/ Term	Nested random intercept model		Nested random slopes model		Nested random intercept model		Nested random slopes model	
	Unstand -ardized coefficient	SE	Unstandar-dized coefficient	SE	Unstandar -dized coefficient	SE	Unstandar -dized coefficient	SE
Fixed effects								
Intercept	5.041	.060	5.037	.058	4.77	.143	4.745	.142
lotsiz	0.053	.034	0.051	.033	0.067**	.019	0.068**	.019
finarea	0.002**	.000	0.002**	.000	0.002**	.000	0.002**	.000
homage	-0.002**	.000	-0.002**	.000	-0.002**	.000	-0.002**	.000
bath	0.048**	.006	0.048**	.006	0.048**	.007	0.047**	.007
dirdis	-0.000	.000	-0.000	.000	-0.000	.000	-0.000	.000
neighinc	0.001**	.000	0.001**	.000	0.003**	.000	0.002**	.000
bp	-0.007**	.002	-0.007**	.003				
cd	0.005*	.002	0.005*	.002				
hf	0.006*	.002	0.006*	.002				
eno	-0.003**	.001	-0.003**	.001				
noephf					0.003	.002	0.002	.001
bcd					0.001	.001	0.003	.003
p					0.003	.003	0.001*	.000
Random effects – variances and co variances								
Park level (inter)[a]	0.007**	.003	0.008**	.003	0.017**	.007	0.017**	.007
Park level (slope/intercept)			-0.000	.000			0.000	0.000
Park level (slope)[a]			0.000***	.000			0.000*	0.000
Home level	0.019**	.001	0.019**	.001	0.018**	.001	0.017**	.001
-2 log-likelihood (df)	-1602.83 (13)		-1622.98 (15)**		-2604.12 (12)		-2655.00 (14)**	

Note: significance levels *.05, **.01 and ***.1
a – SPSS gives a two-tailed test against a more appropriate singe-tailed test; therefore, the p values have been divided by two

Interpreting Random-Effect Parameter Estimates – The home level (residuals) and park level (intercepts) estimated variances continued to remain significant in both the CPB and CRC datasets. The interpretation was that the means of home values for the parks vary across parks even after home structural, neighborhood characteristics, and park features were accounted for, and home values within park neighborhoods also varied significantly. Simply, even after permitting both intercepts and park-home direct distances to become random, home differences between and within parks matter. Homes within parks were similar and different from homes in other parks indicating the presence of housing submarkets.

There was little change in the park level (intercepts) and home level variances in Models 3.1 and 3.2, that is, permitting park-home direct distances (slopes) to become random had little effect on park level and home level variances in both the CPB and CRC datasets. Considerable home level variance remained un-modeled in both the datasets, which was expected because we had specified a parsimonious model with minimum home structural attributes. However, un-modeled park effects (intercepts) in CRC neighborhoods were larger, τ_{00} = 0.008 in CPB vs. 0.017 in CRC, that is, by adding EAPRS factors to the CPB model had led to the explanation of larger amount of variance in home values.

The park level (slope/intercept) covariance (τ_{10}) failed to achieve significance in both the CPB and CRC datasets, which means that there is no relationship between intercepts and slopes among parks, that is, there is no evidence that the effects of direct distance on home values depends on the average home value in parks. This is intuitive because it is not the case that the increase of home values with decrease of direct distance is greater for expensive properties. The park level slope (τ_{11}) was significant in CRC neighborhoods ($p < .05$) and in CPB neighborhoods

($p < .1$), which implies that the variance in the slopes (home-value vs. direct distance) differs, although at higher alpha levels, among parks in the CPB dataset.

Hypothesis # 3

Research Question #3 – Using multilevel models to investigate the interaction of park-home direct distance with network distance in its effect on the assessed home market values, after controlling for home structural features and park attributes.

Hypothesis # 3 – Park aesthetic experiences are dependent on park-home direct distances and park visitation is related to network distances; therefore, both direct and network distances affect home values, and it is hypothesized that the effect of park-home direct distance on home value is conditional on the values of the network distance.

Generally, the suggestion is to include the main effects with interaction terms in the model and interpret the interaction effects as a system (Jaccard, Turrisi, and Wan 1990; Aiken and West 1991); therefore, Model 3.3 contained direct distance, the categorical walkability variable, and the interaction term, which was the product of direct distance and the categorical walkability variable (dirdis *by* netdis). Moreover, Model 3.3 was nested in Model 3.1, that is, all the variables in Model 3.1 were contained in Model 3.3. Further, only intercepts were permitted to be random in Model 3.3.

In Model 3.3 the walkability variable was entered as a categorical variable in the SPSS syntax. SPSS treats category three as reference and compares network distances one and two with the reference level (netdis 1 vs. 3 and 2 vs.3). The order of entry in the SPSS syntax was important – the interaction term was added to the model equation after the main effects, because changing the order was likely to affect parameter estimates for fixed effects (Tabachnick and Fidell 2007).

Table 4.10 gives the fixed and the random estimates of the nested intercept model and the nested interaction models generated using the CRC and CPB datasets. Pitting the intercept model against the interaction model showed that the Model 3.3 generated using the CPB dataset only led to prediction that was significantly better than chance (CPB $-2LL_{\text{Model 3.3}} - 2LL_{\text{Model 3.1}} = 62.41$, df (3), $p < .001$; CRC $- 2LL_{\text{Model 3.3}} - 2LL_{\text{Model 3.1}} = 2.18$, df (3), $p > .250$); therefore, only the CPB model was interpreted.

Interpreting Fixed-Effect Parameter Estimates – Generally, the coefficients and the standard errors in the intercept and the nested models were robust in both the fixed and random parts of the CPB model. Finished area, home age, number of bathrooms, neighborhood income, Aesthetics, General Services, Physical Activity Resources and Family Facilities reached significance in the intercept model. The signs were expected – positive for all except home age, Physical Activity Resources and Family Facilities. Lot size continued to have an insignificant relationship with home values.

Table 4. 10. Nested random intercept and interaction models for CPB and CRC parks

	CPB (Models 3.1 and 3.3)				CRC (Models 3.1 and 3.3)			
Variable/ Term	Nested random intercept model		Nested interaction model		Nested random intercept model		Nested interaction model	
	Unstandardized coefficient	SE	Unstandardized coefficient	SE	Unstandardized coefficient	SE	Unstandardized coefficient	SE
Fixed effects								
Intercept	5.041	.060	5.056	.062	4.77	.143	4.77	.143
lotsiz	0.053	.034	.053	.033	0.067**	.019	0.067**	.019
finarea	0.002**	.000	0.002**	.000	0.002**	.000	0.002**	.000
homage	-0.002**	.000	-0.002**	.000	-0.002**	.000	-0.002**	.000
bath	0.048**	.006	0.048**	.006	0.048**	.007	0.048**	.007
dirdis	-0.000	.000	-0.001**	.000	-0.000	.000	-0.000	.000
neighinc	0.001**	.000	0.001**	.000	0.003**	.000	0.003**	.000
bp	-0.007**	.002	-0.007**	.002				
cd	0.005*	.002	0.005*	.002				
hf	0.006*	.002	0.006*	.002				
eno	-0.003**	.001	-0.003**	.001				
noephf					0.003	.002	0.002	.000
bcd					0.001	.001	0.002	.001
p					0.003	.003	0.001	.000
netdis 1 vs.3			-0.139**	.029			-0.029	.029
netdis 2 vs.3			-0.070**	.009			-0.02	.009
dirdis *by* netdis			.0004**	.000			0.000	.000
Random effects – variances								
Park level (inter)[a]	0.007**	.003	0.008*	.003	0.017**	.007	0.017**	.007
Home level	0.019**	.001	0.019**	.001	0.018**	.001	0.018**	.001
-2 log-likelihood	-1602.83 (13)		-1665.24 (16)**		-2604.12 (12)		-2606.30 (15)	

Note: significance levels *.05 and **.01

a – SPSS gives a two-tailed test against a more appropriate singe-tailed test; therefore, the p values have been divided by two

There were two main effects – direct distance and walkability (network distance category). Importantly, the addition of walkability made the variable direct distance significant with a negative sign, that is, average home values decreased with increasing distance from the park. When an interaction term was included the main effects were interpreted as the average effect (not constant effects) of an independent variable on a dependent variable across values of the moderator variable (Jaccard, Turrisi, and Wan 1990). The interpretation was that the relationship between home values and average effect of direct distance was negative and significant, and was conditional on the network distance category.

The two walkability categories were negative and significantly related to home values. This meant that homeowners living within one-eight mile (netdis 1 vs. 3) and between one-eight and one-fourth (netdis 2 vs.3) walking distance from the park valued accessibility less than households living beyond one-fourth mile distance. The values of the fixed coefficients also gave some important information – accessibility was valued more by homeowners living between one-eight and one-fourth walking distances from the park as compared to home owners living within one-eight mile walking distance.

Interpreting Random-Effect Parameter Estimates – The home level and park level (intercepts) estimated variances continued to remain significant in both the CPB and CRC datasets. Home values for the parks varied across parks even after home structural; neighborhood characteristics, park features, and walkability were controlled. There was little change in the park level (intercepts) and home level variances between Models 3.1 and 3.3, that is, including the moderating influences of network distance on direct distance had little effect on park level and home level variances in the CPB dataset.

Interpreting Interaction Effects – The interaction term was significant and positive, although the coefficient value was relatively small (dirdis *by* netdis = .0004, $p < .01$). The interaction term had a positive sign showing that the value of proximity to a park was diminished as travel distance increased. Moreover, the intercept was greater in value for homes located within one-eight mile travel distance from parks, that is, residential properties located within one-eight mile walking distance from parks had greater home values.

Hypothesis # 4

Research Question #4 – Using multilevel models to explore the effect of neighborhood level social capital indicators on home values.

Hypothesis # 4 – Social networks and trust in park neighborhoods confer advantages to households' therefore, it is hypothesized that park neighborhoods with greater levels of social trust and associational activity have greater home values.

The re-specified Model 3.1, with five additional social capital variables was estimated, separately for CPB and the CRC datasets. The validity of the results generated from Model 3.1 using the CPB and the CRC datasets was doubtful because the final Hessian matrix was not positive definite. Therefore, non-significant variables were removed step-wise and the model converged after removing social trust and informal interactions (strstcat and schmzcat). Accordingly, the re-specified model with orgincat, civparcat, and grpinvcat was estimated. However only the model generated from the CRC dataset predicted better than chance (CRC $-2LL_{\text{Model 3.2 (soccap)}} - 2LL_{\text{Model 2.0}} = 162.61$, df (8), $p < .001$); therefore, only this model was interpreted. The results are shown in table 4.11.

Table 4.11. CRC Model 3.1 with social capital indicators

Variable/Term	Unstandardized coefficient	SE
Fixed effects		
Intercept	5.101	.042
lotsiz	0.06**	.019
finarea	0.002**	.000
homage	-0.002**	.000
bath	0.055**	.006
dirdis	-0.000	.000
neighinc	0.003**	.000
orgincat 3vs.1	-0.100	.057
3 vs.2	0.059	.076
civpartcat 4 vs 1	-0.175*	.064
4 vs. 2	-0.033	.089
4 vs. 3	-0.068	.079
grpinvcat 4 vs.1	-0.282*	.018
4 vs.2	0.033	.053
4 vs. 3	-0.078	.063
Random effects – variances		
Park level (intercept)[a]	0.002*	.001
Home level	0.015**	.000
-2 log-likelihood	- 2762.23 (17)**	

Note: significance levels *.05 and **.01
a – SPSS gives a two-tailed test against a more appropriate singe-tailed test; therefore, the p values have been divided by two

The signs of the home structural attributes, direct distance, and neighborhood income, in table 4.11, were expected. The fixed effect coefficient estimates and the standard errors were robust. Only two fixed effect estimates were significant and negative - civpartcat (4 vs.1) and grpinvcat (4 vs.1), that is, significant difference in home values was only found in neighborhoods having very low levels of civic participation and group involvements. The random estimates were similar to other models. Home values within park neighborhoods still differ significantly and so do the average inter-park home values.

The model using the CPB dataset failed to converge, most probably, due to absence of respondents in some parks neighborhoods. Raw data analysis showed that this happened due to missing values in three social capital indicators on some categories as a result some categories were removed from the estimation. The parks affected by the absence of responses were Leblond, St Clair's Heights, Valley, Westwood Town Hall, and Wilson Commons (park numbers - 17, 30, 31, 33, and 34).

Chapter V

DISCUSSION AND CONCLUSIONS

The final chapter of the dissertation summarizes the results followed by their discussion. The conclusion, connections between research findings and theory, and the implications for practice follow next. In the end, directions for future research are identified and the limitations of this research discussed. This research makes three significant contributions to knowledge. First, this study estimates household preferences for specific park attributes, which can be used by park planners to design better informed neighborhood revitalization strategies. Second, the model developed in this research is expected to be used by County Auditor's to assess property taxes of proximate homes around parks. Finally, this research identifies park attributes that are preferred by households, and therefore, contributes to the Field houses vs. Meadows debate in park literature.

5.1. Summary of Results

Factor analysis of park elements led to generation of different factors for CPB and CRC parks. Four factors, Physical Activity Resources; General Services; Family Facilities; Aesthetics, were extracted from the CPB dataset and the reasons for labeling are as follows - Walking paths and ball game grounds promote physical activity; therefore, this combination of elements was called Physical Activity Resources. Unstructured open spaces and greenery please the senses and were accordingly, categorized as Aesthetics. Restrooms, tables, and benches provide services to park users and were labeled as a General Services. Finally, grill pits/fire pits, picnic areas combine with children's play equipment to generate the Family Facilities factor. This is an area in the park in which children play while parents and friends picnic.

Factors for the CRC parks were labeled as follows – Children's Activity and Supporting Features, Moderate Activity Attributes, and Intensive Activity Attributes. Children's Activity and Supporting Features consisted of activity features for children, leisure activities for adults (e.g. children's play sets, picnic spots), and resources that support activities (e.g. restrooms, sitting places); Moderate Activity Attributes promote passive activity, such as walking on pathways, perambulating around water bodies, and playing Frisbee in open spaces; and Intensive Activity Attributes, such as courts and playfields, lead to relatively higher levels of physical activity.

The first hypothesis tested the association between home values and park attributes, such as open spaces, restrooms, shelters, and activity areas inside parks. For CPB parks two factors (General Services and Aesthetics) were found to be positively associated with home values and two (Physical Activity Resources and Family Facilities) showed a negative relationship. In contrast, only one factor (Intensive Activity Attributes) in the case of CRC parks was found to have a significant positive association with home values. Second, it was hypothesized that the decay of home values across parks was different and this decay of home values was associated with park attributes. Models estimated using both the datasets (CPB and CRC) improved prediction. In both the datasets the average home values across parks were significantly different across parks, confirming that park neighborhood boundaries were “break lines” for hedonic prices.

Third, it was hypothesized that the travel distance is more valuable for households living farther away from parks and that the proximity value of parks is reduced (moderated) if the travel distance is greater. Results indicated that households located beyond walking distances, value travel distance more than families living closer to parks. Interaction effects were also significant demonstrating that travel distance moderated the relationship between home values and direct distance. Finally, it was hypothesized that high levels of neighborhood social capital were positively associated with home values. Evidence for negative association of home values was obtained only for very low levels of civic participation and group involvement in the park neighborhoods.

5.2. Discussion of Results

Lot, size, finished area, number of bathrooms, home age, and neighborhood income were significantly associated with home values. However, direct distance in the case of both the CPB and the CRC parks and lot size in the case of CPB parks failed to reach significance. The signs of the home structural coefficients were expected – positive in the case of living space attributes (lot size, finished area, bathrooms) and negative for home age. Intuitively we know that larger homes cost more and older homes are less valuable. Moreover, home values were also positively associated with neighborhood income – homes in richer neighborhoods are more expensive. The results for home structural attributes and neighborhood income were in accordance with the results obtained from hedonic studies (Sirmans et al. 2006) and park studies (Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001; Miller 2001; Anderson and West 2006). The non-significance of lot size in the CPB dataset was surprising; more so, because lot size reached significance in the case of CRC parks. Power computations showed that the CPB dataset did not possess sufficient power (lotsiz = 40.2%) to detect a significant difference.

Non-significance of the direct distance coefficient was another unexpected finding. However, the sign was negative indicating that home values decrease with increasing distance from the park. Power computations showed that lack of sufficient power had led to non-significance (CPB = 9.7%, CRC = 65.5%). Population pyramids for number of homes located at different distances from the park were generated for the CPB and CRC datasets. Figure 5.1 shows the population pyramids and the lesser number of homes in the range 100 feet to 600 feet, as compared to homes located beyond 700 feet, is noticeable. Park literature indicates that park effects are strongest between 200 to 600 feet. Bolitzer and Netusil (2000) found that park was strongest between 401 and 700 feet (linear model) and 100 and 400 feet in the semi-log model. Espey and Owasu-Edusei (2001) found the maximum effect for small attractive parks was below 600 feet. Most likely the direct distance showed non-significance due to small number of homes in the distance range 600 – 700 feet from the park boundary.

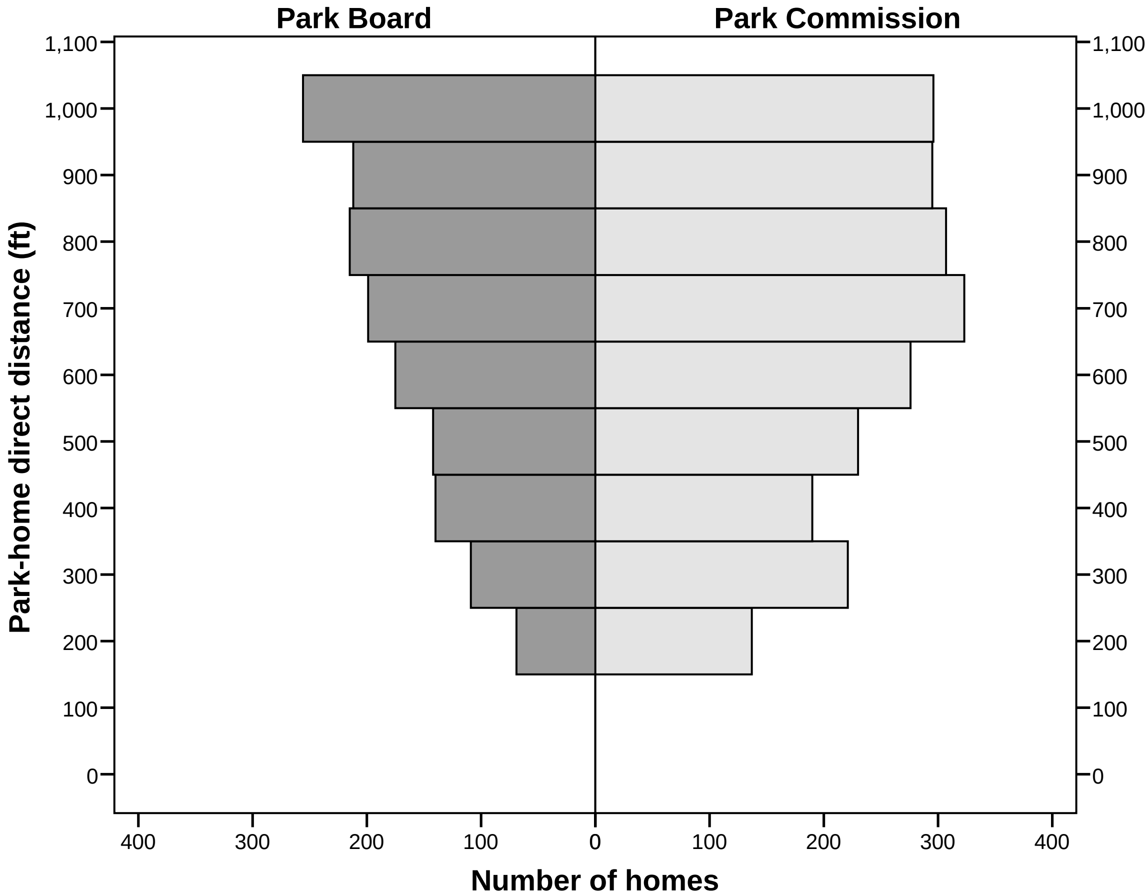

Figure 5.1. Park-jurisdiction wise frequency of homes at 100 feet direct distance intervals from parks

Hypothesis #1 – Valuing Park Attributes

This dissertation quantified park attributes using the EARPS tool, followed by hedonic estimation to evaluate preference of households for specific park elements. The "active use zones" in the CPB parks, that is, Physical Activity Resources and Family Facilities, were negatively associated with home values. Specifically, the negative association was with the following combinations of park elements – (1) ballgame grounds plus pathways, and (2) children's play equipment plus eating and drinking features (drinking water fountains, grill pits/fire pit, picnic areas, and vending). Most probably, households do not prefer active elements in parks because of the nuisance caused by picnicking families, who use grills and often leave trash behind; and the noise generated by baseball fields and basketball courts, which also have the potential to be used during nights.

In contrast, informal open spaces (open spaces, meadows, wooded areas) and supporting areas (benches, tables, restrooms, and shelters) were found to be positively associated with home values. This finding supports the experiential insights of park professionals and researchers that people prefer "unstructured open spaces" and that the "noise, nuisance, and congestion" caused by human activity reduces home values (Barrette 2001; Crompton 2001).

In the CRC dataset, Intensive Activity Features showed a significant positive association with home values. This was in contrast to the EAPRS factor, Physical Activity Resources, which was negatively associated with home values in CPB parks. In other words, households look for different park attributes when deciding to buy homes near active and passive recreation facilities. Near passive recreation facilities home owners value intensive activity attributes negatively; but prefer ball game grounds near parks meant for active recreation areas. Families decide to stay near active recreation facilities because of the opportunities offered for children and adults to lead an active life.

Earlier park studies had also found that parks exert both a positive and negative effect on home values (Crompton 2001a), but the park attributes were defined only in qualitative terms. Aesthetics was left undefined by Ward (1966). Espey and Owasu-Edusei (2001) qualitatively classified parks into attractive and unattractive. While attractive parks contained playground equipment, walking trails, and natural areas; the unattractive parks had play equipment in poorly maintained sandy areas, bare spots, and absence of natural areas. This park research valorized specific-park attributes, which were categorized in general terms, such as Aesthetics and Natural areas. Valorizing household preferences for specific park attributes was one of the significant empirical contributions of this research. The positive and negative influences operating in park proximity are given in figure 5.2 (Li and Brown 1980). This research advances knowledge by identifying the precise park attributes that lead to positive and negative effects.

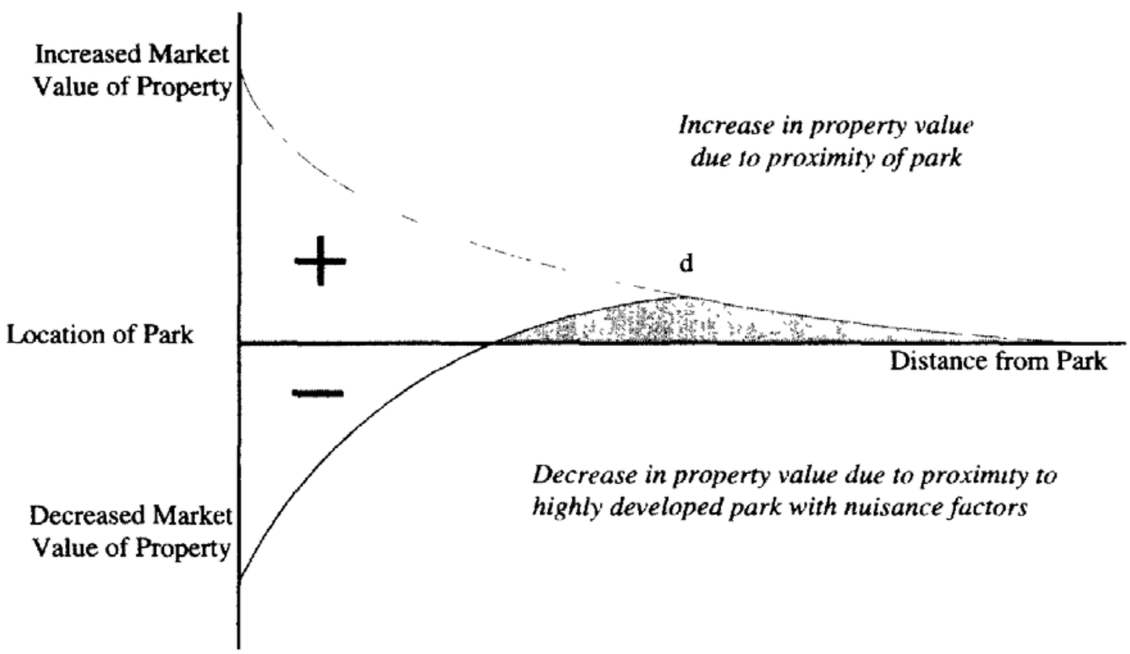

Figure 5.2. The positive and negative impacts of parks on residential property values
Source: Li, M.M and H. J. Brown (1980, 127)

Inconsistencies and ambiguities found in earlier studies are also explained by the findings of this research. During his investigation of the differential effects of school-park combinations on home values, Hendon (1973) found that undeveloped park area was negatively associated with home values. The open spaces in Hendon's study were small sized, inadequately developed, and poorly maintained leading to low positive scores on the Aesthetics and General Services factors and high scores on Physical Activity Resources leading to an overall negative association with home values.

More, Stevens and Allen (1988) investigated the effect of park design on home values. The Elm Park-Beaverbrook Park complex, was a highly developed park with a water body, playgrounds, and undeveloped woodlands; the Hadwen Park, was a wooded area overlooking a lake containing ball game grounds; the Greenwood Park, was primarily developed for active recreation; and the Lake Park, was an undeveloped area having facilities for active recreation also. Location rent curves showed that households were willing to pay the maximum premium paid ($ 5,000; mean $ 2,675) for housing located next to the Greenwood Park, which contained facilities for active recreation, primarily. Households in the case of Greenwood Park decided to reside close to the active recreation facility, and therefore, they were willing to pay higher premiums.

Hypothesis #2 – Evidence for "break lines" in hedonic prices

Multilevel models permitted the decomposition of the variation of the average home value (around the grand mean) into home level and the park level variances, which was contained in the random part of the output. While park level decomposition gave information about the contextual effects, the home level variance indicated the presence of compositional influences. Earlier park studies had disregarded context (Hendon 1973; 1974; More, Stevens and Allen 1988; Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001; Miller 2001), and only Anderson and West (2006) had included fixed effects to control for observed and unobserved neighborhood characteristics.

Home-level Effects - Addition of home structural attributes and neighborhood income to the unconditional models reduced variation in home values. This was expected because lot sizes, finished area, home age, number of bathroom, and direct distance explain a considerable amount of differences in property values among homes around a park. However, even after adding these home structural variables, substantial variance in home values was left unexplained. Most likely this happened because a parsimonious model was specified. Hedonic estimation has used numerous other home level variables (e.g. fireplaces, garages, basements, and air-conditioning; Bolitzer and Netusil 2000; Miller 2001; Sirmans et al. 2006), which are likely to be also valued by Cincinnati home owners.

Park-level Effects - The intraclass correlation was a measure of the degree of dependence of homes in park neighborhoods. High values implied that a large proportion of the variance in home values was accounted for by differences in the park neighborhoods, that is, homes in park neighborhoods were more similar or that the context matters. Using the unconditional model (M1.0) as the benchmark, high intraclass correlations were found for both CPB (72.38 percent) and CRC (56.57 percent) parks, which showed that multilevel hedonic estimation is to be preferred over multiple regression analysis.

The values of the interclass correlation computed from the unconditional model for the CPB and the CRC parks showed interesting differences. Home values showed a greater dependency in CPB park neighborhoods. This was expected because in the case of CPB parks four EAPRS factors were significantly associated with home values, while only one factor achieved significant in the case of CRC parks. Therefore, this research demonstrated that nested effects are required to be modeled and are different for parks designed for active and passive recreation. Adding park attributes to estimate the nested models left small quantities of unaccounted variance in the case of the CPB parks (.007), but larger for CRC parks (.017) showing that the variance accounted for by park attributes in the case of CPB parks was greater.

The smaller quantities of unaccounted variances left in the CPB dataset are also supported by variance explained at park neighborhood. Home structural features, park-home direct distance, and neighborhood income explained approximately 35.14 percent of the variance in the CPB dataset and 45.45 percent in the CRC data. However, park attributes explained nearly 92.78 percent of the level-2 variance in the home values in the CPB dataset. Smaller variance was accounted for by home level variables because a parsimonious model was estimated, but the high variance accounted for by park attributes demonstrated the importance of the park in the park neighborhood and this finding is a significant contribution to the understanding of the influence of park level variables on home values. Level-2 variance in the case of CRC dataset could not be computed because the nested intercepts model did not improve model prediction.

In contrast, earlier park studies had combined parks possessing different attributes in to one regression equation (Bolitzer and Netusil 2000; Lutzenhiser and Netusil 2001; Miller 2001) and generated variance explained (R^2) for the full model. The values of R^2 estimated by different studies are as follows - .48 to .81 (Weicher and Zerbst 1973); .82 (Hammer, Coughlin, and Horn 1974); .61 to .63 (Bolitzer and Netusil 2000); .66 (Lutzenhiser and Netusil 2001); .79 to .81 (Miller 2001); and .60 to .87 (Anderson and West 2006).

Graphically, varying slopes and intercepts were observed in the park-wise trellis plots, which were generated by using the PANEL sub-command in SPSS. The circles in the trellis plots, in figures 5.3 and 5.4, show the home locations at various distances from the park boundary. The varying intercepts are clearly visible, implying that the average home value differs across parks, again justifying estimation of a multilevel model. Slopes across different parks are either a straight line or show a small decay with increasing distance and the decay is more visible in the CRC dataset. As discussed earlier this was caused by the relatively small number of homes in the 150 to 500 feet distance.

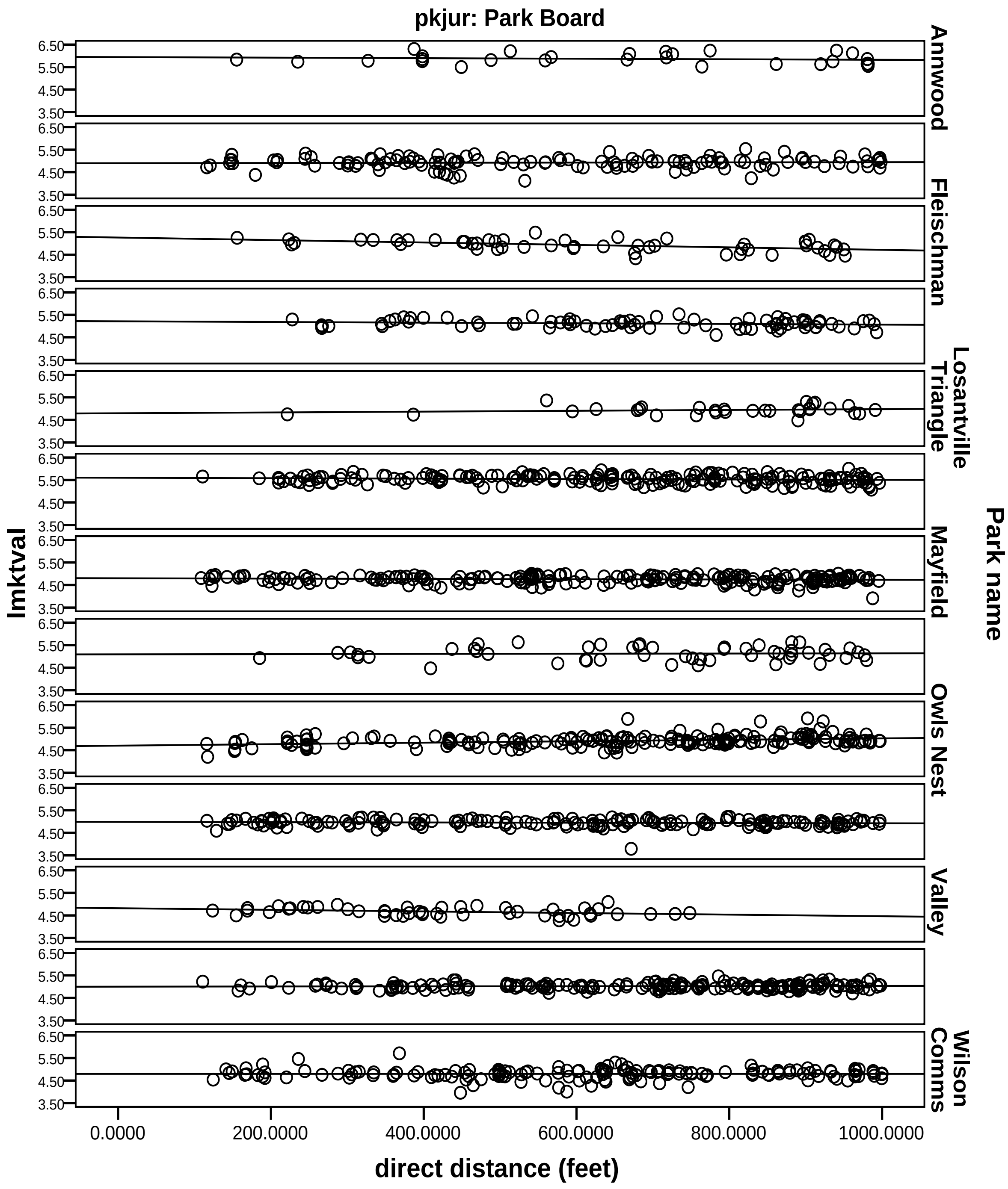

Figure 5.3. Trellis plots of home values vs. park-home distances for CPB parks

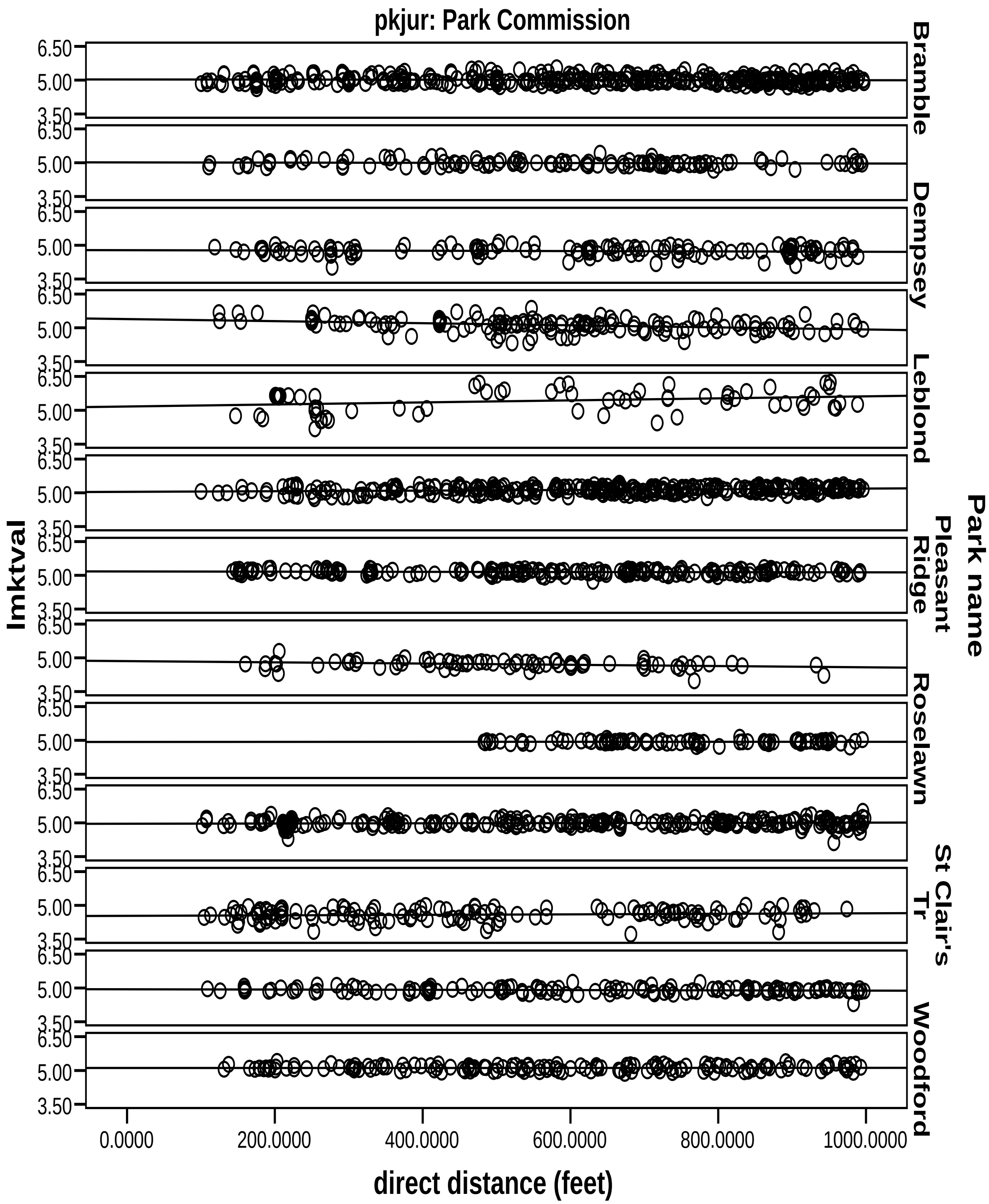

Figure 5.4. Trellis plots of home values vs. park-home direct distances for CRC parks

Housing Submarkets - The means of home values across parks (around the grand mean) and the slopes of home value vs. direct distance (around the average slope) varied significantly in both the CPB and CRC parks. This indicated that the park neighborhoods constitute separate housing submarkets, for the limited purposes of using this model to better predict and evaluate the results of neighborhood revitalization plans. The findings are in accordance with contemporary trends, which are focusing on the smallest possible unit of geographical cluster of housing (Bourassa and Hoesli 1999; Bourassa et al 1999; Bourassa, Hoesli and Ping 2001; Bourassa, Hoesli and Ping 2003; Day 2003). Generally, the finding that park neighborhoods constitute housing submarkets adds to the evidence obtained from contemporary studies (Bourassa, Hoesli and Ping 2001; Day 2003), which have found that location and neighborhood characteristics, rather than home structural features, better define sub-markets.

Hypothesis #3 – Moderation Effects of Travel Distance

The model estimated with the CPB dataset predicted better than chance; therefore, only this model is discussed. In the fixed part of the output the signs and the magnitude of the home features, neighborhood income, and park attributes remained unchanged. The random part was also unaltered – home values differ significantly within parks and across parks even after adding a categorical walkability variable and an interaction term formed by multiplying the direct distance and the network distance. However, the direct distance variable became significant and was inversely associated with home values, that is, home values decrease with increasing distance from the park. This was expected and the earlier insignificance occurred due to the direct distance capturing the effects of network distance, which was now accounted for by the separate network distance term in the re-specified model.

People living closer to parks place lower values on travel distance. Comparing homes located within one-eight mile with homes located farther away showed that as distance from the park increased households began to place a greater value on travel distances. Most probably, households living closer to parks are able to enjoy park views and pass by the park several times of the day; therefore, the value placed on travel distance was reduced. On the other hand, home owners living farther away are able to enjoy park views only when they visit the parks and the value of travel distance becomes more important. The results of this research support the general findings of Miller (2001) that roads and sub-collectors around park perimeter are positively associated with home values.

The interaction term was positive and showed that the positive value of park proximity was reduced by longer travel distances, that is, home values are reduced if homes are connected by convoluted paths to the park. In fact, the reduction in home values was greater if the travel distance is more than the walking distance (one-fourth mile).

The role of travel distance in moderating the effect of direct distance explained some of the inconsistent results obtained by Miller (2001) and Nicholls and Crompton (2005). Miller (2001) used neighborhood parks and found a significant inverse association between home values and network distance, but insignificant association with direct distances. In contrast, Nicholls and Crompton (2005) used network distance and got contradictory results during their investigation of the effect of a greenway on three neighborhoods located on the border. One reason for the ambiguous results was the method used to compute network distances – Miller computed the network distances from multiple points around the park, but Nicholls only used the official entry points to the park.

The findings of this research suggest that direct and travel distances interact, which provides an explanation for the above inconsistencies. Miller (2001) computed network distances from multiple points on the park perimeter; therefore, network distances captured a large part of the effects of direct distance leading to a significant negative relationship between home values and park-home network distance. However, Nicholls and Crompton (2005) used the network distance from a few entry points around the park, that is, the network distance could no longer capture the effects of direct distance, thereby leading to inconsistent results. More importantly, the direct and network distance were interacting, which was ignored by the two researchers.

Hypothesis #4 - Valuing Relationships

The estimated model with the CRC dataset only converged; therefore, only the CRC parks were analyzed. The signs of the coefficients for home structural variables remained unchanged and the magnitudes were nearly the same. Evidence for the relationship between trust and home values was inconclusive because the model in which trust was added as an independent variable failed to converge. Another indicator of social capital, organized group interactions was not significantly associated with home values.

Two social capital indicators – number of group involvements and civic participation showed a significant negative association with home values. The variable civic participation is a measure of political and community engagement, including working on a community project.

Group involvements gauges involvement in organizations, associations, support groups, and service clubs. In the model park neighborhoods were compared to a reference, which was the neighborhood having high levels of social capital. Only neighborhoods having very low levels (high vs. very low) of group involvements and civic participation showed a significant negative relationship. Therefore, neighborhoods with very low levels of community engagement are not preferred by home buyers. Low levels of social capital were associated with lower home values, but high levels may not lead to higher home values. Households do not discriminate between neighborhoods having low, medium, and high levels of social capital, but give less value to neighborhoods with very low levels of social capital. The inference is that households do not have a special preference for intensive interactions with neighbors, but they want to know them through associational activity and participation in group interactions.

5.3. Relationship of Results to Theory

The research framework can be used to empirically verify theories that use the built environment as raw material for theory formation (e.g. New Urbanism), but have not been subjected to empirical testing (Fainstein 2000). Tools can be developed to evaluate the built environment and determine household preferences for different components of the built environment. This approach has already aroused research interest and one recent example is the valorization of three urban design types – traditional neighborhood development, enclave, and infill housing in Chicago (Ryan and Weber 2007).

Second, this research used multilevel techniques to do hedonic estimation. Multilevel techniques permit investigation of nested relationships in data measured at different levels. In Regional Development Planning, data are often measured at various levels – individual, homes, neighborhoods, cities, regions, and nations and multilevel models are useful to investigate the variance and variation in social and economic outcomes caused by determinants measured at multiple levels.

5.4. Conclusions

One of the objectives of this research was to model the effects of the park and the park neighborhood on home values and use the findings to support the Cincinnati Park Board's strategy to use parks as agents of neighborhood revitalization. Parks were conceived as tools to revitalize neighborhoods in the draft Centennial Master Plan prepared by the Cincinnati Park Board (CPB). Traditionally, parks have contributed to neighborhood revitalization through their effect on the quality of life of families, health of residents, increased residential property values, stronger social ties, and programmed park activities (Crompton 2001a; Leinberger and Berens 2001; U.S. Department of Housing and Urban Development 2004). However, the role of parks as central organizing elements in neighborhood revitalization was never spelled out clearly.

The conceptualization of the park neighborhood showed the way to the design of park-centric neighborhood revitalization plans. Generally, neighborhood revitalization planning starts with the identification of a target neighborhood (U.S. Department of Housing and Urban Development 2004), and planners have followed traditional neighborhood boundaries to define target neighborhoods, often ignoring the housing market. Admittedly, traditional neighborhood boundaries are more useful to predict and evaluate political and social outcomes, but if the policy objectives are related to supply and demand of housing, as in the case of the CPB revitalization plan, then spatially defined housing submarket is a more appropriate unit to be designated as the target neighborhood (Bates 2006). To meet these practical objectives segmenting housing markets using hedonic prices was considered appropriate (Bourassa, Hoesli and Ping 2001; Bourassa, Hoesli and Ping 2003). This research found evidence for both contextual and compositional effects. Inter-park and intra-park factors matter and home values depend on home features, park attributes, and neighborhood characteristics, which are required to be modeled. Therefore, using multilevel models, which account for both home and park effects is expected to lead to the design of more realistic neighborhood revitalization plans and their evaluation.

If park neighborhoods are housing submarkets and are identified as the target neighborhood then park centric neighborhood revitalization planning is possible. The study found evidence for park neighborhoods to correspond to housing submarkets; therefore, the park neighborhood is an appropriate unit to be identified as a target neighborhood. Once the park neighborhood is designated as the target neighborhood, the results of this research can be used by the Cincinnati Park Board to better predict and evaluate revitalization plans.

Findings related to association between home values and park attributes and the physical and social characteristics of park neighborhoods is expected to be useful to the CPB to reposition parks to perform their roles as neighborhood revitalization agents. Conventionally, park attributes are fairly standardized - a mix of passive and active attributes with larger parks containing greater number of attributes. This is illustrated in the functional classification of parks into Mini, Neighborhood, and Community by the National Recreation, Park and Open Space

Association (Mertes and Hall 1995). In the categorization Mini-Parks contain playground picnic tables with grills (not under shelter), half basketball courts, benches or bench swings, open play area, landscaped public use area and scenic overlook. The variety of facilities increase in Neighborhood Parks - playground picnic shelters with grills, court games, picnic tables with grills (not under shelter), informal play field, benches, bench swings, volleyball courts, and facilities for trails/walking, and parking spaces; and finally, Community Parks contain recreation center picnic tables with grills, basketball courts, benches, bench swings, tennis courts, nature trails, basketball courts/softball courts, restrooms, multi-purpose field parking, soccer fields, playgrounds, amphitheater, observation decks, and lakes

In contrast, this research found “active use zones” (ballgame grounds plus walking pathways, children’s play equipment plus eating and drinking features) were negatively associated with home values, and informal open spaces (open spaces, meadows, wooded areas) and supporting areas (benches, tables, restrooms, and shelters) were found to be positively associated with home values. To maximize the economic impact on home values, planners will need to create informal open spaces and facilities that support passive uses of park. Admittedly, this is a challenge for planners, but one way is to retire facilities once they are no longer functional. Moreover, the concept of the park neighborhood increases choices available to planners. This study found that travel distance moderates the effects of direct distance. For distant homes park proximity effects can be increased by creating shorter travel distances, say, by developing pedestrian pathways to the park. Finally, the findings show that social ties in the park matter – very low levels of household relationships have a negative effect on home values. This finding can be used by planners to promote associational activity in park neighborhoods.

Repositioning parks is expected to make parks more responsive to market demands in order to compete to be useful to the community. In a period of resource crunch in local bodies there "are too many competitors for every dollar" (Garvin 2000); therefore, park planners have to understand and respond to the tastes and preference of households. Research findings can be used by assessors to evaluate values of properties in the park neighborhoods, which in turn will lead to higher property taxes for the community. This proximity effect works as follows (Crompton 2001). Homes located close to park are expected to have higher property values than homes located farther away. This is the capitalization of park land into home values for households. Higher property values are expected to lead to higher tax revenues for the local bodies. Therefore, parks, which were earlier considered to be public goods to be delivered by governments, now pay for their construction and maintenance (Crompton 2001a; 2001b).

5.5. Household Preferences for Neighborhood Level Ties and Trust

Based on Putnam's conceptualization of social capital, this research tested the effects of associational activity and trust levels in park neighborhoods on proximate home values. The multilevel model failed to converge when trust was included as an independent variable; therefore, the precise role of trust in influencing home values could not be ascertained and this was a limitation of this research. Another limitation was that only CRC parks were analyzed because the CPB model failed to improve prediction over chance. In CRC park neighborhoods households preferred associational activity along two dimensions - group involvements and civic participation.

Civic participation is a measure of political and community engagement, including working on a community project, and group involvements gauges involvement in organizations, associations, support groups, and service clubs; therefore, these dimensions evaluate both bonding and bridging types of social capital. Accordingly, households value the presence of both bonding and bridging varieties of social capital in park neighborhoods.

How is associational involvement expected to benefit households residing around CRC parks? Participation in neighborhood associations and local community projects generates bonding and bridging social capital. Bonding social capital promotes specific reciprocity, while the bridging variety is associated with generalized reciprocity. Bonding and bridging capital are not interchangeable, but households in park neighborhoods act along both dimensions of social capital. In specific reciprocity exchange takes place immediately – you look after my child playing in the park and I look after your child. More importantly, the norm of generalized reciprocity predisposes households to assist one another without expectation of immediate returns. Earlier findings indicated that households prefer active play facilities in CRC parks. Most probably, households choose to reside near CRC parks because of the availability of ball game grounds for children and adolescents. Such household preferences are increased if the CRC park neighborhoods contain high levels of generalized reciprocity. In turn, greater generalized reciprocity is expected to lead to norms, such as the norm of adults looking after unattended children in parks, which facilitate park usage by children. Coleman (1990, 303) gives the example of a family that decided to move from Detroit to Jerusalem due to different levels of bridging capital in the two cities -

“A mother of six children, who recently moved with her husband and children from suburban Detroit to Jerusalem, described as one reason for doing so the greater freedom her young children in Jerusalem. She felt safe letting her eight year old take the six year old across town to school on the city bus and felt her children to be safe in playing without supervision in a city park, neither of which she felt able to do where she lived before. The reason for this difference can be described as the difference in social capital available in Jerusalem and in suburban Detroit. In Jerusalem the normative structure ensures that unattended children will be looked after by adults in the vicinity, but no such normative structure exists in most metropolitan areas of the United States.”

5.6. Fieldhouses vs. Meadows Debate

Generally, Fredrick Law Olmstead is regarded as the progenitor of the park movement in the United States. The debate started because one set of park elements (Meadows) give “green relief” from the noise and confusion of the city and another set of elements (Fieldhouses) are associated with opening up places for “play” (Weir 1924; Garvin 2000). The discourse over the relative importance of passive (green relief) and active (play) elements in parks is known as the Fieldhouses vs. Meadows debate in park literature and this research by determining the values placed by households on elements constituting Meadows and Fieldhouses contributes to the ongoing discussion.

This discourse has had two turning points. The first turning point occurred in the 1880s after the construction of sand courts for children and outdoor gymnasiums in Charlesbank area of Boston, which led to the “play-ground movement for children”. The second defining moment happened soon after in the form of the “recreation movement” at the turn of the century, which ultimately led, in the 1960s, to the amalgamation of the parks departments with their recreation wings in most of the cities. Political pressures to add facilities and the prevailing perspective of park managers that active facilities could be included in parks as long as the essential nature of the park remained unchanged, led to increased mix of passive and active recreation elements in parks. However, the result of creating active recreation areas in parks was that unstructured open space were "denigrated" and nowadays the challenge before park managers is to meet needs for active recreation without spoiling the open space (Garvin 2000; Barrette 2001).

This research has found that park elements in CPB parks combine into four sets of factors in which two factors (Aesthetics; General Services) were positively related to home values and the other two (Physical Activity Resources; Family Facilities) were negatively associated. Factors positively associated with home values contain unstructured open spaces, water bodies, and the supporting elements, which are identifiable as the meadows in the debate and gives users a more contemplative experience (Crompton 2001) or opportunities to exercise their imaginations (Barrette 2001). In contrast, factors negatively associated with home values were the active facilities - the Fieldhouses. Therefore, the findings of this research show that households do not prefer Fieldhouses in parks designed for passive recreation, but desire Fieldhouses (ball game grounds) in parks designed for active recreation, which demonstrates that proximate households located around active and passive facilities discriminate between the facility types.

5.7. Implications for Further Research

Social capital in CPB parks could not be investigated because the multilevel model failed to converge. Future research is required to determine multiple dimensions of social capital in park neighborhoods using the survey instruments developed by the Saguaro Seminar (2000). Second, only the travel distance was examined. However, open space studies have shown that the physical characteristics of the travel path are also important (Correll, Lillydahl and Singell 1978; Hobden, Laughton and Morgan 2004); therefore, evaluating the physical characteristics of the network paths and other features of the park neighborhoods is another area for future research. Third, exploratory factor analysis was used to extract EAPRS factors, which have to be subjected to confirmatory factors analysis. Fourth, research results indicated the presence of housing submarkets. This concept can be developed further by examining demander characteristics and home structural features in park neighborhoods. Finally, the model has to be calibrated for handy use by park organizations.

5.8. Limitations

In this dissertation research parsimonious models were specified. Theoretically, an unlimited number of variables can be included in the hedonic price models. Home structural variables were limited to home age, lot size, finished area, and number of bathrooms. This was based on a survey of 125 studies, which had used hedonic estimation and the most common variables used in park studies. The assumption was that the excluded variables were not highly correlated.

Second, semi-random sampling was used to select parks and homes in park neighborhoods. This was done to identify the unique park effects, which is the primary research question. Only single-family homes under the dominant influence of the park (100 and 1000 feet) were sampled. Moreover, parks located on multiple levels and having other facilities (e.g. interstates, shops, and commercial establishments) in the buffer were excluded from the analysis. Similarly, homes under the joint influence of two or more parks and outliers (large sized homes, old properties, and recently constructed houses) were deleted. Therefore, the generalizability of the findings to other park systems has to be done cautiously. Third, the relatively small number of responses used to compute social capital indicators is the another methodological limitation, especially in the case of CPB parks in which no responses were available around some parks resulting in non-convergence of the model.

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ANNEXURES

Annexure 1. E-mail from Brian Saelens, University of Washington, Portland

From: Brian Saelens [mailto:bsaelens@u.washington.edu]
Sent: Friday, September 28, 2007 1:30 PM
To: 'carrie franklin'; 'Christopher Auffrey'; 'Jacqueline Kerr'; 'Jim Sallis'; jimchapman@lfcplans.com; Karen Glanz; kcain@projects.sdsu.edu; 'Lawrence D. Frank'; 'Nicole Dubruiel'; 'Saelens, Brian'; 'Sarah Couch'; 'Trina Colburn'; Vlearnihan@lfcplans.com
Subject: NIK park reliability

Hello NIKsters,

Just did some NIK data analysis and wanted to pass findings along to the team – nothing as exciting as actual human participant data, but will hopefully bring warm fuzzies to the methodologist in you.

The Seattle team has completed the park evaluations in the high walkable block groups in the Seattle/King County area. As you may recall from San Diego, we did reliability testing (inter-rater) on these park evaluations. As I have reported to you earlier, the San Diego team set a very high bar, coming in with an ICC for inter-rater reliability at .96 – based on 29 parks that were rated twice by independent raters.

Drum-roll please……based on the 62 parks that were rated twice by independent raters in Seattle, the ICC for inter-rater reliability was .87!

Brian

Annexure 2. E-mail from Norman Miller, Professor, School of Business, University of Cincinnati

Date: Sun 22 Jul 14:53:17 EDT 2007
From: <realestate@fuse.net>
Subject: Re: assistance in home price indices
To: Sameer Sharma <sharmasr@email.uc.edu>

OFHEO is the best standardized home price index so that is the one you should use, otherwise you can use median prices but this is not as good.

I attached a med price series for you.

--- Sameer Sharma <sharmasr@email.uc.edu> wrote:
Dear Professor Miller:
Using the hedonic price model, I am examining the associations between the built environment and home values. One part requires that I adjust home sale values to the year 2006; therefore I was looking for a home price index from 1995, particularly for Cincinnati. In this connection I have looked at the Consumer Price Index (www.bls.gov/opub/hom/homch17_a.htm) and the Office of Federal Housing Enterprise Oversight (http://www.ofheo.gov/download.asp).
>Which one do you suggest I use or is there a single home price index for Cincinnati, which I have missed?
Thanks,
Sameer
Sameer Sharma
University of Cincinnati
Ph# 1(513)469-0818

Annexure 3. Email granting approval by the Institutional Review Board, University of Cincinnati, to use restricted Saguaro Seminar data

Date: Fri 24 Feb 12:22:59 EST 2006
From: "Norman, Claudia \(normancr\)" <NORMANCR@UCMAIL.UC.EDU>
Subject: Sharma #06-01-31-12X "The Role of Parks..." approved 2-13-06
To: "BOL-Sharma, Sameer \(sharmasr\)" <sharmasr@email.uc.edu>
Cc: "Auffrey, Christopher \(auffrec\)" <AUFFREC@UCMAIL.UC.EDU>

Sameer:

RE: IRB #06-01-31-12X "The Role of Parks in Creation of Social Capital: An Empirical Study"

The University of Cincinnati Institutional Review Board – Social and Behavioral Sciences (UC IRB-S) has reviewed your protocol and has granted approval for Exempt status, **effective 2-13-06.**

The Principal Investigator must report to the Chair of the UC IRB-S any changes affecting the protocol upon which this certification is based. **No changes may be made without prior approval by the Board** except those necessary to eliminate immediate hazards.

A copy of this approval on UC letterhead is also being sent to you. If you have any questions, please feel free to contact me.

Claudia R. Norman, BA, CIP
Program Manager
UC IRB, ML 0567
Wherry Hall, Rm. G-8
Cincinnati, OH 45267-0567
Phone: (513) 558-5784
Fax: (513) 558-4111
claudia.norman@uc.edu

Annexure 4. List of Park Board properties sent by Steven Schuckman, Superintendent, Division of Planning and Design/Program services

Date: Tue 6 Feb 09:39:54 EST 2007
From: "Schuckman, Steven" <Steven.Schuckman@cincinnati-oh.gov>
Subject: Cincinnati Park Properties/Addresses
To: <sharmasr@email.uc.edu>

Let me know if you have any questions on this.

Attachment: CPB Properties Size Locs 10.28.03.xls (192k bytes)

Annexure 5. Cincinnati parks

S. No	Name of park	Size (acres)	Neighborhood	Address and location
Park Recreation Board administered				
1	Annwood	2	East Walnut Hills	1900 Madison Rd
2	Bellevue	15	C.U.F	2191 Ohio Ave
3	Dunore	2	Clifton	600 to 786 Ludlow Ave.
4	Ferry Street	3	3 East End	2201 Eastern Ave. / Ferry
5	Fleischmann	4	Avondale	524 Forest Ave/Washington Ave
6	Glenway	3	East Price Hill	3201 to 3299 Glenway Ave/Purcell
7	Hauck Gardens	8	Avondale	2625 Reading / Oak
8	Hoffner	2	Northside	4101 Hamilton Ave/Blue Rock
9	Inwood	20	Mt. Auburn	2308 to 2434 Vine St
10	Jackson Hill	9	Mt. Auburn	2001 Eleanor Pl
11	Kennedy Heights	12	Kennedy Heights	6037 Kennedy Heights
12	Larz Anderson	9	Hyde Park	2905 to 3035 Golden/Ononta
13	Laurel	9	West End	500 to 926 Ezzard Chas Dr
14	Lincoln	10	West End	1000 to 1099 Ezzard Chas Dr.
15	Losantiville Triangle	5	Mt. Auburn/Avondale	2501 to 2599 Reading/Burnet
16	Lytle	2	CBD	501 E 4th /Lawrence
17	Madison	4	Hyde Park	2501 Madison Rd/Erie
18	Mayfield	2	Price Hill	3600 Mayfield/Carson
19	MLK Jr.	6	North Avondale	3740 Reading Road/Burton
20	Mt Echo	16	E. Price Hill	Shelter 202 Chestline Dr
21	Owls Nest	10	Evanston	1984 Madison Rd
22	Pioneer Cemetery	2	Linwood	333 Wilmer
23	Sayler Park	2	Sayler Park	6600 Gracely/Monitor
24	Seasongood Square	2	North Avondale	3801 Reading/ Shuttlesworth Cir
25	St. Clair Triangles	3	University Heights	410 to 550 W MLK Jr Dr
26	Valley	3	Camp Washington	3250 Colerain/ Bates Aves
27	Washington	6	Over the Rhine	1230 Elm/Race
28	Westwood Town Hall	2	Westwood	3019 Harrison/ Montana
29	Wilson Commons	15	E. Price Hill	2951 Bodley/Wilsonia
30	Woodward	10	Avondale	891 Rockdale/Victory Pkwy

Annexure 5. (continued)

Park Recreation Committee administered				
31	Bond Hill	5	Bond Hill	Yarmouth
32	Bramble	10	Madisonville	Bramble
33	Brown/Lane	2	N. Avondale	Reading Road / Victory
34	College Hill	5	College Hill	Belmont/Larch Ave
35	Coy	2	University Heights	Wagner & DeVotie
36	Dempsey	7	East Price Hill	Price/Purcell
37	Evanston	6	Evanston	Evanston
38	Fairview Playground	4	Fairview / Clifton Heights	Scenic Dr.
39	Filson Playground	4	Avondale	Ringgold St
40	Laurel Playground	4	West End	W. Liberty/ John Sts
41	Leblond	19	East End	Eastern/Collins Aves
42	Oakley	15	Oakley	Taylor/Paxton Aves
43	Pleasant Ridge	9	Pleasant Ridge	Ridge Ave
44	Riverside	8	Sedamsville/Riverside	Southside Ave
45	Roselawn	19	Roselawn	Eastlawn Dr
46	Ryan	23	Westwood	Fischer/Meyer Pl
47	South Fairmount	4	South Fairmount	Queen City/Grand Aves
48	St. Clair Heights	18	South Fairmount	Fairmount/Irquois Sts
49	Taft Field	4	Camp Washington	Stock St
50	Turkey Ridge	21	East End	Kellogg/Delta Aves
51	Victory Ballground	3	N.Avondale	Victory Parkway
52	Winton Commons	13	Winton Place	Hand & N. Edgewood
53	Woodford	2	Kennedy Heights	Woodford & Kennedy

Source: http://www.cincinnati-oh.gov/cityparks/downloads/cityparks_pdf7940.pdf (accessed on Jan 30, 2007)

Annexure 6. Analysis of potential outliers using Mahalanobis and Cook's D distance and DFBeta values

Home id	Park jurisdiction (park name)	Mahalanobis distance	Cook's D Distance	Variables DFBeta value > 1	Deleted/ Retained	Variables causing extreme scores
2.020	CPB (Bellevue)	10.04	0.186	None	Retained	
2.150	CPB (Bellevue)	3.499	0.04	None	Retained	
2.151	CPB (Bellevue)	9.773	0.104	None	Retained	
3.093	CRC (Bramble)	3.55	0.01	None	Retained	
3.624	CRC (Bramble)	2.663	.02	None	Retained	
3.685	CRC(Bramble)	3.473	0.62	None	Retained	
4.197	CRC (College Hill)	29.467	0.451	Home age	Retained	
6.129	CRC (Dempsey)	6.312	0.10	None	Retained	
6.190	CRC (Dempsey)	7.17	0.009	None	Retained	
9.023	CPB (Fleischman)	45.689***	1.08	Lot size	Deleted	Lot size, finished area
14.069	CPB (Kennedy Heights)	9.47	0.354	Lot size	Retained	
16.029	CRC (Leblond)	5.668	0.03	None	Retained	
16.041	CRC (Leblond)	28.235	0.32	None	Retained	
16.127	CRC (Leblond)	17.089	17.088	None	Retained	
16.145	CRC (Leblond)	60.427***	1.75	Lot size	Deleted	Lot size, finished area, direct distance
16.147	CRC (Leblond)	8.166	0.083	None	Retained	
17.027	CPB (Losantville Triangle)	10.517	1.336	Lot size, finished area, and home age	Deleted	None – (Univariate outlier)
19.259	CPB (Mayfield)	8.447	0.06	None	Retained	
19.331	CPB (Mayfield)	4.378	0.177	None	Retained	
19.352	CPB (Mayfield)	92.959***	0.28	Lot size	Deleted	Lot size, home age
20.047	CPB (MLK Jr)	9.72	0.45	Finished area	Retained	

Annexure 6. (continued)

21.538	CRC (Oakley)	7.151	0.06	None	Retained	
22.134	CPB (Owls Nest)	8.329	0.144	None	Retained	
22.274	CPB (Owls Nest)	21.284	0.14	None	Retained	
22.320	CPB (Owls Nest)	73.758***	0.0756	Finished area	Deleted	Lot size, finished area, home age
23.115	CRC (Pleasant Ridge)	81.553***	1.024	Lot size	Deleted	Finished area, direct distance
24.017	CRC (Riverside)	3.129	0.21	None	Retained	
24.054	CRC (Riverside)	3.129	0.21	None	Retained	
24.059	CRC (Riverside)	60.313***	1.87	None	Deleted	Lot size, home age
25.064	CRC (Roselawn)	2.791	0.11	None	Retained	
25.078	CRC (Roselawn	7.59	0.19	None	Retained	
25.081	CRC (Roselawn	8.08	0.203	None	Retained	
26.021	CRC (Ryan)	5.974	0.2	None	Retained	
26.241	CRC (Ryan)	3.31	0.01	None	Retained	
26.411	CRC (Ryan)	104.449***	0.18	Lot size	Deleted	None (Univariate outlier)
27.045	CPB (Sayler)	81.132***	0.248	Lot size	Deleted	Lot size, home age
27.470	CPB (Sayler)	2.470	0.271	None	Retained	
30.001	CRC (St Clair's Hts)	35.42***	0.19	Finished area	Deleted	Finished area, bathrooms
30.033	CRC (St Clair's Hts)	7.417	0.139	None	Retained	
30.062	CRC (St Clair's Hts)	21.35	0.19	None	Retained	
31.007	CPB (Valley)	28.179	0.752	Lot size	Retained	

Annexure 6. (continued)

33.056	CPB (Westwood Town)	163.394***	21.13	Lot size	Deleted	Lot size, finished area, home age, neighbor income
34.038	CPB (Wilson Commons)	1.84	0.034	None	Retained	
34.039	CPB (Wilson Commons)	98.667***	0.933	Lot size	Deleted	Lot size, bathrooms, neighbor income
34.102	CPB (Wilson Commons)	19.871	0.204	None	Retained	
34.173	CPB (Wilson Commons)	4.67	0.055	None	Retained	
34.181	CPB (Wilson Commons)	4.425	0.07	None	Retained	
35.070	CRC (Winton Commons)	6.98	0.07	None	Retained	
35.151	CRC (Winton Commons)	2.70	0.156	None	Retained	
35.175	CRC (Winton Commons)	81.619***	1.2	Lot size	Deleted	Lot size, neighbor income
35.215	CRC (Winton Commons)	62.78***	0.91	Lot size	Deleted	Lot size, finished area, neighbor income
35.216	CRC (Winton Commons)	39.339***	0.99	Intercept	Deleted	Neighborhood income, direct distance, home age

Note: *** $p < .001$

Annexure 7. Comparison of park descriptive statistics with scores of the multivariate outliers

Home id	Park jurisdiction	Variable causing cause to be outliers	Parks mean score on variable causing outlying values	Home score on variable causing outlying values	Comments
9.023	CPB	lotsiz	0.08	2.47	Equal to maximum park score on variable
		finarea	5,651.11	8,113	Equal to maximum park score on variable
16.145	CRC	lotsiz	0.35	4.64	Equal to maximum park score on variable
		finarea	2,589.36	2,825	
		dirdis	535.56	604.12	
19.352	CPB	lotsiz	0.14	0.89	Equal to maximum park score on variable
		homage	1,325.46	2,374	
22.320	CPB	lotsiz	0.12	0.46	
		finarea	1,469.94	7,164	Equal to maximum park score on variable
		homage	98.52	85	
23.115	CRC	finarea	1,406.07	5,393	Equal to maximum park score on variable
		dirdis	873.15	873.15	
24.059	CRC	lotsiz	0.33	5.43	
		homage	90.01	75	
27.045	CPB	lotsiz	0.21	1.14	Equal to maximum park score on variable
		homage	85.14	55	
30.001	CRC	finarea	1,315.40	4,176	
		bath	1.26	1.0	

Anexure 7. (continued)

33.056	CPB	lotsiz	0.19	2.87	Equal to maximum park score on variable
		finarea	1,660.56	4,688	Equal to maximum park score on variable
		homage	85.12	129	
		neighinc	51,57.84	47,293	
34.039	CPB	lotsiz	0.14	1.33	
		bath	1.34	1.5	
		neignince	5,122.47	35,252	
35.175	CRC	lotsiz	0.24	3.87	Equal to maximum park score on variable
		neighinc	35,972.64	36.393	
35.215	CRC	lotsiz	0.24	3.10	
		finarea	3,251	1,325	
		neighinc	35,972.64	19,224	
35.216	CRC	homage	81.10	140	
		dirdis	624.11	976.90	
		neighinc	35,972.64	19,224	Equal to minimum park score on variable