Alternative Approaches to Modelling Housing Market Segmentation: Evidence from Istanbul

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Abstract

There is a large literature on housing submarket definition and identification. They did not address how to model submarkets once they have been identified. Yet the modelling literature has produced several different approaches. These approaches are being applied in different contexts at different times and using different data sets. This thesis seeks to control some of this variation. It applies four (market-wide hedonic model, hedonic models with submarket dummy, separate hedonic models for each of submarkets, multi-level model) of the most common methods to a data set comprising 2175 transactions in the Istanbul housing market. The performance of these models is compared on the basis of their accuracy in terms of proportion of estimated prices that fall within tolerable range of the actual price. The results show that that the hedonic and multi-level models with experts' submarket dummy variable can predict more accurately than the models with a priori and cluster analysis stratified submarkets. Similarly, the root mean square error test results indicate that the hedonic and multi-level models with experts' submarket dummy variable show better performance than other models. These test results show that both the hedonic and multi-level models with experts' stratified submarkets dummy variable yields better performance than market-wide hedonic models.

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CHAPTER 1 INTRODUCTION

1.1. Motivation of the Study

Housing price models

This study has been motivated by two concerns. First, the study seeks to make a contribution to debates about the best way to capture market segmentation within models of urban house prices. Second it seeks to provide a basis from which to better understand the workings of the owner-occupied sector of the Istanbul housing market.

Housing is a composite and complex commodity that satisfies the sheltering need of individuals. It has a complex structure because each dwelling comprises a series of internal structures, has a number of external characteristics and locational and neighbourhood attributes may differ (Maclennan and Tu, 1996). Being a part of urban structure and a need for individuals, housing plays a major role in most economies. For most of the households in the majority of economies it has priority in expenditures. In many economies, a residence is the most valuable asset owned by households and a very large share of total household wealth (Sheppard, 1999). Housing and residential construction are of central importance for determination of both the level of welfare in society and level of aggregate economic activity.

As the house is a multifunctional composite good, all kinds of investments, interventions, and actions about the house affect the structured environment as well as the socioeconomic environment of the city and this differentiation leads to segmentation in the housing market. Both demand and supply side of the market bring about segmentation in the market. On the demand side of the market, the consumer groups vary according to their socio-economic profile, cultural background, life style and taste, household composition. Like demand side, variation in supply side as well results in segmentation in the market. The product groups in the supply side can vary according to the size, type, quality of construction. Due to the interaction between supply and demand side, price differentiation across space arises. The system is subject to change not only in demand and supply factors but also the changes in the characteristics of the neighbourhoods with its dynamics such as life quality, public and private investments, security, amenities and disamenities have influence in the segmentation of markets.

Housing economics attempts to identify and define models of the system. The starting point into housing economics is a model which ignored most of the special features of housing. In recent years the literature has evolved by the modification of standard neo-classical model that recognise market forces with special characteristics (Smith et al, 1988). With all of these modifications housing market become more complex to analyse. Therefore, the evolution of housing market analysis has to include techniques that capture heterogeneity and spatial complexity of the market (Watkins, 2008). The analysis, taking special characteristics of market forces into account, provides a better understanding about housing markets. In the last years, there is a well accepted need to try to make house price models behaviourally and institutionally richer (Gibb, 2003). It is in this area that this thesis seeks to contribute to debates.

The Istanbul Housing Market

In this study Istanbul housing market is chosen specifically to have a better understanding of a highly segmented urban housing system. Like in many economies, housing construction is an essential driver of the cyclical structure of the Turkish economy. Since the population of the country has tripled in the last 50 years, the housing market has a dynamic structure with different segments with different supply and demand formation. However, the consequences of rapid urbanization, high population growth, migration from rural areas to urban areas, the rate of residential construction for all of income levels has not been enough to meet the housing need of all household formations. Beyond, there has not been an efficient housing policy for producing social housing units and there has been a lack of financial regulation system such as mortgage markets. Because of all of these factors, the demand for low- income people has been met by construction of informal housing units in squatter settlements. The housing supply for high and middle income households and legalization of these squatter settlements are the major strategies that shape the housing policies in Turkey (Akin, 2008).

Istanbul, the economic, culture, information centre of the country, shows different characteristics from western cities. The population of Istanbul rose from 3 million in 1970 to 7.3 million in 1990 and finally to 12.5 million in 2009 (TUIK, 2009). This is analogous with the urban sprawl, which has a dramatic change especially between 1990 and 2005. The built up areas increased from 252 km^2 in 1975 to 448 km^2 in 1990 and to 863 km^2 in 2005 (Terzi and Bolen, 2009). Regarding the fact that 48% of Istanbul consist of forests (IBB, 2009), the built environment covers around 34% of the city that has 5,461 km^2 surface area. Similarly, as it can be seen in census 2000, half of the buildings in the city were constructed between 1970 and 2000 (TUIK, 2009). Therefore, Istanbul is an old but a dynamic city where destruction and construction process go on fast at the same time.

What makes Istanbul an interesting case for a housing market study is the fact that it is a city characterised by forms of different socio-economic structure and urban pattern. Regarding the urban pattern, Istanbul is a naturally segmented city because of its geomorphologic structure, which makes it a unique city. Being located both in Asia and Europe, Istanbul is already segmented into two geographical units which have different characteristics. Even without regarding the social, economic and demographic demands, Istanbul has had a segmented, segregated urban pattern which also created a poly-centric urban change by time. This is more or less equivalent to the residential area change in the city. The rapid change in the population and migration that had begun from 1950's, created housing demand in the market. However, there was not enough supply, plot with urban infrastructure so local authorities increased the construction densities in the existing settlements in 1960's. On the other hand, new socio-economic dynamics lead illegal housing construction nearby industrial areas. Due to the lack of social housing policies, constructing squat was the solution of low- income people. This "self-organising housing", was substitution of social housing for the migrants seeking for job opportunities. The pre-1990 policies ignored and moreover encouraged squatter settlements by legalising them in return for their votes.

With the neo-liberalisation context in the post 1980's, constant job decline in formal sector associated with the deindustrialisation urban economy has instigated dramatic changes in the city form. Policies endorsed by investors and state authorities –that envisioned Istanbul as a financial and cultural centre- mandated the relocation of industrial areas in the periphery of Istanbul (Karaman, 2008). In the 1980's and early 90's industrial areas and employment rate had a dramatic increase in the peripheral districts. The change in the city, the development of its communication systems, the public and the private investments caused spatial transformation of Istanbul from a monocentric to poly-centric city. New CBD areas were emerging at the intersection of the radial and two peripheral highways (E5 and TEM) and sub-centres were developed at the peripheral areas of Istanbul (Dokmeci and Berkoz, 1994). The segmentation in the property market in this poly-centric structure was showing a clear pattern in the 1980's and early 1990's. The Marmara Sea, the major highways (E5 and TEM) and forest areas were the barriers in the delineation of submarkets. Moreover, the construction of the second bridge on the Bosphorus at the north of the city has changed the accessibility and land-use formation from mono-centric to poly-centric structure.

A clear submarket pattern could be drawn with the high-income people along the Marmara Sea coast, low- income people at the periphery of the city especially along the E5 and TEM highway and middle-income people between the coast and highways. This clear segmentation pattern began to disappear by the late 1990's especially after the Marmara Earthquake in 1999. Media tools declaring that north of the city had a solid ground formation have directed public perception of earthquake risk. High-income people moved to the gated communities that were mostly at the north of Istanbul close to the forested areas and water reservoir area. In addition to this, in the post-1990 context of globalisation foreign entrepreneurs invest for shopping malls, five star hotels, gated communities and offices mainly nearby major highways where more land supply was available. Thus, the periphery of the city became eligible not just for low- income people but also for middle and high-income groups. Therefore all of these changes (such as: construction of the second bridge on the Bosphorus and major highways; spatial transformation of the city from a monocentric to poly-centric structure; urban sprawl towards to the north of the city especially after the Marmara Earthquake; construction of shopping malls, five star hotels, gated communities in the globalisation process), caused an impressive boom in Istanbul's property market and change the clear segmentation pattern of Istanbul.

All of these changes bring about dramatic change in the property values tripling especially between 2003 and 2008. On the other hand, Turkish Parliament passed a series of laws that granted local authorities rights to execute urban transformation projects in collaboration with a central foundation Mass Housing Administration (MHA) in 2005 (Karaman, 2008). The squatter settlements were target areas for gated communities and sites for the urban transformation projects and deprived historical city centre areas were picked out for urban regeneration projects.

It can be seen that the city has experienced a dynamic urban change in a short period. As it is mentioned above, there were three submarkets, which were delineated with major highways in 1980's and 1990's. However, it is not possible to get this simple segmentation pattern anymore. The submarket system is getting more complicated as time goes by. Therefore with its complex segmentation pattern as a case study Istanbul is chosen to apply different models that analyze the housing market. By doing this, it is envisaged that a better understanding of the spatial complexity of the market will be provided and it is hoped that this can help assist urban planners and policy-makers in place making activities.

1.2. The Nature of Housing Market Segmentation and Submarkets

There is a voluminous literature that attempts to develop on understanding of the market of housing systems. The most distinctive feature of housing markets that differs from traditional markets is the effects of city characteristics which play essential role in segmentation of the market. Cities are characterised dominantly by residential areas that are divided into neighbourhoods where their characteristics tend to have more homogeneous structure. Usually, neighbourhoods have geographic boundaries that are determined by administrative authorities often according to historical background of space. The neighbourhoods differ on many factors such as physical form, amenities, and socio-economic structure. The physical form factors include the distance to CBDs, the public and private services such as schools, hospitals, shopping centres and accessibility to transportation facilities, whereas amenities can be green spaces, existence of seas, rivers and lakes. On the supply side, structural characteristics of housing units (such as property age, type) also matter in neighbourhood differentiation. On the demand-side socio-demographic and economic structure such as the income, education of the dwellers and ethnic background impact on the differentiation of the neighbourhoods. All of these factors are typically taken into consideration in the standard hedonic price models that investigate housing price differences across space.

Pervasive neighbourhood segmentation, however, emphasis that the housing market is not really a single market in the neo-classical sense, but a series of overlapping submarkets differentiated by location, housing type, socio-economic profile of inhabitants and quality of neighbourhood (Smith et al, 1988). In some studies, segments of the housing market are taken into consideration in the models in an attempt to find out how do the submarkets differ in the context of spatial distribution of housing prices. The segments in the housing market are formed by aggregating neighbourhoods with similar characteristics. This is not a new idea; Robinson (1938) stated that "Market segmentation involves viewing a heterogeneous market as a number of smaller homogeneous markets, in response to differing preferences, attributable to the desires of consumers for more precise satisfaction of their varying wants". According to Bourne (1980), segmentation arises because of several factors such as disequilibrium in the market, the diversity of demand and the heterogeneity of the housing stock. These segments form housing submarkets that are "collections of dwelling units which offer similarly perceived packages of housing services'' (Gould et al, 1997). In this sense, housing market segmentation means that we need to analyse a heterogeneous market that consists of a number of smaller homogeneous markets, known as submarkets. Therefore, a submarket is a cluster of neighbourhoods that have similar housing characteristics.

Unlike neighbourhoods, the definition of submarket depends on not only the spatial and housing qualifications but also on demand, supply factors, and price levels. Segmentation reflects preferences of consumers and suppliers. On the supply side, the construction of different types of housing units in different locations causes heterogeneity in the housing segmentation. On the other hand, the demand side of the market differs according to the household composition, income, education, socio-economic status. In this context, Bourne (1980) defines submarkets as quasi-independent subdivisions in which supply and demand interact to produce homogeneous clusters of housing types and household characteristics. According to this study, there is a unique set of prices or rents in the submarkets, where between them there is a little substitution of one unit for another. Substitution and equilibrium are important aspects of housing submarkets where prices are assumed to equalize across substitutes (Bourrasa et al, 2003). Housing prices show coherent attitudes due to the close substitution within a submarket. The reason for consistent price within submarket is pointed out by Rothenberg et al (1991, p32) stating that "units in adjacent quality submarkets are more likely to be closely related, and therefore more similarly affected by market events, than units in different nonadjacent submarkets". Therefore, it can be suggested that segmentation arises from many factors including housing unit, built environment, socio-economic characteristics of neighbourhood, and supply-demand dynamics of the market. In this study, segments in the market are taken into consideration in modelling in order to capture effects of spatial factors.

The most commonly used definition of housing submarkets can be traced to work of Fisher and Fisher (1954). It is now well established that submarkets exist in urban housing systems (Maclennan, 1982; Goodman and Thibodeau, 2008; Jones and Watkins, 2009). There have been numerous attempts to define and identify submarket boundaries. Typically the submarket studies are classified into spatial submarkets, structural submarket and, nested spatial/structural and demander based submarkets (Watkins, 2001).

The spatial segmentation depends on the submarkets classification that bases on the spatial characteristics. Schnare and Struyk (1976), one of the earliest study that operatinalised housing markets on the basis of spatial factors, used census boundaries in order to aggregate submarkets as inner and outer of the city. Similarly, Munro (1986) classified areas as inner and outer suburban areas according to a priori assumptions. Palm (1978), Goodman and Thibodeau (1998), Bourassa (1999, 2001) used statistical tools such as principal component analysis, cluster analysis in grouping the administrative boundaries.

The other classification for submarket identification depends on the characteristics of the housing unit. Grouping housing units with similar characteristics identifies structural submarkets (Dale-Johnson (1982), Bajic (1985), Rothenberg (1991), Fletcher et al (2000)) Usually statistical tools such as factor analysis, cluster analysis are employed to identify submarkets.

In the last years, it has been accepted the importance of both spatial and structural characteristics and segmentation of supply and demand in determining submarket boundaries (Watkins, 2001). This hybrid definition that involves both spatial, structural factors provides better results for delineating submarkets (Maclennan and Tu (1996), Goodman and Thibodeau (1998, 2003, 2007), Watkins (2001), Bourassa et al (2003, 2007), Tu et al (2007)).

Surprisingly, although the vast majority of studies with this focus, find evidence of submarket existence (see Watkins, 2001; Jones and Watkins, 2009 for reviews), attempts to incorporate segmentation in to house price models have been limited. Where this has been attempted methods vary and relative performance of different approaches is still unclear.

It is not clear precisely how well these approaches perform. They have been applied in specific locations and time periods. In addition, there have been variations in the way in what results have been reported. Four relatively infrequently used approaches have emerged. First, some analysts have sought to include submarket or neighbourhood dummies in a standard hedonic format as a means of identifying the discount associated with market segments (see Gallimore, 1996). Second, some of those studies that have been concerned with identifying submarkets have gone on to estimate submarket-specific hedonic price equations (see Bourassa et al, 1999). Third, emerging spatial statistics and spatial econometrics models have sought to interact attributes with market segments to capture complex neighbourhood effects (see Fik et al, 2003; Pavlov, 2000). Fourth, there have been a few attempts to develop a multi-level modelling approach that capture contextual effects on price (see Orford,2002, Leishman 2009).

The empirical analysis in this study has been designed to control as far as possible for the variations in research design that inhibit comparison of the effectiveness of previous attempt to model neighbourhood segmentation. The four main methods will be replicated. Each of the approaches will be used to construct models that perform broadly as well as in those in the peer reviewed literature. For example, the signs and magnitude of hedonic coefficients, the fit of the model and its performance against standard diagnostics is comparable to other outputs. This has been verified by peer reviewers in Keskin, 2008. In addition, each of the models will use a standard variable set. Powerful explanatory variables will not be used to advantage one method over the others.

This study seeks to compare the effectiveness of these techniques by applying them to a single data set. More specifically, 2,175 transactions are used from the

Istanbul market in between November 2006 and April 2007. The size of the data set is similar with those used in the hedonic studies and submarkets.

1.3. Aims and Objectives

The aim of this research is to explore the relative merits of different approaches to capturing neighbourhood segmentation within house price models. The analysis will focus on Istanbul and seeks to develop our understanding of structure of the urban housing market. There are several subsidiary objectives. The study will:

- Examine the alternative ways to conceptualise the structure of owner occupied housing market
- Identify alternative approaches to modelling the segmented model structures
- Apply these methods to data from Istanbul
- Establish tests that allow us to compare the "accuracy" of these models
- Draw conclusions about the most appropriate tools for modelling segmented housing markets

1.4. Structure of the Thesis

The remainder of this study is divided into eight chapters. The second chapter, structure and operation of housing markets, reviews the literature on theoretical and applied approaches within the framework of housing markets and suggest that taking submarkets into consideration may be more sufficient for understanding the housing market structure.

Chapter 3 describes the study area in order to have a better understanding of study area: Istanbul. In the first section, information about socio-economic indicators and the property market in Turkey are provided. Overview of Istanbul's property market is explored by considering the submarkets and land use in the city. The chapter also reviews housing market in Istanbul by taking housing supply and demand into account.

Chapter 4 is concerned with the research design of the study. It begins by charting the research design with the stages of the research process. It provides an overview of the structure of the thesis and the focuses on the data set which is used in modelling the housing market. The data set is analyzed by categorising it into housing unit characteristics, socio-economic characteristics of the neighbourhood, neighbourhood quality characteristics. The chapter also offers a definition of submarkets in the Istanbul Housing Market by considering the a priori, experts and cluster analysis delineations. The final part of the chapter explores the comparison of models that considers segmentation in housing markets.

In this context, Chapter 5 examines two different hedonic model approaches. The analysis explicitly gives the results of a market-wide hedonic model and a hedonic model including neighbourhood dummy variables as a proxy for submarkets within the model. The analysis shows that when a series of dummy variables are added the explanatory power of the model increases.

In chapter 6 the results of the third method, which is based on estimating a separate hedonic equation for each submarket, are displayed. This chapter introduces an approach that overcomes the approach which does not allow attribute values to vary with geographical context. The twelve submarkets that are determined by a priori, experts and cluster analysis are modelled in order to capture the variation of characteristic values within locational standpoint.

Chapter 7 presents the theoretical understanding of multi-level approach and the model results. The chapter offers an alternative method that can provide a better understanding of the effects of both individual and contextual level. In this study housing unit is the individual level and submarket is the contextual level. The significant variables in the multi-level models are analogous to the significant variables of hedonic models. It is argued that multi-level modelling can be an alternative of hedonic models since this method can overcome with the technical weaknesses.

Chapter 5, 6 and 7 are basis for comparative analysis of effectiveness of hedonic models and multi-level model that is discussed in chapter 8. Finally, conclusions are drawn from the study and outlines areas for further research that may contribute to advance the understanding of the housing market segmentation structure.

CHAPTER 2 STRUCTURE AND OPERATION OF HOUSING MARKETS

2.1. Introduction

There is a vast literature that is concerned with the structure and operation of local housing systems. This literature has evolved from the earlier contributions at the start of the 20th century and has spanned a wide variety of theoretical traditions and applied approaches. The aim of this chapter is to review the main theoretical traditions and develop the conceptual basis for this study. The review focuses on the challenges posed by the unique characteristics of housing as an economic commodity and considers how these have been dealt with in different strands of the literature.

This chapter has four main sections. The next section discusses the nature of housing as an economic good. This is followed by a discussion of the contribution of neo-classical theory starting with location theories and notes that these provide a platform for explanations including pure competition for heterogeneous goods (or hedonic theory) and simulation models. Some of the limitations of this theoretical tradition are discussed. Section three introduces the (implicitly) institutionalist theories that concludes with a critique of the institutionalist perspective. Section four focuses on the influences of these theories on housing economics literature. This section plots the way forward for this study. It highlights the need to accommodate the housing submarkets and neighbourhood segmentation associated with institutional models within a neo-classical framework. It highlights some of the established and emerging literature that deals with this. The final section contains a summary and highlights the implications for this study.

2.2. The Economic Characteristics of Housing

A broad framework for the analysis of residential areas has been developed by housing economists interested in the spatial distribution of housing prices. Rather than having a unique, well-incorporated and homogeneous structure, housing markets have a segmented, heterogeneous form that reflects market complexity (Watkins 2001). Segmentation arises from heterogeneous structures in housing markets which involve various characteristics such as structural and neighbourhood attributes; public services; private investment and locational attributes. With all these features, the housing market differs from other good markets. Characteristics such as durability, fixity (immobility), and heterogeneity distinguish housing market from other markets (Rothenberg, 1991; Arnott, 1998; Whitehead, 1999; Tu, 2003).

Durability

Housing is a stable, slowly depreciating commodity which can not be relocated and rebuilt easily. Since housing stock is a capital good with a long life, the quantity and quality of it changes with time. The quality of a housing unit can be either improved by renovation or reduced in value because of depreciation over time at any location (Tu, 2003). A property can depreciate quickly if there is no maintenance and the existing stock can be improved by maintenance and renovation. The durability of the housing stock has been taken into consideration in the models of the analysis of household satisfaction and property filtering. On the other hand, since housing is a long life capital good, it enables home buyers to get mortgages, credits from the banks. Therefore, the housing system affects the macro-economy in the form of interest rates, real incomes and economic growth. A recent example is the sub prime mortgage crisis in the USA in 2008 which caused not only national but also a global financial crisis. Significantly, too, the durability of housing seems that over a dwelling's life time consumer preferences will change and so will the position a property and neighbourhood in which it is located occupy in urban price hierarchy.

Immobility

The immobility or fixity of the properties indicates the characteristics of the dwelling related to its location. These locational characteristics include both the physical and the socio-economic features of neighbourhood. Also, accessibility to any desired destinations, such as jobs, relatives, friends, private goods, and public facilities contributes to differences in housing quality and housing prices across locations (Tu, 2003). The immobility of housing is related with locational values, neighbourhood characteristics and local property tax and expenditure effects (Whitehead, 1999). The fact that properties are traded for both their inherent attributes and also their position within space poses one of the most significant analytical challenges in housing studies (see Maclennan et al, 1987).

Heterogeneity

Housing is a complex commodity which is also heterogeneous. Heterogeneity of a dwelling's physical characteristics refers to the essential variation found across housing types, sizes, ages, structure materials, exterior and interior structures and architecture designs as well as to different forms of land leasing (Tu 2003). Not only physical characteristics of the housing units and neighbourhoods are heterogeneous, but also the income levels, household structure, education, occupation of the homebuyers are diverse. Both the preferences and the socio-economic status of the homebuyers create a heterogeneous market conditions. For example, even two houses in the gated communities with the same layout of the plans would be different because of the view of the house, deprivation-renovation difference in the buildings, and the profile of the household.

2.3. Neo-classical Models of Housing Market

Theoretical perspectives explaining segmentation in the market can be categorized into neo-classical economic, institutional and heterodox approaches. The distinction among these approaches arises from the assumptions about preferences, land use, institutions, and behaviours.

The neo-classical economic approach was developed from land rent theory which was derived by David Ricardo and Johann Heinrich von Thunen in the eighteen century from the idea that the price that occupants are willing to pay for a piece of land's depends on locational advantages. From an economic point of view, the more productive a plot of land is, the more valuable it should be. The location of the land could be quantified in terms of the economic cost of getting the produce from the land to the marketplace. The demand for such locational characteristics determines the relative value of land and housing at different locations. On the other hand, land or housing supply determines the overall level of land and housing prices in the city. Understanding demand and supply fundamentals for land and housing markets is therefore important in order to have a better understanding of the spatial distribution of prices

Like the land rent approach, subsequent neo-classical economic analysis has mainly focused on the outcome from the interaction of supply and demand in the market (Adams et al, 2005a). Neo-classical economics explains how the market works in terms of supply-demand relations by focusing on individual decisions. Neo-classical economics theories dominate housing market analysis. The earliest contributions of this approach focused on location. The idea of neo-classical urban economics is based on the explanations of urban structure, the pattern of population location in terms of consumer theory and utility maximisation that was developed by Muth (1961), Kain (1962), Wingo (1961), Alonso (1960, 1964). Utility maximation leads to a bid-rent function showing how prices change with distance from the city centre; the bid rent function depends on the negative of the marginal valuation of travel time

Maclennan (1982) argued that the access-space model is the real starting point for an analysis of local housing markets in the neo-classical economic approach. In this approach, location is the basic point of utility of household. According to the basic trade off model, the city is assumed to be flat and all employment is located in the Central Business District (CBD). According to Quigley (1979), 'the principal conclusions of the mono-centric model are:

- Residential densities decline with distance from the central place
- Densities decline at a decreasing rate
- House price decline with distance
- The land price gradient is steeper than the housing price gradient
- Households with higher incomes locate further from the central place (see Gibb 2003).

Rationality is an important underlying assumption of the neo-classical economic approach. Both the consumers on the demand side and the firms on the supply side are expected to behave and act in a rational way. All economic activities involve individual choices that are the decisions by an individual of what to do, which necessarily involves a decision of what not to do (Krugman and Wells, 2005). Therefore, behaviour of the individuals depends on psychological and social parameters. For example, the sale of a property to a famous person can make people invest in that neighbourhood, even though this is irrational. Thus, to assume that consumers (individuals) that have different housing preferences are rational is unrealistic.

According to the neo-classical approach, entrepreneurs make decisions by taking the market conditions into consideration in order to understand competitive markets with transactions. Perfect competition requires many buyers and sellers who all have freedom of entry and exit, perfect information and a homogeneous product. Property markets are far from meeting the conditions of perfect competition, so this affects their performance and suggests a role for public policy (Adams et al, 2005a).

In the neo-classical economics approach, the consumers and producers are assumed to be fully informed with access to complete, accurate information. This is not usually possible in real market conditions because housing markets are dynamic structures that are influenced by institutions, organisations and key actors. The structural framework for development is obvious in resources like knowledge, information, capital, land, labour to which they have access, the rules they consider manage their behaviour and the ideas that they draw upon in developing their strategies to master rules, capture resources and exploit ideas and achieve their objectives (Tiesdell and Allmendinger, 2005). Thus, information is a temporary and dynamic subject in the housing market. Fully informed consumers and producers are also unrealistic in real market conditions. Even for doing academic research or valuation of the properties the full data -price, surface area, number of rooms, plot size, car park existence- is not available for a lot of housing markets in the world.

In order to conceptualise the market, it is assumed that both the city and market structure should be simplified. Mills and Mackinon (1973) summarised the main characteristics of this approach related to the city structure as:

- The city is located on a featureless plain, it has a predefined Central Business District (CBD) and it has a slice taken off for particular public utilities or natural utilities. Travel consists only of commuting trips to the

CBD, therefore the city can be treated as one dimensional essential for the use of sophisticated mathematical models.

- Travel either costs money or reduces utility, which is a function of consumers goods and housing
- Population is given exogenously, all with the same utility and demand functions and the size of the city is determined by incomes and tastes.

Furthermore, neo-classical economists assume that housing prices are determined by the relationship between supply and demand in the market, which depends on the willingness of consumers to pay, and it is affected by the preferences and budget of individuals. Dwellings vary according to physical conditions like the number of rooms, floor area, structure type, age, structural materials and locational conditions like distance to the CBD, public facilities, private goods, and work locations. On the other hand, consumers vary according to their preferences, income and household composition, and job choice. Different households have different tastes and hence different preferences. When a household rents or purchases a housing unit, they obtain not only the physical unit, but also a set of public services and tax obligations, legal rights and obligations (Arnott, 1998). Therefore, housing is a composite commodity and may be analysed in terms of its service flows or stock in some aggregate way or in terms of individual characteristics (Malpezzi, 1999).

The analysis of demand started with the measurement of income and price elasticity which vary considerably across the ranges of attributes that have been identified with respect to space, structure, environment (Whitehead, 1999). On the demand side of market, inelasticity results inherently from the high cost of changing occupancy. Additional sources derive from households desiring radically different housing attribute packages or from subsets of households being choice-restricted by market imperfections such as discriminations (Rothenberg, 1991).

The supply side of the housing market consists of both the newly constructed and existing houses. Existing supply depends on all factors that contributed to house owners putting their properties on the market and the supply of newly constructed houses depends on consumers' preferences. The overall supply of housing is modified not only by new buildings, but also by improvement and existing stock on the one hand and depreciation of that stock on the other (Whitehead, 1999). Supply depends on the ability of the house building industry to respond to higher prices. In neo-classical economics, demand and supply are expected to determine the price of housing in the absence of controls on the housing market (Arnott, 1998).

Through the interaction of supply and demand, markets will rapidly arrive at a predictable, stable and desirable equilibrium. In neo-classical economics, markets adjust to remove disequilibrium between demand and supply and this adjustment occurs rapidly. However, in real conditions, such an adjustment may not be so rapid (White and Allmendinger, 2003). In the short term, while the housing supply is assumed to be constant, the equilibrium locations of households are derived in this static framework as a "trade-off" between the consumers' demand for living access-space (low travel cost and short travel time) to the city centre (Kauko, 2001). Importantly the 'trade-off' model was extended by Rosen (1974) with the introduction of a hedonic model that enables housing heterogeneity. The heterogeneity of the housing stock has always been on the agenda of the hedonic price approach. The hedonic price models help in explaining the lags in the price, demand and supply side of housing market. In hedonic models, it is postulated that implicit markets existed for housing attributes. The approach was described formally by Rosen, setting out a model of demand, supply and competitive equilibrium (Whitehead, 1999).

A hedonic equation is a regression of expenditures (rents or values) on housing characteristics. The independent variables represent the individual characteristics of the dwelling, and the regression coefficients may be transformed into estimates of the implicit prices of these characteristics (Malpezzi, 2003).The variety of attributes involved in housing has led to a range of hedonic house price studies. The hedonic approach in property market analysis utilizes the heterogeneous nature of property and adopts the view that a unit of property is a bundle of attributes that contribute to the provision of flow of one or more property services. Hedonic price models are applied for numerous purposes, such as to evaluate the impact of policy decisions on the environmental impact assessment, to examine the effect of the planning system, and to examine the impact of transport infrastructure on property value (Dunse and Jones, 2005).

A hedonic function is a regression of expenditures on housing characteristics such as structural features of house, neighbourhood quality, public facilities, and locational elements. The dependent variable rent or value of the house is explained with the help of independent variables such as the number of rooms, floor area of the unit, age of unit, housing type, other structural features like the presence of basements, fireplaces, car parks, major categories of structural materials and quality of finish, neighbourhood quality, neighbourhood rating, quality of schools, socio-economic characteristics of the neighbourhood, distance to CBD, distance to sub-centres of employment, access to shopping, schools and other amenities, characteristics of the tenant that affect price, length of tenure, and racial or ethnic characteristics (Malpezzi, 1999). Analysis of the microeconomic structure of housing and macro-economic effects on the housing market can be employed in hedonic price models. Many studies such Ozanne and Thibodeau (1983); Manning (1988); Fortuna and Kushner (1986) and Rose (1989) explain the housing price differences with variables such as demographic changes, income, consumer expenditures, taxes and the amenities-disamenities of the city.

According to Watkins (2006), the model assumes that buyers purchase housing and employment accessibility. Jointly by taking into account the standard neo-classical behavioural assumptions like being rational and having information, it becomes possible to predict the pattern of residential location choices and spatial distribution of house prices in long run equilibrium. Hedonic models continue to recognize that location plays an important role in property values. In addition to this role, it accommodates product heterogeneity.

But hedonic models suffer from being static, this limitation is addressed in the development of simulation models of urban markets. The models like NBER-

HUDS (National Bureau) were used to predict the market impacts of a variety of policy changes and include assumptions about optimizing actors by recognizing the existence of dynamic filtering processes (Kain and Quigley, 1975). An alternative model to the general equilibrium model of the housing market has been computer simulation models. These models evaluate the short turn analysis of urban housing models, especially how markets react to government housing subsidies (Whitehead, 1999). Simulation models tried to deal with durability, time and temporal dynamics. These models represent characteristics of both trade-off and filtering models and they have been useful tools for policy development and planning purposes (Gibb, 2003).

A critique of neo-classical models

Neo-classical economists have often been criticised by institutional economists due to their unrealistic assumptions. According to neo-classical economists, the behaviour of consumers, producers, and actors of the market are in a reductionist framework of assumptions. Buyers and producers are assumed to be fully informed and they behave rationally. The goods are assumed to be relatively simple and the system is usually regarded as competitive (Maclennan and Tu, 1996).

It can easily be argued that the "actuality" does not fit with these assumptions. Although sometimes the facilities and the social structure of the city are taken into consideration (Thibodeau and Goodman, 1998; Kauko, 2001; Goodman and Thibodeau, 2003), the city structure is usually undervalued in housing market studies in the neo-classical economics approach. Cities are not usually flat and topography is one of the determinants in housing prices because of it affects the landscape/view of the dwelling. Most cities are poly-centric and the employees are spread out in the different locations of the city according to the sectors. The basic model cannot explain polycentrism. The mono-centric model has been an excellent conceptual tool, especially for the studies that explain the role of commuting costs, but it provides no more than a useful starting point to explain the spatial structure of modern cities (Whitehead, 1999). One of the major limitations of the mono-centric model is that employment areas have a steeper bid rent function than residential areas, so they are centrally located. Although neo-classical economists assume that the CBD is the area where employment is concentrated, real world employment has been suburbanizing for a long time. In order to overcome this weakness, Mills specifies a model that involves two point density gradients for employment and population. Mills assumes that the best distribution of land for employment and housing is the allocation that minimizes the sum of goods, transport costs and employers' commuting cost. In this model, the resulting density gradient measures the percentage decrease in population or employment density per mile from the CBD, where a smaller density gradient indicates greater suburbanization (White, 1999). There are some other studies about polycentrism that assume the location choices of the production centres in a secondary centre make land rent decrease.

Another critique of neo-classic model is that the land use in mono-centric models depends on the assumption that there are no externalities. Land use in the poly-centric model depends on the assumption that production and residential areas can occur everywhere in a featureless space but become interdependent because of the consumption-related travel decisions of consumers and the inter-industry linkages among firms. So, for a household, it is important to be able to access work places, shopping centres, and public facilities, whereas access to other producers, labour, and customers becomes more important for producers. In these models, residential land use is dispersed throughout the urban space and a set of conditions under which it clusters into a disconnected number of sub-centres. The mono-centric city arises as the total clustering of jobs (Anas and Ikki, 1996).

Although the neo-classical approach gives the opportunity to understand land use change in terms of a static equilibrium setting from micro-economics, there are still weaknesses. For example, urban housing market choices do not exclusively rely on business area accessibility and locational amenity, but are also related to the normative value and perceptions of households, quality of neighbourhoods, housing quality, and role of the state of the land market. In a long-run term, the role of the state and certain macro-structural aspects of price formation are the key dimensions of an urban housing system. Besides the abstraction of the city structure, there are also assumptions about the market structure. Neo-classical economics explains how the market works in terms of supply-demand, which depends on rationality of individuals, each seeking to maximize their own utility. Housing preferences are based on full available information for both the consumers and the firms. The actors on the supply side act like developers and landowners react according to the price signals. The system is usually regarded as competitive where the good are assumed to be relatively simple (Maclennan and Tu, 1996). Thus, equilibrium, rationality, maximizing utility, access to full information and competitiveness are the principles of the market structure in the neo-classical approach. The neo-classical economists were criticised because of facts like misinformation and goods variety. Also, the market conditions can change due to the space, time and the nature of the housing market.

In conclusion, neo-classical assumptions about a housing market are highly restrictive and unrealistic when applied in order to analyze housing markets. The assumptions of this approach do not offer a correct representation of the real market. The critiques of neo-classical economics can be listed as:

1. The neo-classical approach has an abstract paradigm that does not always apply to the actual economy. However the abstract paradigm may help in operationalising model of the housing market, but it may also undervalue the effects that can not be abstracted.

2. The neo-classical approach has an epistemological limitation which is about the assumptions that consumers make rational decisions. That approach underestimates the behavioural, physiological, and sociological effects in consumers' decisions.

3. Furthermore, assuming that home buyers, developers and institutions are fully informed is not possible in real market conditions. This may cause failure in the models to explain the determinants of housing prices.

These traditional critics about neo-classical approach such as being abstract, assumptions that actors behave rationally and they are fully informed are right to a certain point. However, in order to analyse property market which is a complicated subject some assumptions should be made. According to Ball (1998) it is obvious that abstraction, modelling and working through the consequences of complicated property market processes can both help to analyse and lead to important conclusions.

To abstract is purposely to ignore and simplify by definition. “All theories are abstract, so to claim that elements of reality are missing in them is a truism” (Ball. 1998, p.1456). Therefore the assumptions that actors of the market behave rationally and they are fully informed are consequences of abstraction process. Nevertheless “how to abstract” the real conditions of the market is the crucial point in the practice of neo-classical economics approach. What is included or excluded in the process of abstraction depends both on the questions being asked and the theoretical approach adopted (Ball, 2002).

Neo-classical economics is often treated as “straw enemy” in a structure that can be easily knocked down (Ball, 1998; Adams et.al; 2005; Gibb 2010). This thesis does not want to imply such a negative standpoint. According to Gibb (2010) despite the limitations there are some important qualifications of neo-classical approaches. First there are many examples of intelligent adaptations of the neo-classical models that provide useful, realistic insights. Second, neo-classical approach provides a counter factual about the property market and a critique of public policies.

Despite these criticisms, in practice, the neo-classical model provides the principle platform for the empirical analysis (see section 2.6).

2.4. Institutional Approaches

Housing markets are usually performed in the power filled negotiations of buyers, sellers and market professionals (Smith et al, 2006). According to their study, housing market performance can be investigated with a complex interplay of cultural, legal, political and institutional arrangements. The institutionalist approach contains large potential for analysing housing markets: explaining their operations in terms of goals, plans and actions of individuals taking social and cultural phenomena such as networks in the market. In addition to that, this approach allows one to understand price, value and context. It also reflects key connections between the costs of exchange and institutions

More specifically, the cumulative effect of the central behavioural assumptions of neo-classical economics is that it over-states. The extent to which housing markets should be seen as unitary entity rather than highly differentiated systems is a distinction between neoclassical and institutional approaches. They have all criticised institutional economists for their unrealistic assumptions. Samuels (1995) explains that new institutional economics 'works largely within neo-classicism and shares its rationality, maximisation, and market or market-like orientation and likewise tends to seek, though with less formalisation, the conventional determinate, optimal, equilibrium solutions to problems (see Adams et al, 2005a). There are numerous forms of institutionalist analysis.

Institutional economics, for instance, includes new, neo and old perspectives. These differ from neo-classical economics by varying degrees. The political economy of institutionalism represents an alternative to neo-classical economics since it emphasises the social construction of economic life and takes a strongly disaggregated view of market structures, with distinctive routines, cultures, procedures and institutions evident in each submarket (Adams et al, 2005b).

According to Adams et al (2005b), there are three main institutional features of land and property markets: "the formal rules" which are determined by governance directly or indirectly; "rules of the game" which are informal and unwritten conventions; "network of relationships" which is between market operators or agents and the extent to which policy induces the development of trust and the creation of other forms of social capital within the market place.

Institutional approach is concerned with economic systems and much of the literature normally defines as binding rules or systematic rule-directed behaviour (Eggertsson, 1998). The formal rules regulate access to the market, which rights may be traded and which cannot, land-use and environmental rules, fiscal rules, subsidies, inheritance rules (Needham and Segeren, 2005). In an analysis based on ideas from neo-classical economics, assumptions are made that the interaction of demanders and suppliers emerges in the absence of all rules. In institutionalist analysis, it is assumed that institutional factors influence supply-demand relations and the market is assumed to be more heterogeneous than in the neo-classical approach. However, it is impossible to define exact boundaries in the more classical approaches (Kauko, 2001).

Depending on the demand and supply curve and on the number of actors, the amount transacted and the price can be predicted. The object of investigation is the market outcomes. Thus, the way in which the interaction takes place is usually assumed, not investigated. Neo-classical analysis takes such rules into account by studying their possible effects on the market outcomes predicted first as if there were no rules. In that way, the rules are exogenous to the analysis. It is recognised that ignoring rules is unrealistic. All those rules create a structure which affects the availability of information, risk and uncertainty, transaction costs, organizations for buyers and sellers and brokers, etc (Needham and Segeren, 2005). The rules and also how to react to demanders and suppliers must be investigated. Another criticism of the assumptions made by neo-classicism is, if the state constrains supply or encourages demand, then, other things being equal, prices will rise. In order to return supply and demand to a state of equilibrium, the price mechanism is operated.

According to Ball (1998), for feasible equilibrium, both the demand and supply sides must be able to access the full available information when making their decisions. Thus, equilibrium conditions depend on the institutional characteristics. In institutional economics, institutions are often regarded as 'the rules of the game' in contrast to the 'players' or 'organisations'. "Informality or informal rule systems are defined as those activities governed by well-agreed upon private methods of regulation rules among individuals and groups, outside the state's legal framework" (Pamuk, 2000). According to institutionalists, property markets are the combination of rules, conventions and relationships. They attempt to provide a clear account of the property market process as a moderator of economic change (D'Arcy and Keogh, 1997). Institutional approaches offer an alternative to the 'positivist theories' that idealise and isolate economic structures and individual behaviours (Guy and Henneberry, 2000). Housing market structures are affected not only by economic or social-behavioural situations, but also by institutions, organisations and key actors. Institutional factors are the combination of cultural, legal, political, and administrative issues. Informal social rules dependent on cultural factors, belief systems, values, the rules, formal and informal, affect the costs of bringing about a transaction.

According to the institutionalist approach: In a property market there are relationships among:

Actors ⟶ Network

Formal rules ⟶ Regulations

Informal customs ⟶ Convention

The framework for development is obvious in the resources like knowledge, information, capital, land, labour to which they have access. The rules they consider manage their behaviour and the ideas that they draw upon in developing their strategies to master rules capture resources, develop ideas and achieve their objectives (Tiesdell and Allmendinger, 2005).

Because it is regarded as a social institution, the market is not considered to be a single uniform unit by instutional theory. Indeed, a strongly disaggregated view is taken of market structures, with each particular market seen as having its own routines and procedures with a particular social-culture and other institutions. Accordingly, there is not just one type or set market, but many different markets, each depending on its instutional context (Adams et al, 2005b). In order to analyze the housing market with an instutional perspective, qualitative methods, such as interviews and analysis of dialogues, are employed. In addition to these techniques, Kauko (2003a) investigated housing market segmentation with the help of self organizing maps in a neural network. This technique is a heterodox method which uses quantitative inputs and produces qualitative outputs. Although this technique is pragmatically based on neo-classical theories, Kauko proposes models based upon analysis of the choice set in the individual decision making process, determined by a range of institutional constraints (Wallace, 2003).

2.5. Review of Housing Market Segmentation Theory

Recent research has sought to make a link between the segmented structure implied by institutionalist approaches and standard neo-classical models (Kauko, 2003; Smith, in press). This can be best understood by explaining the evolution of the literature that deals explicitly with the existence of housing market segmentation (also known as housing submarket). This broad conception of the behaviour of markets, as mentioned in the previous section, informed development of a distinct strand of applied housing market analysis in the US during the twentieth century. Watkins (2008) describes this as the Columbia School. The main contributions were to derive analytical models of local housing systems that emphasised the co-existence of separate but interrelated market segments (or housing sub-markets) and sought to investigate the dynamic nature of submarket linkages and the extent to which 'filtering' takes place (Watkins, 2008).

Housing submarkets refer to the diversity of homebuyers' profiles and supplies in various markets for the sale of different types of housing units. Hence, segmentation can be identified according to the supply and demand side of the urban housing markets. Fundamentally, the submarket/segment concept involves subsets of homebuyers that are grouped into subdivisions where there are various characteristics. The variety of supply and demand in the housing markets provides clarification for the occurrence of segments/submarkets.

In this context, Watkins (2009) points out that multiple equilbria and disequilibrium are the two potential explanations for the existence of housing submarkets. Most of the researchers recognize the existence of price differentials among market segments, and estimate housing prices with hedonic models that must be based on the assumption of equilibrium within submarkets (Watkins, 2009). According to Tu (2003), submarket housing stock and submarket turnover rate are positively related to the equilibrium submarket housing demand and supply and disequilibrium takes place when there is a mismatch between demand and supply.

One of the potential explanations for the existence of submarkets is "disequilibrium," which is caused by financial and personal preferences, such as search and information costs; homebuyer's preference to live close to friends or workplaces and financial affordability (Tu, 2003; Watkins 2009). The prevalence of imperfections such as information cost and transaction costs give rise to the concepts of equilibrium and disequilibrium in the housing market and causes submarkets (Whitehead and Odling-Smee, 1975). Long adjustment lags on the supply and demand sides guarantee that housing market is barely fully adjusted to exogenous unexpected changes. These exogenous shocks will change the market processes towards a new equilibrium solution (Watkins, 2001). These facts suggest that in order to have accurate housing market analysis results, housing markets should be investigated by considering submarket existence. Maclennan and Tu (1996) point out that submarkets are evidence of disequilibrium in the market rather than multiple equilibria.

The other submarket existence explanation suggests that housing market tend towards multiple equilibria (Goodman, 1978) which means that each submarket will exhibit its own equilibrium price. This assumption dominates most of the housing market studies since they recognize the existence of housing price differences among submarkets and employ hedonic models that are based on the assumption of equilibrium within submarkets (Watkins 2009). This argument is based on the notion that what has been observed in empirical studies is in fact a system of multiple equlibria. This idea can, in fact, be traced to the work of Goodman (1978). It is based on the view that within each segment there is an internal equilibrium that can be revealed by hedonic price models where each coefficient represents the attribute price determined by the balance of supply and demand forces. The submarket-specific prices vary but as each segment is in balance this should not be viewed as evidence of disequilibrium. The empirical analysis that follows in the thesis develops from the assumption that the Istanbul market is in a state of multiple equilibrium (see Watkins, 2009 for future details of this argument).

Definition and identification of housing submarkets

In practice, most of the housing market researchers have suggested that the urban housing market system is best analyzed as a collection of "functionally independent geographic submarkets differentiated by the characteristics of their housing units and/or the locations of the submarkets" Rothenberg et al (1991, p.63). Although it has been agreed that taking submarkets into consideration is essential, there has not been a consensus on the definition of submarkets.

As pointed out by Watkins (2001), there are five reasons for the failure: the lack of consensus on the definition of submarkets, the lack of agreement on identification of submarkets in practice; the variation of study areas; the time period of the study and, lastly, the different statistical tools that test the existence of submarkets. In this section, the first two reasons stated by Watkins, lack of consensus on definition and identification of submarkets, are investigated, since these issues are the main subjects of the debate on segmentation of housing market.

Definition of housing submarket

"A housing market area is the physical area in which all dwelling units are linked together in a chain of substitution. In a broad sense, every dwelling unit, within a local housing market, may be considered as a substitute for every other unit." (Rapkin et al, 1953, cited in Grisby, 1963, p.33). Regarding the concept of close substitution, it is desired that the housing unit characteristics, locational characteristics and socio-economic characteristics within a submarket display similar attributes. On the other hand, dissimilarity among submarkets is evidence of the existence of different segments in a market.

The earliest mainstream contributions to the submarket literature (e.g Ball and Kirwan, 1977; Schnare and Struyk, 1976) implicitly present a picture of a market that is in equilibrium. They test for segmentation on the basis of a temporary departure from the equilibrium state but do not take submarkets into account as an enduring challenge to that state. Adapted from the study by Cliff et al (1975), Tu (2003) pointed out that there are three criteria to apply in identification of housing submarkets:

- Similarity (housing units within a submarket should have a high degree of homogeneity or substitutability), while the housing units in different submarkets should perform a higher degree of heterogeneity. This means that the properties of a housing unit should be similar to the other housing units in the same submarket.

- Simplicity: An analysis with few submarkets is better than an analysis with many submarkets. In other words a solution with a few submarkets is superior than with many submarkets.
- Compactness: Housing units in the closest areas are more likely to be in one submarket than areas farther away. Dwellings located in geographically close areas tend to be grouped into one submarket than dwellings that are further away.

The criteria such as similarity (close substitution), simplicity and compactness assist in defining housing submarkets. In addition to these norms, the criterion used in defining submarkets is determining ad-hoc boundaries by taking into account the different components of a housing market. Housing market characteristics have been traditionally divided into spatial characteristics and structural characteristics. However, structural characteristics have been far easier to account for in the price of houses than spatial ones (Orford, 1999). The way in which this definition is operationalised, in practice, is of course highly variable.

Although there is a consensus on the theoretical existence of submarkets, there is not enough agreement on how to delineate the submarkets. Grigsby's approach on substitutability is the basis of submarket definition. Grisgby (1963) explains substitutability in terms of optimisation of preferences within a price limitation. For example, if being close to the city center is more important, the size of the housing unit may have to be compromised. Substitutability, requires home buyers to be indifferent between the entire bundle of structural, locational and neighbourhood quality attributes which characterise the competing housing units

(Watkins 2001). This statement implies that in determining the submarket "structural characteristics of a housing unit are important" (p. 2239) and spatial characteristics of submarkets are neglected Although locational and neighbourhood characteristics suggest that spatial attributes matter, it is neglected that search cost and information limitations may impose geographic limits on substitutability (Watkins 2001).

On the other hand several studies on housing submarket acknowledge, "spatial characteristics are more important" than structural characteristics (Watkins, 2001). According to this approach spatial factors are the determinants of the housing unit characteristics. Housing quality is defined by locational factors and this makes sense to delineate submarkets as spatial realities, not abstracted market spaces (Bates 2006).

Another approach suggests that both structural and spatial characteristics are important in housing segmentation (Adair et al. 1996; Maclennan and Tu 1996; Watkins 2001; Kauko 2002; Bourassa 2007). As Evans (1995, p.6-7) pointed out " the buyer is purchasing a property which is a bundle of characteristics. So, in the case of a house, the *purchaser buys a location relative*, say, to shops and workplaces, fertility in the sense of the quality of environment, also a house where attributes of the house – central heating, number of bathrooms, size and number of rooms- *cannot be detached and sold separately* (emphasis added).

Housing submarkets are often defined as geographic areas where the price per unit of a housing service is constant (Goodman and Thibodeau, 2003). The term housing service has a broad explanation that may include housing unit characteristics, socioeconomic characteristics of neighbourhoods and locational characteristics. As mentioned above, the definition of housing submarkets is based on different assumptions, such as spatial/geographic, structural/housing unit attributes or nested/combined (Watkins, 2001) or topographically based/locational, quality based/structural attributes (Tu, 2003). Bourne (1980) defines submarkets according to housing stock (tenancy, housing type); household type (race, economic status, age, family status) and location (inner city, inner suburban, outer suburban). Another approach is defined by Kauko (2002) according to tenure/lease; house type, number of rooms; source of finance; age of building and location.

Table 2.1. Definition of submarkets (Adapted from Bourne (1980) and Watkins (2001, 2009))

Studies	**Study Area**	Definition **Categories**
Submarket definition due to spatial attributes		
Grigsby (1963)	Philadelphia, USA	Spatial
Needleman (1965)	London, UK	Spatial
Harvey and Chatterjee (1974)	Baltimore, USA	Spatial
Straszheim (1975)	San Francisco Bay, USA	Spatial
Schnare and Struyk (1976)	Boston, USA	demander group, spatial and structural
Ball and Kirwan (1977)	Bristol, UK	spatial
Palm (1978)	San Francisco Bay, USA	Spatial
Sonstelie and Portney (1980)	San Mateo, USA	Spatial
Gabriel (1984)	Beer Sheva, Israel	Spatial
Munro (1986)	Glasgow,UK	spatial and

		demander
Maclennan et al (1987) ; Maclennan (1987)	Glasgow, UK	Spatial
Michaels and Smith (1990)	Boston, USA	Spatial
Hancock (1991)	Tayside, UK	Spatial
Bourassa et al (1999)	Sydney & Melbourne, Australia	Spatial
McGreal et al (2000)	Belfast, UK	
Berry et al (2003)	Dublin, Ireland	
Clapp and Wang (2004)	Connecticut, USA	Spatial
Submarket definition due to structural attributes		
Kain and Quigley (1975)	Pittsburgh, USA	Structural
Dale-Johnson (1982)	Santa Clara, USA	Structural
Bajic (1985)	Toronto, Canada	Structural
Rothenberg et al (1991)	Des Moines, USA	Structural
Allen et al (1995)	Clemson, USA	Structural
Goodman and Thibodeau (1998, 2003, 2007)	Dallas, USA	Structural
Fletcher et al (2000)	Midland Region, UK	Structural
Wilhelmson (2004)	Stockholm, Sweden	Structural
Submarket definition due to nested attributes		
Goodman (1981)	New Haven, USA	Nested
Adair et al (1996)	Belfast, UK	Nested
Maclennan and Tu (1996)	Glasgow,UK	Nested
Watkins (1999, 2001)	Glasgow, UK	Nested
Kauko (2002)	Helsinki, Finland	Nested
Bourassa et al (2003, 2007)	Auckland, New Zealand	Nested
Bates (2006)	Philadelphia, USA	Nested
Bourassa et al (2007)	Auckland, New Zealand	Nested
Tu et al (2007)	Singapore	Nested

From all of these studies, it can be concluded that segments in the housing submarkets arise because of the differences in spatial, structural or nested attributes. However, these attributes are not sufficient to describe the segmentation in housing markets. As it was pointed out in the previous section, a housing market may have a complex structure that is mainly composed of supply and demand side characteristics. If segmented demand matches with a differentiated housing stock, which is also on the supply side of the market, then submarkets occur (Watkins, 1998).

It can be argued that there are key actors, formal and informal rules that form the configuration of segmentation and determine submarket boundaries. For example, agents can contribute to the segmentation of the property market and can shape the spatial extent of housing search since they can distribute information about housing stock, including the ways in which listings are organized (Jones and Watkins, 2009). In addition to the agents, developers can also play a crucial role in determining the boundaries of submarkets. Some of the developers have good reputations and they inspire confidence among the home buyers. Brand image of the developers can influence house consumers' perception in the decision making process. Governmental institutions such as MHA (Mass Housing Administration) played a crucial role in determining the new submarkets during the 1980's. By the 2000's, the entrepreneurship of governmental institutions with the developers drew out submarket structures of the market. Therefore for this study, different approaches are used to identify submarkets such as a priori, experts', cluster analysis.

In conclusion, urban housing segmentation is not only related to micro-economic or macro-economic factors, but is also related to institutions. Actor-network relationships, rules, regulations, and informal customs constitute the public policy of an urban housing market. Thus, taking actors, networks, formal rules, regulations, informal customs, and institutions into consideration in the studies allows the researchers to analyse the political, economic, social, and cultural dimensions of urban housing submarkets in a more detailed way.

2.6. Conclusions

In sections 2.2 and 2.3, a selective overview of the neo-classical and institutional approaches is given. Neo-classical economists are concerned about market outcomes, especially price and the quantity. Institutional economists are more concerned about the process of the market including its habits, formal and informal rules and cultures. While the neo-classical approach is focused on distances, accessibility to CBD and travel time to work, the institutional approach deals with interactions among actors, institutions and rules and segmented structures. Both approaches have weaknesses and strengths in analysing the urban housing system and this has given rise to calls for greater effort to combine different perspectives. Smith (in press), in particular, suggests that sociology of markets needs to be accommodated within neo-classical economic models of house price. This provides some of the intellectual rationale for the approach developed here.

In the neo-classical economics approach, a basic urban land model is assumed in order to construct a model and understand the local housing system, but these assumptions make the theoretical model appear simplistic. The urban structure of every city is assumed to be the same-flat. One of the major weaknesses of this paradigm is not taking urban patterns and structures into account. In addition, the rules, social interaction among actors and institutions are withdrawn. It is obvious that an urban housing system is too complicated to be described adequately with a simple, competitive equilibrium model (Whitehead, 1999). In the institutional approach, these interactions are taken into consideration but the city structure is withdrawn. Every market has its own norms, hence it is hard to generalize or model according to this paradigm.

Much of the recent literature is built on investigating the structures and dynamics of local housing markets. They usually focus on exploring price distribution in space over time and new housing supplies within the market adjustment mechanism. Impediments to household movement, such as neighbourhood attachment and high transactions costs or reproduction of housing, might mean that prices will not be equalised across the market. Thus, the institutional aspects of submarkets become important.

Usually, neo-classical economic models deal with equilibrium, a process that is at the quantitative framework and experiments with models of complex spatial processes with new thinking about the way in which a consumer processes market information and engages in the search for housing. The neo-classical analytical framework is being introduced to the dynamic concepts associated with the "institutional economic aspects" and the emphasis placed on disaggregated structures with the help of behaviourally realistic quantitative analysis.

Significantly the institutional approach highlights social interaction, norms, rules, and behavioural determinants and in the housing context has emphasised how these give rise to neighbourhood segmentation (or submarkets). Neo-classical models have been used to test for the existence of such phenomena. Submarkets have not, however, been routinely accommodated within mainstream theories of how markets work or in the applied models used throughout the literature. This is surprisingly given the compelling evidence that these 'institutional' ideas are important. It may, of course, be a consequence of the failure to establish a convincing approach to the development of models. This is an issue at the core of the empirical part of this thesis. The remainder of this thesis is concerned with the effectiveness of these techniques and, although the methods used are primarily those associated with applying neo-classical theory, several of the modelling strategies tested, following Smith (in press), seek to accommodate some of institutionalists concern about social and cultural drivers of price distribution.

CHAPTER 3 THE STUDY AREA: ISTANBUL

3.1. Introduction

The aim of this chapter is to provide an understanding of Istanbul, Turkey (study area) in terms of its structural environment and social-economic structure, including the broad property market within that structure. This chapter is divided into three sections. In the first section, the property market in Turkey is described in general, including the effects of macro-economic indicators on the property market. In the second, an overview of Istanbul's property market is provided by displaying the land-use and submarkets in Istanbul. In the final section, the housing market is discussed by taking the demand and supply side features into consideration.

3.2. The Property Market in Turkey

In order to provide a better understanding of the spatial distribution of housing prices in Istanbul, it is important to describe the structure of the property market dynamics that is affected by the macro-economic indicators of Turkey. In this section, an overview of the socio-economic and demographic structure of Turkey, as well as the housing finance system is given.

Because of the 1999 Marmara Earthquake and the financial crises in 1994 and 2000, the property market tended to cease in Turkey, especially in Istanbul. After the economic crisis in 2000, the Turkish economy constricted regulation systems, especially for the financial sector. Due to this, the construction sector was negatively affected. After the economic crisis in 2000, several interventions and the regulatory reforms in the banking sector enabled the Turkish economy to improve, which resulted in a decrease in inflation rates and an increase in the GNP (Table 3.1).

Table 3.1. The Economic Indicators

Year	Real GDP Growth %	Real interest rate %	Inflation Rate %
2000	7,4	38,9	54,9
2001	-7,4	92,4	54,4
2002	7,8	38,5	45
2003	5,8	23,8	25,3
2004	7	15,6	9,3
2005	5,6	17,9	7,7
2006	6,9	18,30	9,7
2007	4,7	18,90	8,4
2008	1,1	5,91	10,6
2009	4,7	2,67	6,5

Source: Turkish Statistic Institution, Central Bank of Turkish Republic, Association of Treasury Controllers

The construction sector share was 16 billion USD before the crisis and it became 4 billion USD in 2002 (Kobifinans, 2006). The total production of the construction sector in 2006 was 27.2 billion USD and 1.5 million people worked for this sector, which was 6.84% of total employment (Genc, 2008). As it can be seen from Figure 3.1, the number of housing units with construction licences in 2002 was 161,431, which increased dramatically in 2006 to 597,786, and later to 501,005 in 2008 (GYODER, 2009).

This financial and political stability caused a significant increase in the housing prices from 2003 to 2008. However, the sub-prime mortgage crisis in the USA in March 2008 affected the financial system, especially the investments in property market. The global financial crisis posed significant challenges for the Turkish property market all of these non-stable financial dynamics caused price decreases in the property market.

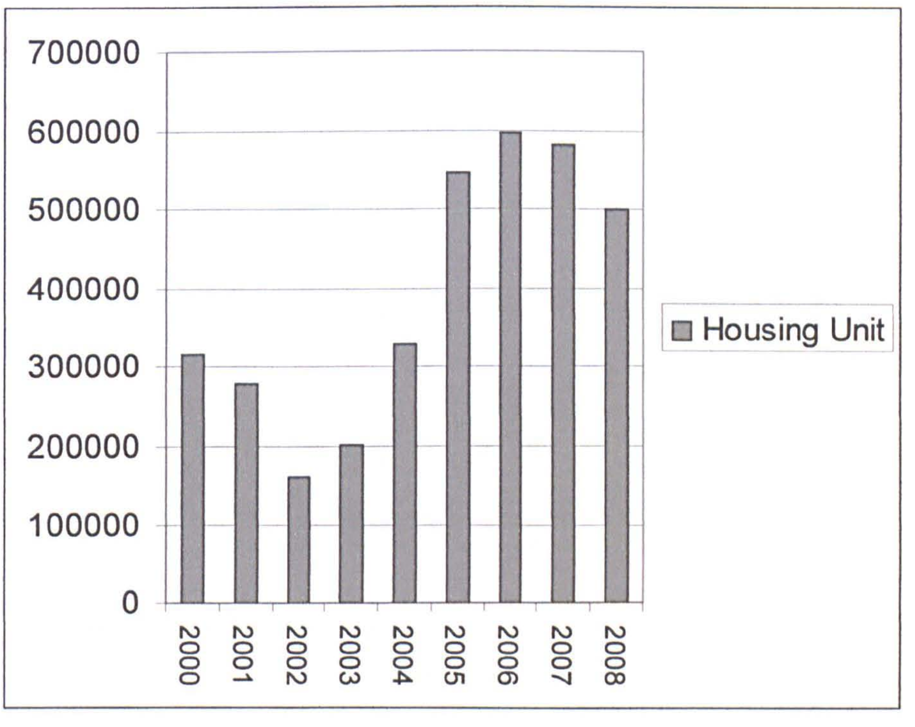

Figure 3.1 Housing units that have construction licence (Source: GYODER, 2009)

Turkey's credit ranking, however, raised two levels, from BB- to BB+, in December 2009 according to Fitch Ratings, which cited the economy's "resilience" during the global financial crisis (Turkishdailymail, 2009). It is possible to say that this announcement may attract the foreign investment for the Turkish property market, which may increase housing prices next year under more stable conditions.

In addition to the macro-economic indicators shown in Table 3.1, population growth provides potential for the property market. To evaluate the matter in terms of demographics, the population of Turkey was 71.5 million in 2007, and the percentage of young people under age of 30 was 52% (TUIK, 2009) of the total population.

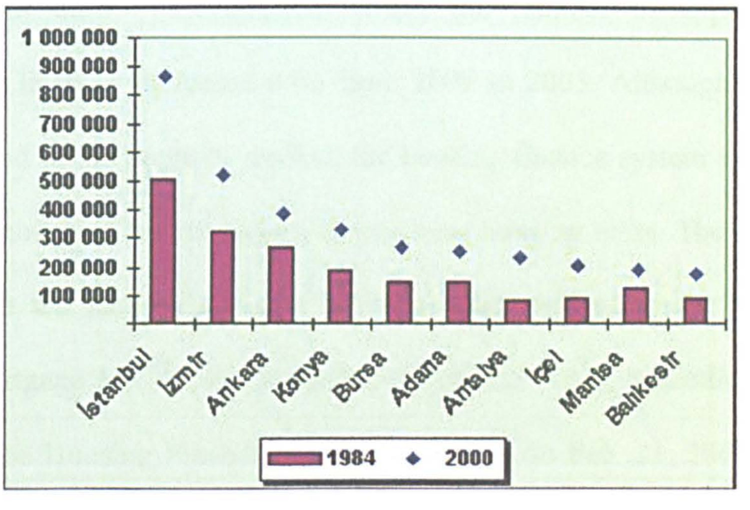

Figure 3.2 Number of Buildings in Turkey, Source: Turkish Statistic Institution

Due to the fact that the young population tended to get married or move away from their parent's houses in their mid 20's, there was a significant increase in the number of buildings (Figure 3.2) and the number of housing units (Figure 3.3) in Turkey.

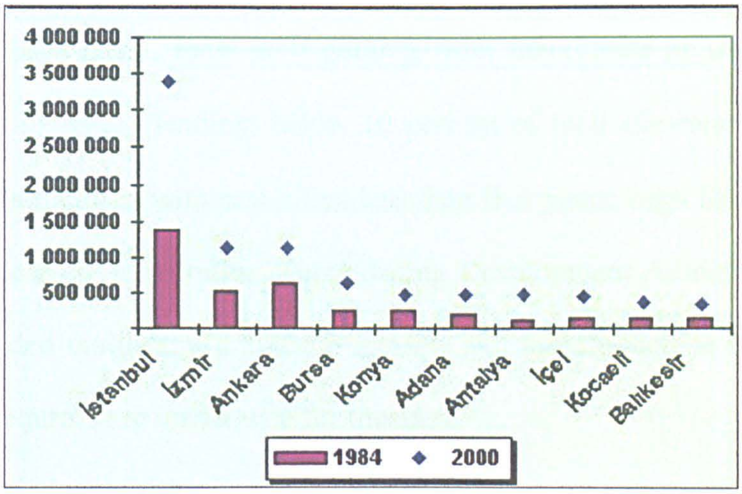

Figure 3.3 Number of Housing Units in Turkey, Source: Turkish Statistic Institution

According to the 9th Development Plan, the number of applications for construction licences increased 85% from 2001 to 2005. Although there was a sharp demand in the property market, the housing finance system was not well-organized enough to enable buyers to purchase housing units. The main reason for this was the lack of efficient housing credit and mortgage system. The Turkish mortgage law (Law No. 5882, called the "Law Amending the Laws Related to the Housing Finance System"), enacted on Feb. 21, 2007 is still not adequate for the Turkish finance system. According to Dilek (2007):

> "The Turkish mortgage market (e.g., in terms of mortgage loans to GDP ratio) is still very underdeveloped relative to other OECD countries. The secondary market for securitized mortgages does not exist. In the absence of a mortgage system, Turkish banks have given out medium-term

housing loans as consumer credit. They have financed these loans by borrowing short term, creating maturity mismatches in their portfolios. Less than 5 percent of housing finance has been provided by banks as consumer credit, most of it coming from inheritance or self-financing. Bank mortgage lending, below 10 percent of total consumer credit, has been structured with maturities less than five years, high fixed rates and low loan to value ratios. The Housing Development Administration has provided multi-family housing for low and middle-income families, but its resources are inadequate for this task."

Table 3.2 The Housing Unit Sales and Mortgage Credit in Turkey, Source: Onaran, C. 2008

Year	Housing Unit Sales (1000)	Mortgage/Credit (1000)
2000	1014	24
2001	937	13
2002	927	8
2003	1018	14
2004	1216	57
2005	1363	197
2006	1378	230
2007	1384	232
2008	1363	281

It is assumed that after setting up the mortgage system in Turkey, people from the middle class will have their own houses and there will therefore be a demand increase in the housing market. In addition, within the mortgage system there are different payment options available, such as 15-20-30 years pay back instalments and these are formulated based on the income per house holder. However, considering the high inflation rates and the uncertainty in the economy, the applicability of this system remains very low for now. Nevertheless, after constructing a ground for this system by bringing direct foreign investment and support into the market, experts are considering making it available for people in Turkey under attractive terms. In 2001, the interest rate of pay back instalments dropped from 7.7% to 1.25% (Hurriyet Emlak, 2006). Despite this large decrease, the number was still high. By December 2009, the monthly housing credit is 0.99% for 60 months for a housing unit with a 100.000 TL (USD 66.000) sales price (HSBC, 2009). As it can be seen in Table 3.2, the amount of housing units purchased with housing credit was 24,000 in 2000, 57,000 in 2004, and 281,000 in 2008. The housing units bought by mortgage credit were only 20% of all transactions (Figure 3.4).

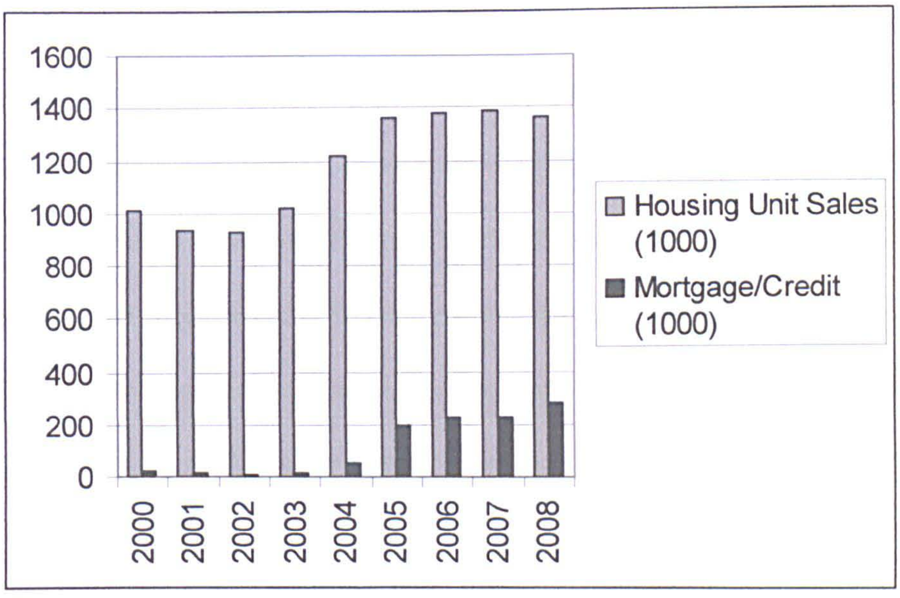

Figure 3.4 The Housing Unit Sales in Turkey, Source: Onaran, C. 2008

In addition to the insufficient mortgage system, the lack of efficient social housing regulation is a problem that causes gaps among the segments of the housing market. The institutions established in order to construct affordable houses for low- income groups (widows, orphans and other vulnerable groups) produce housing units that are affordable only for middle income people because of the impractical plans and policies. According to UN Habitat II (1996) assumptions, for an affordable housing unit, the housing budget should not be more than five times that of the household's annual income. The GDP per person was 10,436 USD in 2008 and according to the UN assumptions; the affordable housing unit price should have been 50,180 USD. According to the data collected for this study, however, it can be seen that the percentage of the housing units that are under USD 50,000 is only 0.87%.

Those in the low- income category cannot find affordable housing to either rent or own. Thus, squatter settlements emerge as a result of the demand from low-income people. The squatter settlements spread over 51,760 ha area, which means that 54 % of the Istanbul area (Gokmen et al, 2005) is constructed without the planning rules that can be defined as irregular residential areas. Legalizing squatter settlements has always been a populist policy for politicians and it was indeed a substitution of social housing. In order to construct housing units for middle and low- income people, The Mass Housing Administration (henceforth MHA, TOKI in Turkish), a state institution, was founded in 1984 by means of Mass Housing Law No. 2985 (TOKI, 2009). MHA's role was to implement the central government's housing policy by providing low-cost housing and loan opportunities for low- income people. Gundogdu and Gough (2008) stated that, as a result of a severe fiscal crisis, the major role of the MHA was sharply curtailed in 1993, although more than 200,000 residential units for middle and low- income people were constructed in the late 1980s and early 1990s. Since the 90's, the MHA has collaborated with developers in order to clear inner-city squatter settlements and develop luxury housing instead. 28,000 units of luxury inner-area housing were initiated through this programme by the end of 2007, especially in Istanbul, and several municipal authorities have applied to the MHA to develop 113,000 more units (Gundogdu and Gough, 2008). It is obvious that the MHA is an autonomous organization that mainly produces housing units for high- income people, rather than low or middle income people. It is evident that the MHA policy has an impact not only on the segmentation of the market, but also on social segregation. This unfair distribution of the land causes enormous gaps among the different levels of socio-economic classes in society. As a surveyor points out:

> The residential projects are not enough for low- income people due to the high land prices. The paradoxical issue is that the MHA is responsible for providing affordable housing units however it is the main reason for the land speculation in Istanbul. If MHA constructs residential units in any location in the city for any income level, then the land prices or housing prices over this area will increase automatically. A 100 m² unit can cost 50,000 TL to construct because MHA owns the land. However they sell it for 100,000 TL even to the low- income people. On the other hand, I do not believe they have a social housing policy. When I had some debates with some professionals of MHA, they also told me that it is easier to sell extremely expensive houses than the cheaper ones [A1].

From this overview of the Turkish Property Market, it can be concluded that the lack of an efficient housing finance system and the lack of housing policies, especially for low- income people, creates segmentation in the market. Unfortunately, there are dramatic inequalities within these segments. This is particularly evident in some urban markets such as Istanbul.

3.3. Overview of Istanbul's Property Market

Istanbul is Turkey's cultural, financial, educational, industrial and information centre, and it is located on two continents, Europe and Asia. The advantage of this strategic location in the regions of Eastern Europe, the Middle East and the Black Sea Region is that it attracts the attention of national and international investors. Istanbul's large economic hinterland and its proximity to the European market have defined Istanbul as a city that can meet global functions (Eraydin, 2008). Istanbul has a population of 12,697,164 (17.75% of the total population of Turkey) (TUIK, 2009), which surpasses the population of 22 EU countries (Eurostat, 2009). Istanbul has a remarkable population, not only on a national scale, but also on a global scale. The greater city of Istanbul is one of the most densely populated cities in the world. According to World Bank (2009), Istanbul is the 21st most crowded city in the world and the third in Europe.

Table 3.3. Population of Turkey-Istanbul

Year	Turkey	Istanbul	Ratio of Istanbul/Turkey (%)
1950	20,947,188	1,166,477	5.57
1955	24,064,763	1,533,822	6.37
1960	27,754,820	1,882,092	6.78
1965	31,391,421	2,293,823	7.31
1970	35,605,176	3,019,032	8.48
1975	40,347,279	3,904,588	9.68
1980	44,736,957	4,741,890	10.60
1985	50,664,458	5,842,985	11.53
1990	56,473,035	7,309,190	12.94
1997	62,606,157	9,198,229	14.69
2000	67,844,903	10,033,478	14.78
2007	71,517,100	12,697,164	17.75

Source: Turkish Statistic Institution (2009)

The population grew from 1 million in 1950 to 5 million in 1980, and to 12,697,164 in 2008. Between 1950 and 2007, the population increased more than tenfold (TUIK, 2009). This dramatically increased the demographic profile of the city, which indicates that Istanbul's urban growth process is not a balanced development. Like most of the large cities in developing countries, Istanbul's rapid population increase is due to the job opportunities the city provides; the variety in the facilities makes it a destination for migrants from other cities in Turkey.

There are many differences in the economic, social and environmental conditions in Istanbul. It is the most important financial, cultural and educational area of the country. At the same time, it is a world-famous city because of its natural beauty and historical monuments, reflecting its role as the capital of three separate empires. It borders the Black Sea, the Marmara Sea, and the Bosphourus. This attracts people throughout the country, which then increases the demand for housing in Istanbul.

Istanbul, with its demographic, cultural, locational and economic dynamics, has experienced a significant transformation since the 1950's. Although it is not the capital city of Turkey, Istanbul holds 27% of national GDP, 40% of tax revenues, 38% of total industrial output and 50% of services of the whole country (OECD, 2008). As is shown in Table 3.3, the percentage of Istanbul's population with respect to the whole country has increased over time; it was 5.57% in 1950's, 10.60%, and it reached 17.75% in 2007 (TUIK,2009).

The rapid growth of the city since the 1950s as a result of rural migration has affected the quality of life in various sections of the city. While some of the modern districts have become more attractive, the historical districts have lost their high- income population due to the deterioration of their neighbourhoods and the settlement of low- income migrants (Onder et al, 2004). Because of the expansion of industrial areas and the migration from rural areas, legitimating the dwelling type in Istanbul has developed from detached single family housing units into multi-storey housing blocks since 1960. Landowners were dealing with small-scale entrepreneurs who were compensated per apartment unit depending on the level of land and rent (Guvenc and Yucesoy, 2009). Multifamily housing units/apartments are still the most common form of residential development in Istanbul.

On the other hand, when migrants first arrived in Istanbul during the 50's, they settled in peripheral areas of the city, constructing "gecekondu," literally meaning "illegal squat". The squatter settlements spread over half of the area of Istanbul (Gokmen et al, 2006). Unlike the single-family "gecekondus" built between the 50's and the 80's, today's "gecekondus" are unfinished, multi-storey buildings constructed from cheap materials without plastering or flashing. Public authorities contributed to the chaotic development of the city and to the emergence of the legal-illegal division by legalizing the "gecekondu" settlements. They did this because of popular political concerns and voting apprehension (Keyder, 2005).

Like most cities in developing countries with the dynamics of growth and globalization, physical transformation has occurred since the mid 1980's in Istanbul. The construction of shopping malls, five-star hotels, new office areas, gated communities, the gentrification of the historical and deprived neighbourhoods, and the expansion of the city, have transformed the city from a mono-centric form to a poly-centric structure. These global influences of neo-liberalism have resulted in inequality among the socio-economic classes and differences in the quality of the built environment.

All these changes have created advantages and disadvantages with respect to location, which are reflected in demand for housing and housing prices. According to the 2000 Population Census in Turkey, 68% of households are owned, 24% are rented, and 8% are used for public institution employees. In Istanbul, 58% of the households are privately owned, whereas 35% are rented (TUIK, 2009). The reason that the rate of the ownership in Istanbul is less than Turkey's average is due to Istanbul's high housing prices.

The total number of households in Istanbul is 2,550,607 and the average household size is 3.85, which is below Turkey's average. According to the Property Registry office, there were 132,440 housing and land transactions in Istanbul in 2004, and in 2006 this increased by 42.3% to 188,478. The housing market in Istanbul has seen a very dynamic period since 2004, with significant new housing construction in progress. New housing projects have reached between 50,000 and 70,000 dwelling units in the period between 2004 and 2007, of which 60% are located on the European continent [A1](Figure 3.5).

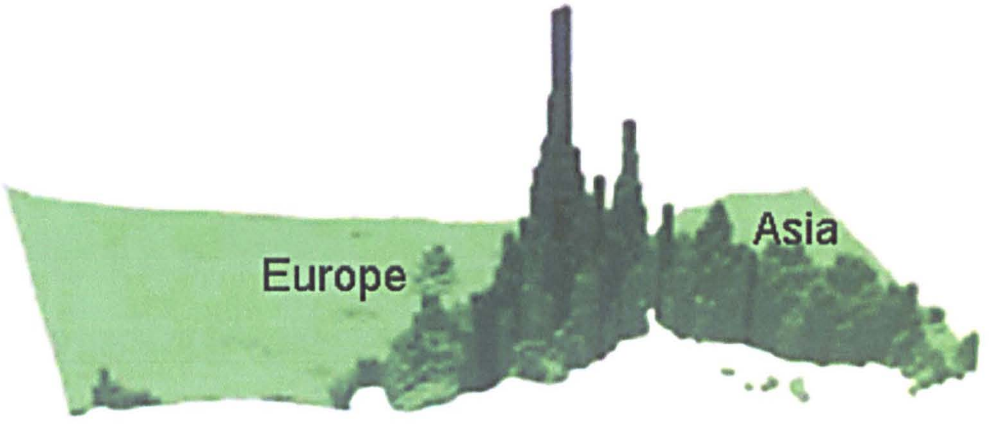

Figure 3.5 Residential Density of Istanbul (Source: Urban Age, 2009)

The increase in the number of new residential projects reflects the influence of both demand and supply and this indicates that property is one of the major investment tools. In addition to the increase in the number of residential developments, the increase in long-term housing loans coincides with declining inflation and the new mortgage law ratified by the Turkish Parliament in 2007, making property an important investment vehicle in Istanbul.

In the last few years, the property market has enjoyed high appreciation in value in Istanbul's housing market. This has occurred as a result of urban growth, the changing economic structure, and a new regulatory system in housing finance.

3.3.1. Submarkets and Land use in Istanbul

In this section, the land use of Istanbul is overviewed with respect to the property market in order to give an idea about the segmentation in the property market.

The built environment and socio-economic structure of the urban local housing system cause differences and inequalities among the neighbourhoods. These inequalities generate segments in the urban housing market. In order to understand the segmentation in the market, the property market in Turkey and the housing market in Istanbul, housing supply and demand in Istanbul will be analysed in the next sections.

Enormous changes in population have caused a rapid growth in the city since the 1950's. These dramatic changes, however, have not been planned. The demographic changes had consequences on the built environment as well. In order to give information about the built environment, this section will explain land use in Istanbul (see Figure 3.6).

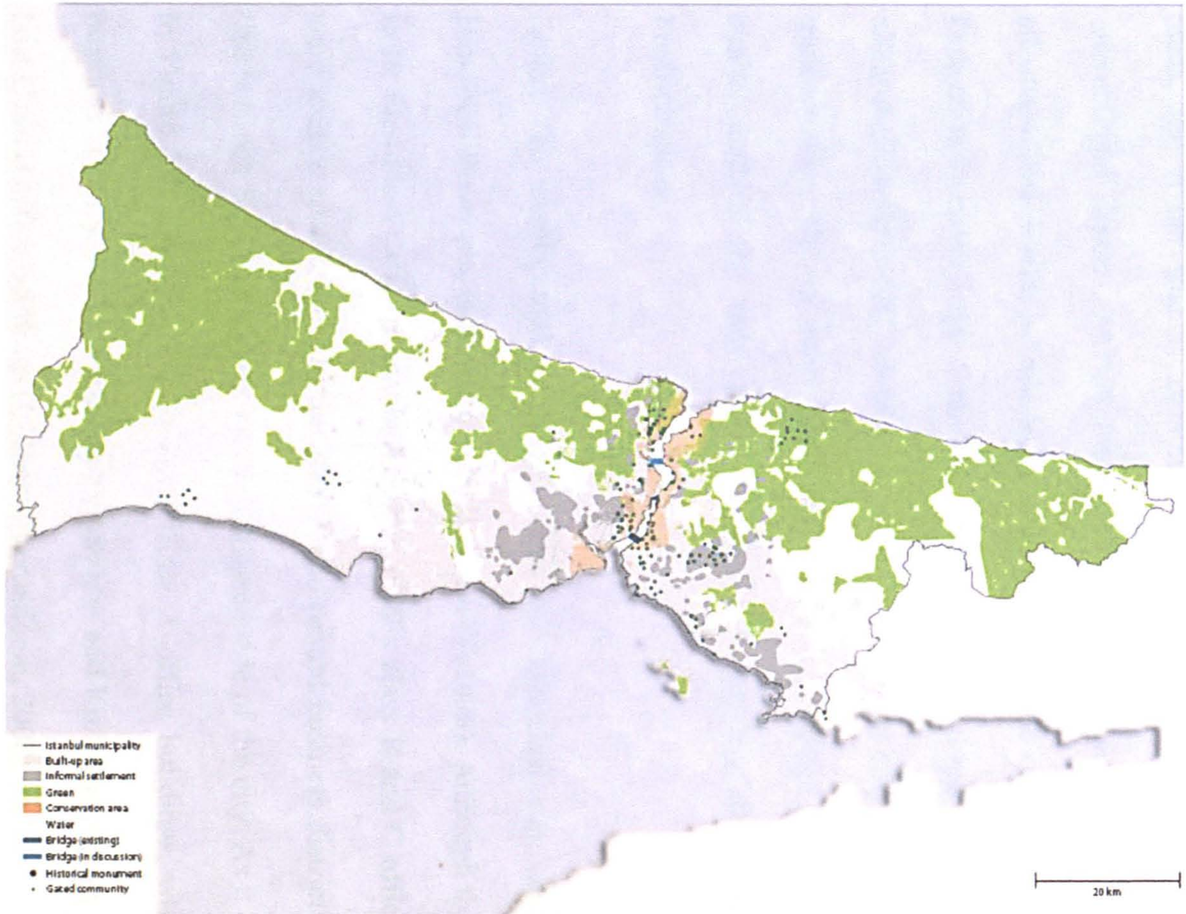

Figure 3.6 Built up environment in Istanbul, (Source: Urban Age, 2009)

Istanbul, located on both the Asian and European continents, consists of 39 districts covering an area of 5,461 km^2 (IBB, 2009) on a linear urban form. It has to be noted that during the data collection period in this study, there were 32 districts in Istanbul. While the European side is mostly dominated by commercial areas, the Asian side is dominated by residential areas. Istanbul has two international airports. Ataturk International airport, which has 300 destinations all around the world, is located on the European side of the city, and Sabiha Gokcen is located on the Asian side. Although Istanbul has a linear urban form along the Marmara Sea, sea transportation accounts for only 6 % of total public transportation. On the other hand, the Bosphorus, one of the world's busiest straits, enables the only water passage between the Black Sea and the Mediterranean.

Before the development of office areas, the historical city centre was on Historical Peninsula, in Eminonu and Beyoglu (Taksim). Although this area used to be the oldest CBD of Istanbul, by the 1990's class B and C office buildings were located in this area. In the 2000's, the central business district of Istanbul lied between Sisli and Maslak on the European side of the city. As it can be seen in Figure 3.7, the Maslak area hosts Class A office buildings, whereas other business districts, such as Altunizade, Kavacik and Kozyatagi on the Asian side, host Class B office buildings (Colliers International, 2008).

Figure 3.7 CBD's and Office Areas in Istanbul , (Source: DTZ Pamir and Soyuer,2009)

The historical city centre lost its function of being the central business district due to the increased accessibility provided by freeways, the opportunity to provide large and cheap land in the urban periphery, and the development of communication technology (Tekeli, 1998). By 2009, new CBD areas were Grade A Office Supply. The main areas were nearly 1.5 million m^2 and the estimated total supply including secondary areas was approximately 2 million m^2 (DTZ Pamir and Soyuer, 2009). These new office areas owned by banks, research and development, insurance, advertisement, real estate companies are located at the intersection of major highways (TEM and E5) mainly close to the public and private universities, and airports. The spread of the office areas in the city caused an increase in the land values in their surrounding areas and a significant transformation from squatter settlements to residential areas for high- income (Ozus, 2009). Therefore, the office areas attract developers for building luxury housing project in their surrounding areas.

As is shown in Figure 3.8, there has been significant rental growth since 2006. However, because of the negative impacts of the global financial crisis in 2008 Q4, there has been a decline in the trends. As a result, prime rent has been reduced from USD 40/m^2/month to USD 33/m^2/month (DTZ Pamir and Soyuer, 2009).

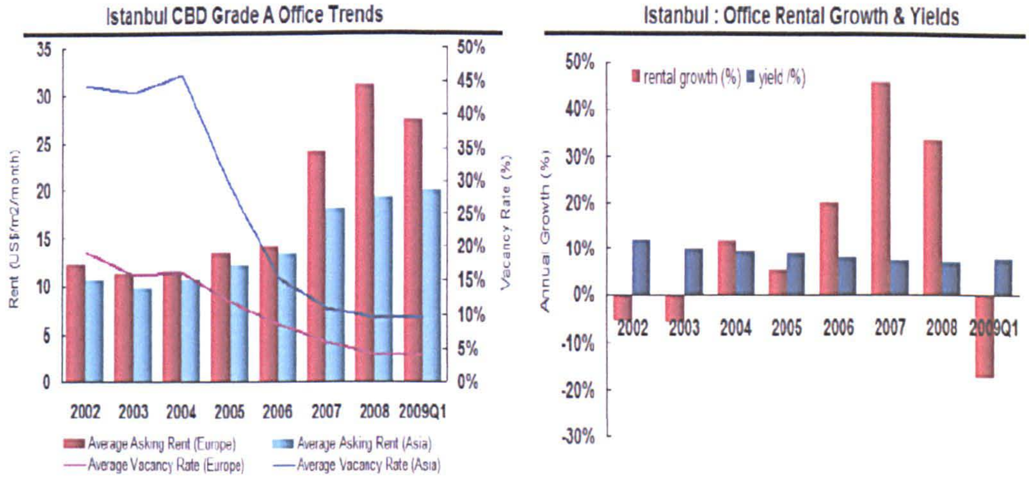

Figure 3.8 Grade A Office Trends and Office Rental Growth, Source: DTZ Pamir and Soyuer, 2009

As it can be seen in Figure 3.9, there are two express roads passing through the city. The older one, called E5, is mostly used for inner city traffic while the more recent TEM highway is primarily used for intercity or intercontinental traffic. The Bogazici and Fatih Sultan Mehmet Bridges provide passes over the Bosphorus Strait (Figure 3.9). The industrial areas were located around the E5 highway because of the transportation facilities. However, in recent years, transformation from industrial to commercial usage occurred, thus the industry sector began to relocate around the TEM highway, where the land was cheaper compared to that in the E5 area. The housing needs of the employee working in the industrial areas could not have been provided by either the central or local governments. As a result, industrial areas were surrounded by squatter settlements.

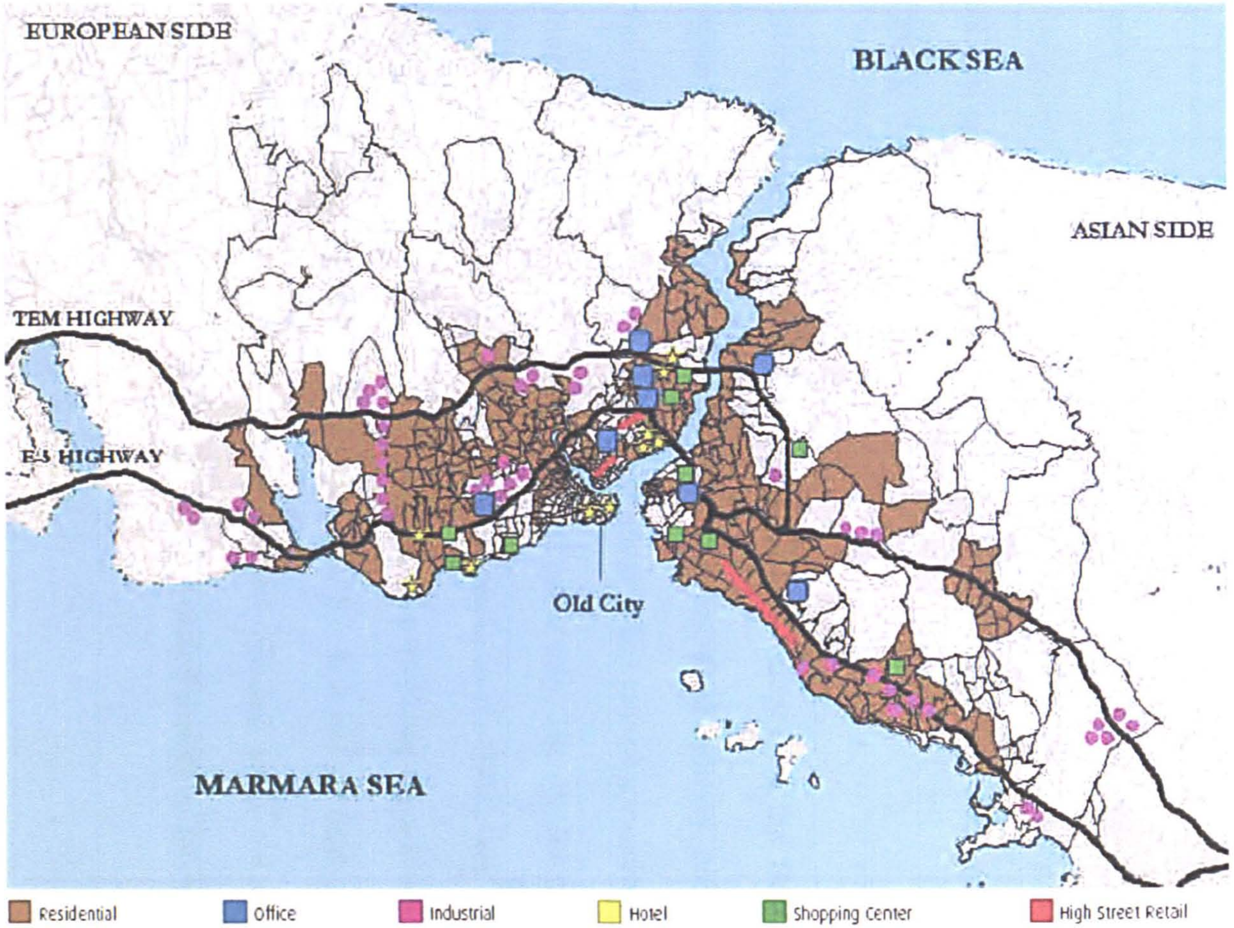

Figure 3.9 The Land Use of Istanbul (Source: Colliers Resco, 2006)

During the 80's most of the informal settlements were legalized and were given extra development rights, which increased their densities (Bolen et al, 2007). Nowadays, several industrial or squatter settlements are in the process of transformation in the city because of the urban sprawl in the city. There are four major areas where this urban transformation process is going on: Kucukcekmece and Avcilar districts, which are recreational, cultural and touristic areas; Beylikduzu and Kagithane districts, which are central construction areas; Kartal, Ikitelli and Zeytinburnu districts, which are residential areas (Alkiser et al, 2009).

Moreover, the construction of highways and bridges on the Bosphorus, the housing projects on the periphery, the investments in industry, and the squatter settlements for the industrial sector employees has caused a transformation from mono-centric to poly-centric development in the city. The city has shown a poly-centric growth for the last three decades (Onder et al, 2004), and the trends of this poly-centric growth have changed since the 1999 Marmara Earthquake. Due to the fact that the northern part of the city has less risk of earthquake damage because of its solid ground formation, new housing areas are mostly gated communities. Unfortunately, these areas are located mainly in forested areas and water reservoir areas.

This uncontrolled growth has caused some negative changes that pose a threat to the sustainable development of the city. These negative changes include:

- The poly-centric, rapid, unplanned land-use development
- Informal settlements

- The settlements that spread out toward forests and water reserve areas
- Immigration, informal sectors in the economy, and social segregation

All these problems are consequences of inefficient plans that cause differences in socio-economic structure, segments in the built environment, and social segregation. This means that every single segment with its own built environment and socio-economic characteristics shows different attributes. Therefore, all different segments should be taken into consideration separately in a comprehensive framework during the policy decision process. Having a better understanding of segments in the city may help produce efficient and feasible policies for strategic urban development plans.

3.4. Housing Market in Istanbul

The rapid growth of the city since the 1950s as a result of rural migration has affected the quality of life in various sections of the city. While some of the modern districts have become more attractive, the historical districts have lost their high- income population due to the deterioration of their neighbourhoods and the settlement of low- income migrants (Onder et al, 2004). Because of the expansion of industrial areas and the migration from rural areas, legitimating the dwelling type in Istanbul has developed from detached to multi-storey housing blocks since 1960. Multifamily housing/apartments are still the most common form of residential development in Istanbul.

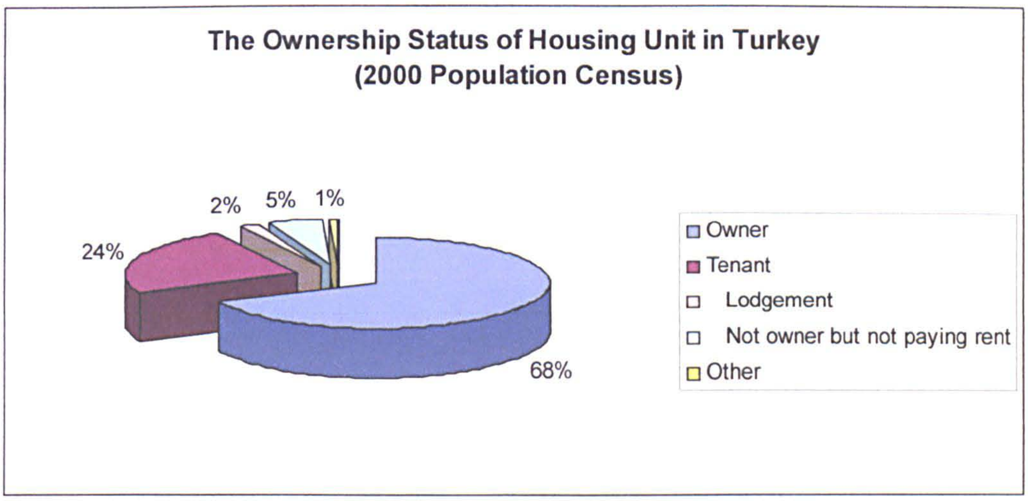

Figure 3.10 The Ownership Status of Housing Unit in Turkey, Source: Turkish Statistic Institution

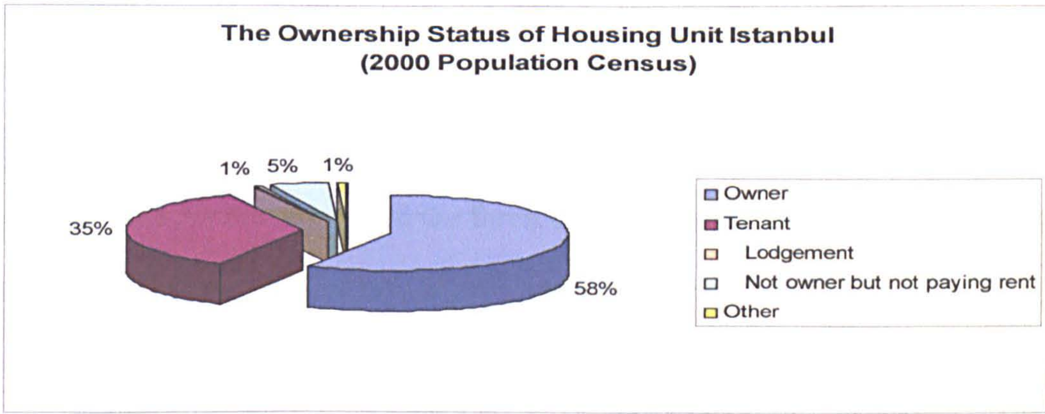

Figure 3.11 The Ownership Status of Housing Unit in Istanbul, Source: Turkish Statistic Institution

According to the Population Census in 2000, 68% of households are owned, whereas 24% of households are rented in Turkey. For the case of Istanbul, according to the Population Census in 2000, 58 % of households are owned, whereas 35% of households are rented. As shown in Figure 3.10 and Figure 3.11, the rate of ownership in Istanbul is less than Turkey's average. In 2000, the number of households in Turkey was around 15 million, whereas in Istanbul, it was 2.5 million (Table 3.4).

Table 3.4. The ownership rate in Turkey and Istanbul

Number of	Turkey	Istanbul
Households	15,070,093	2,550,607
Owner	10,290,843	1,476,687
Tenant	3,604,367	893,427
Lodgement	310,347	28,100
Not Paying	730,065	131,662
Other	125,452	17,425
Unknown	9,019	3,306

Source: Turkish Statistic Institution (2000)

Since the 1950's, Istanbul has experienced different forms of land-use, such as squatter settlements, mass housing areas, luxury gated communities, residences from the historical areas toward the forest areas, and also water reserve areas. In the 2000's, the total residential area in Istanbul was 80167.27 ha. and 69% of the residential area was planned. (Bolen et al, 2006, cited in Yirmibesoglu, 2008).

According to Onder et al (2004), the transformation of Istanbul from a mono-centric to a poly-centric structure, in addition to the effects of the earthquake, produced three peak housing areas. One of these is located between the new CBD Sisli-Mecidiyekoy and along the Bosphorus Coast. This area is easily accessible, has scenic views of the Bosphorus, and also contains three prestigious universities. As a result of these three attractive reasons, the area appeals to upper middle-high- income people, making it a prestigious area with high residential prices.

Bakirkoy is the district with the second highest residential prices, followed by Yesilkoy, Yesilyurt and Florya. It is located on the Marmara Shore, close to the airport, and it has the first shopping mall built in Turkey. It also has a marina. These reasons made this area attractive which increased housing demand from high paid airline personnel who preferred to live closer to the airport.

The district with the third highest residential prices is Kadikoy, which is located on the Asian side of Istanbul. This area, with its modern housing and exclusive pedestrian shopping street (10 km long), enjoys amenities resulting from being on the sea shore. This is traditionally a high-class area that is continuously attracting many high- income families from other districts. In these three residential regions the housing prices tend to increase under any conditions (Figure 3.12).

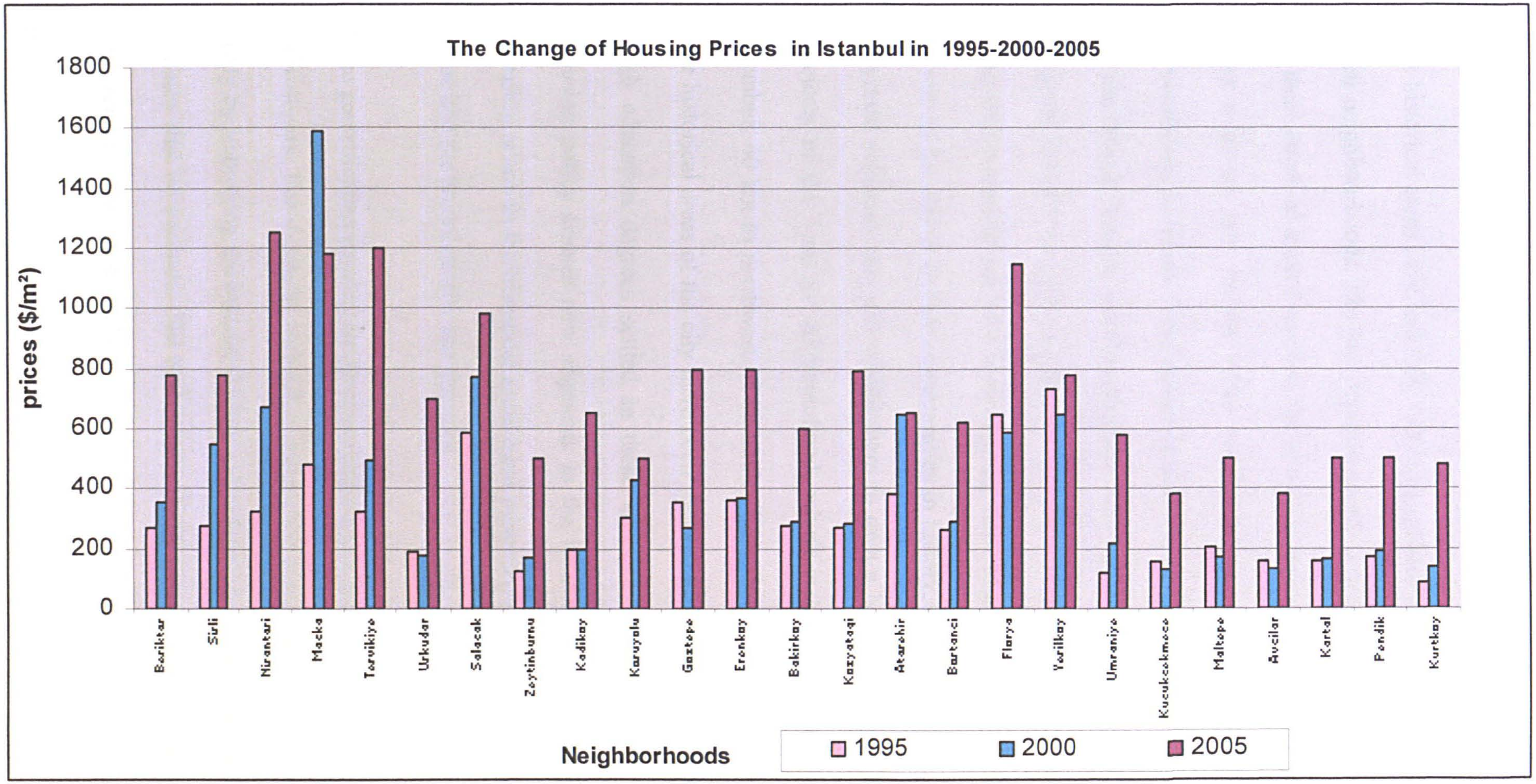

Figure 3.12 The Change of Housing Prices Per m² in Istanbul in 1995-2000-2005 (Source: Onder et al. 2004, Emlak Pazari, 2005).

While some of the modern districts have become comparatively more attractive, the historical areas have lost their wealthy populations due to the deterioration of their neighbourhoods. The low- income people migrating from other cities settle in these deprived areas located in the historical parts of the city. These extremely poor areas are now on the urban transformation agenda of central and local governments, however. The Greater Istanbul Municipality, which is represented by the Islamic "Justice and Development Party" (JDP), has several gentrification projects. Usually they choose the deprived areas in the historical areas. One such area where demolitions have been ongoing since March, 2007 is Sulukule, home to one of the oldest Roman communities in history. Current tenants are offered payment schemes that will enable them to own a home in one of the MHA's projects in the Tasoluk neighbourhood, which is located on the outskirts of Istanbul, 40 km to northwest of Sulukule (Karaman, 2008). Some buildings in the historical areas of the city have been restored and high- income people with high education degrees settled in these areas. Therefore, JDP's inequitable housing policy creates new segments in the housing market of Istanbul. The housing prices in the historical areas have increased dramatically in a very short time and the tenant profile has changed.

The gentrification process in the historical centres provides a lot of profit for the developers. For example without changing the static structure of the building, only by improving the interior design, a developer can make twice amount of the money that he invested. The best way to yield, is to divide the house into flats and rent it to foreigners [A4]

As shown in Figure 3.13, although the locations are close or even adjacent to each other, there are gaps among them. For example, in the northern portion of Istanbul, there are some gated communities where the average housing price is USD 2,000 per m^2, whereas in the middle of a squatter settlement the average housing price is USD 200 per m^2 (Onder et al, 2004). By 2008, the average housing prices per m^2 varied from USD 600 to USD 3500 in the city (Milliyet Emlak, 2009).

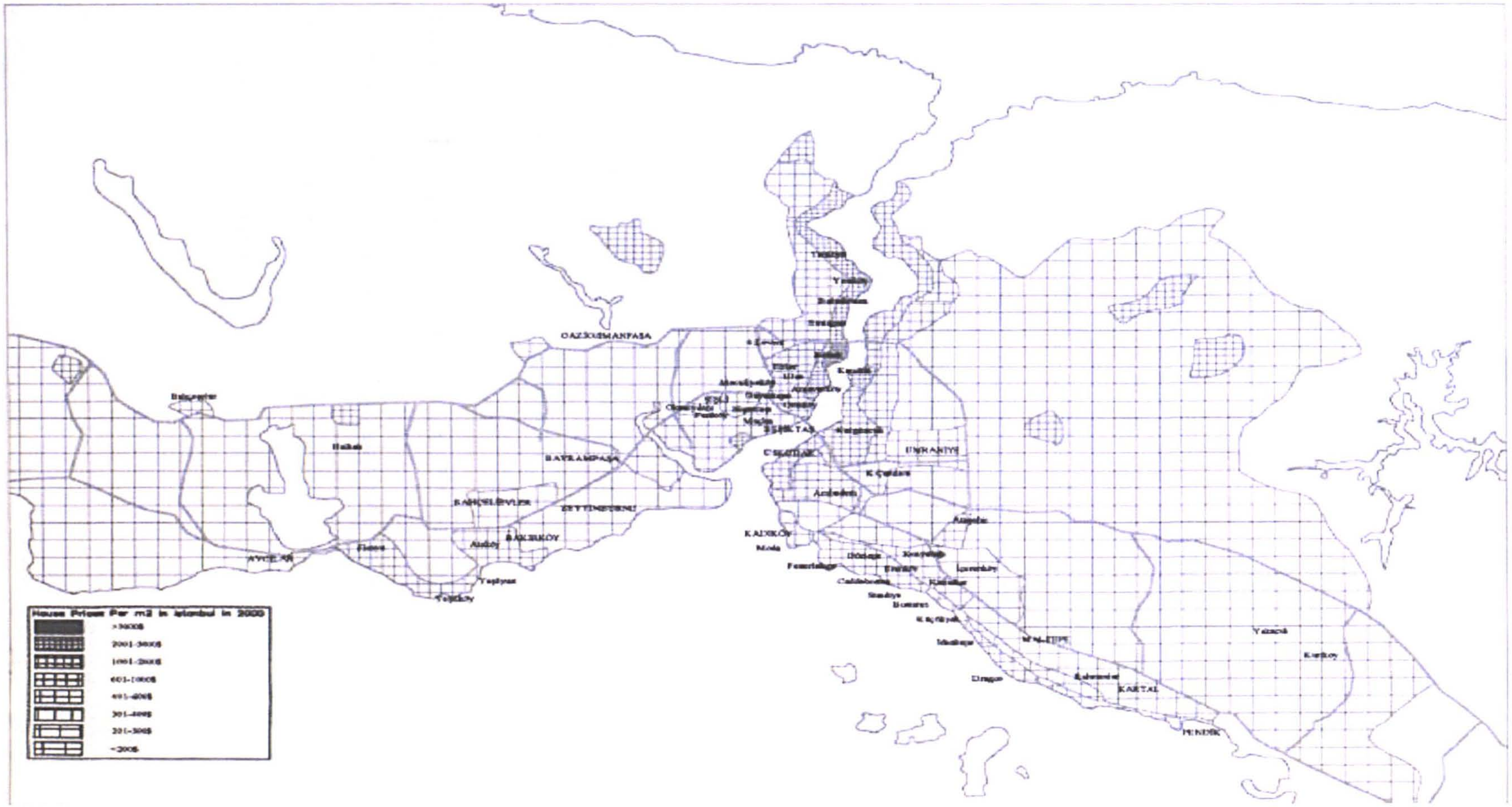

Figure 3.13 Housing Prices per m² in Istanbul in 2000 (Source Onder et al, 2004).

The new residential and shopping mall projects are planned to be constructed on the city's periphery. There are two main reasons for this new trend:

- The lack of sufficient amount of plots in the city.
- The high land prices in the city.

According to the former president of Istanbul is Metropolitan planning department, Prof. Dr. Huseyin Kaptan (cited in Genc, 2008), "4 million people migrating to Istanbul will need 1 million homes and we think this will happen in 15 years... A more social, more equitable and better environment has to be created. There is no room for housing in Istanbul... There is no land left in the hinterland of Tuzla, Kartal or Pendik (districts at the east periphery of Istanbul) to accommodate the flow of settlers coming from the eastern part of Turkey. So we shall consider Selimpasa and Silivri (districts at the east periphery of Istanbul) to create housing for this additional population of 2 million, which means 500,000 new homes... Even if people do not agree, we have to accept that low density areas are a thing of the past, we have to build multi-storey housing."

From this, it can be concluded that in 15 years, approximately 1 million housing units will have to be constructed in Istanbul according to the scenarios predicted by the Istanbul Metropolitan Planning Department. This demand will cause changes in the urban pattern and segment the property market even more.

3.4.1. Housing Supply in Istanbul

Until the 1950's, there were only the individual means of supplies for residences. Those wishing to own a house purchased a piece of land, (used the construction rights of this land) got permission from the municipality for the implementation of the project prepared by a person with a technical profession, and had the house constructed by contractors. In the 1950's, the rapid urbanization caused increases in prices in urban areas. This problem was solved by means of a legal arrangement allowing the construction of apartments that are owned by different individuals. With the help of this regulation, it became possible for the middle income group to own a residence and, therefore, housing cooperatives became a means of supplying residences in the housing market (Yirmibesoglu, 2005).

On the other hand, the unplanned and illegal areas spread all over the city during this process. The suppliers for the squats are mostly constructed by the owner with minor help from outside. By the 1980's and 1990's, the legitimization process caused squatter settlements to be developed vertically, causing the tenancy rate to increase. Therefore, the owners of the squats got rent from these dwellings. However, the way to rent these kinds of dwellings is networking rather than advertising it in the newspapers or real estate agencies.

By the 1990's, with mass housing projects underway, the city is dominated with high rise buildings and high density developments. On the other hand, old residential buildings were reconstructed as multi-storey buildings. All of these changes in the built-environment put pressure on existing infrastructure and social facilities (Bolen et al, 2007). The new era of the property market in

Istanbul began after the 1999 Marmara Earthquake. After the earthquake, gated communities became the latest trend in housing. According to Baycan and Gulumser (2004), there are four types of gated communities in Istanbul :

1. Vertical Gated Communities: They are high-rise buildings located in the city centres or office areas at the CBD areas. These developments are also called residences and they are generally generated with offices and shopping malls. Usually young professionals and couples with upper income are the residents in these kinds of developments.

2. Horizontal Gated Communities: They consist of detached or attached houses with several facilities such as swimming pool, social clubs. Since t houses are located at large plots, horizontal gated communities are usually established at the periphery of the city. Usually upper class families are the residents of these settlements.

3. Gated Apartment Blocks: These are apartment blocks are located either inner city or periphery of the city. Like vertical and horizontal gated communities, gated apartment blocks have security system. They also have some facilities such as swimming pools, playgrounds, shopping units.

4. Mixed Type Gated Developments: These settlements usually consist of horizontal gated communities and gated apartment blocks.

(In this study gated apartment blocks and mixed type gated developments are referred as "site".)

Gated community options, which are located primarily in the northwest and northeast of Istanbul in regions such as Kemerburgaz, Zekeriyakoy and Omerli, were appealing because the soil type in such places is less susceptible to an earthquake. The risk of an earthquake and the appeal of living in a less dense area with a high quality environment caused an increase in demand for gated communities.

Since the 1999 Marmara Earthquake, the role of the developers and constructors with good reputations and a high status has been getting more important. House buyers prefer to buy homes from the companies that provide professional projects with concept and design. Usually these companies collaborate with MHA so that they can provide the land for their projects [A2]. On the other hand, there are lots of advantages for the company to collaborate with a state organization, such as being able to obtain planning permission easier and faster. In addition, local governments are also preparing revision plans and increasing the construction rate.

Home buyers have begun to seek for trademarked constructors and more sophisticated projects. These projects involve social, recreational facilities and provide reports about the earthquake risk [A5]. The trademarked companies are very loyal to their contracts and they are focused on customer satisfaction. They use high quality materials in the interior design and provide maintenance services such as security [A1]. Advertising the housing projects makes home buyers to purchase the housing units before they are being constructed [A5].

It can be concluded that there are five types of housing supply in Istanbul:

- Build-sell production type (target group: middle income people)
- Cooperatives and mass housing (target group: middle income-low-income people)
- Gated communities and residences (target group: high- income people)
- Squatter settlements (target group: low- income people)
- Regenerated historical residential areas, especially in the historic centres (target group: high- income people)

The recent conditions in the market can be described as an oversupplied market. Although the market in general experienced difficulties, developers of a certain quality always attracted attention and maintained desirability (Kuzeybati, 2003).

3.4.2. Housing Demand in Istanbul

The urbanization movement, migration, and the agglomeration of both industrial and service sector in Istanbul cause the population to increase. According to the Turkish Real Estate Summit IV Report by the Association of Real Estate Investors in Turkey in 2005, 50% of the 3.4 million houses in Istanbul are illegal. The housing demand in Istanbul from 2000 to 2015 is estimated to be 2.5 million housing units. For every year, it is estimated that A class luxury housing demand is 10,000, B class qualified standard housing demand is 170,000 and C class social housing demand is 70,000. The reasons for the demand are: 118,000 are housing demand, 119,000 are for filtering, and 13,000 are for investment. It is estimated that 180,000 houses will be built by the private sector and 70,000 of the houses will be built by means of collaboration between public and private entities (see also Table 3.5.)

Table 3.5 Estimated Housing Demand in Turkey (According to Development Plans of State Planning Organization)

Development Plans	Housing Unit Need
1st Five Years Development Plans 1963-67	1,112,052
2nd Five Years Development Plans 1968-72	1,200,000
3rd Five Years Development Plans 1973-1977	1,663,000
4th Five Years Development Plans 1979-1983	2,080,065
5th Five Years Development Plans 1985-1989	1,219,000
6th Five Years Development Plans 1990-1994	1,300,000
7th Five Years Development Plans 1995-2000	2,540,000
8th Five Years Development Plans 2001-2005	2,714,000
9th Five Years Development Plans 2007-2015	Not specified

Source: State Planning Organization

The increase in the demand side of the market has been very high in the last years (Figure 3.14). The supply side has fulfilled the need for high- income people. It seems that there will not be this amount of demand need in the future for high- income people. The demand for middle and low- income people should be taken into consideration for the future investments [A4].

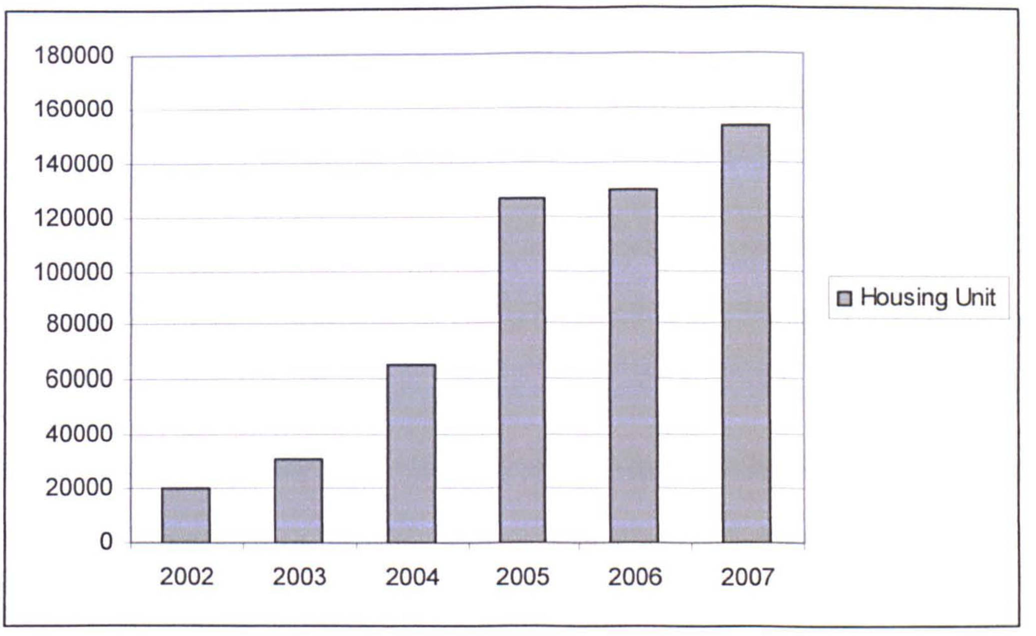

Figure 3.14 The number of the housing unit with construction licence source: GYODER, 2009

As a consequence of urban sprawl, there are four main factors that affect the residential demand in Istanbul and these are, the distance to transportation junctions, the distance to destinations where large scale holdings invest, the distance to shopping centres and malls, and the distance to CBDs (Colliers International, 2008).

3.5. Conclusions

This chapter has provided background details of the property market in Turkey, and Istanbul's Property Market. This provided a context that provides to understand the Housing Market in Istanbul. The supply and demand side of Istanbul property market has been discussed are displayed in order to draw a clear picture of the study area. Istanbul has a population of around 12 million, which is 17.75% of the country's total population (TUIK, 2009). Although Istanbul is not the capital of Turkey, it is the economic, social, and cultural centre of the country. Recently, lots of international cultural and artistic festivals, congresses, and organizations are held in Istanbul, which makes Istanbul attractive for foreign investors. Advantages such as being a transportation centre and having infrastructure facilities make Istanbul an attractive location for any business and also make it a means for the Turkish economy with its labour potential to improve. In addition to these amenities and potentials, population growth attracts the attention of investors. The percentage of young people under age of 30 is 52% (TUIK, 2009) of the total population. The rapid urban growth and migration to Istanbul has caused an increase in the demand for housing that causes spatial differences in the built environment. The market with its supply and demand dynamics and the problems pointed out above cause housing price differences over space. This leads to diversity in the urban pattern, spatial inequalities and socio-economic structure in the market. As the housing price differences among the neighbourhoods rise, the physical and socio-economic structures of the neighbourhoods are clearly distinct even though they are spatially close to each other.

Due to the fact that half of the population in Turkey consists of young people, transformation from expanded families into a nuclear and single size family is expected in the future. Not only do the household profiles vary, but also the social and economic structure, the life styles and tastes of the households vary over the space. Therefore, these variations result in different types of requests by the potential house-buyers. Recently, the target groups of the housing suppliers have been the middle or high- income households. The current Turkish planning system can solve neither urban problems nor the housing need problems. In order to make realistic plans and develop practical policies, the local housing system must be revised in a logical way. The determinant of the housing prices in the local housing market and the structure of the housing submarkets should be well-defined. In other words, the dynamic structure of Istanbul's property market must be revised and analyzed by using the housing market theory as a guide.

All of the differences and problems pointed out above cause segments in the property market. These segments, which are called submarkets, should be considered as pieces of a puzzle, where every piece should be defined clearly so that the whole picture can be seen as a whole. Housing problems can be solved only if the submarkets are delineated accurately and analyzed clearly. In this study, it is crucial to have a clear understanding of the housing market structure in order to delineate a priori submarket boundaries and capture important spatial differences in market performance and house prices. This will affect the efficiency of the models that are employed for this thesis.

CHAPTER 4 RESEARCH DESIGN: DATA AND MODELLING

4.1. Introduction

This study investigates the spatial distribution of housing prices at a particular point in time. The aim of this is to compare the effectiveness of the different models of house prices that capture the segmented price difference in Istanbul.

The aim of this chapter is to explain the research design, data and statistical methods used to answer the questions raised about the identification of the strengths and weaknesses of the segmented model structures. This chapter is divided into four sections. Section one provides an overview of the research design. In the second section, the data used in the study is explained and some descriptive statistics are presented. In the third section, segments in the Istanbul housing market are described, including the techniques used for defining and identifying of submarkets in the study area. Finally, the existing techniques used in conceptualizing housing market structures are overviewed.

4.2. Research Design

As already mentioned, the aim of this study is to compare the effectiveness of the different house price models that capture the segmented price difference. The case study, Istanbul, is selected as it has a highly segmented housing market. The research design consists of five stages (Figure 4.1).

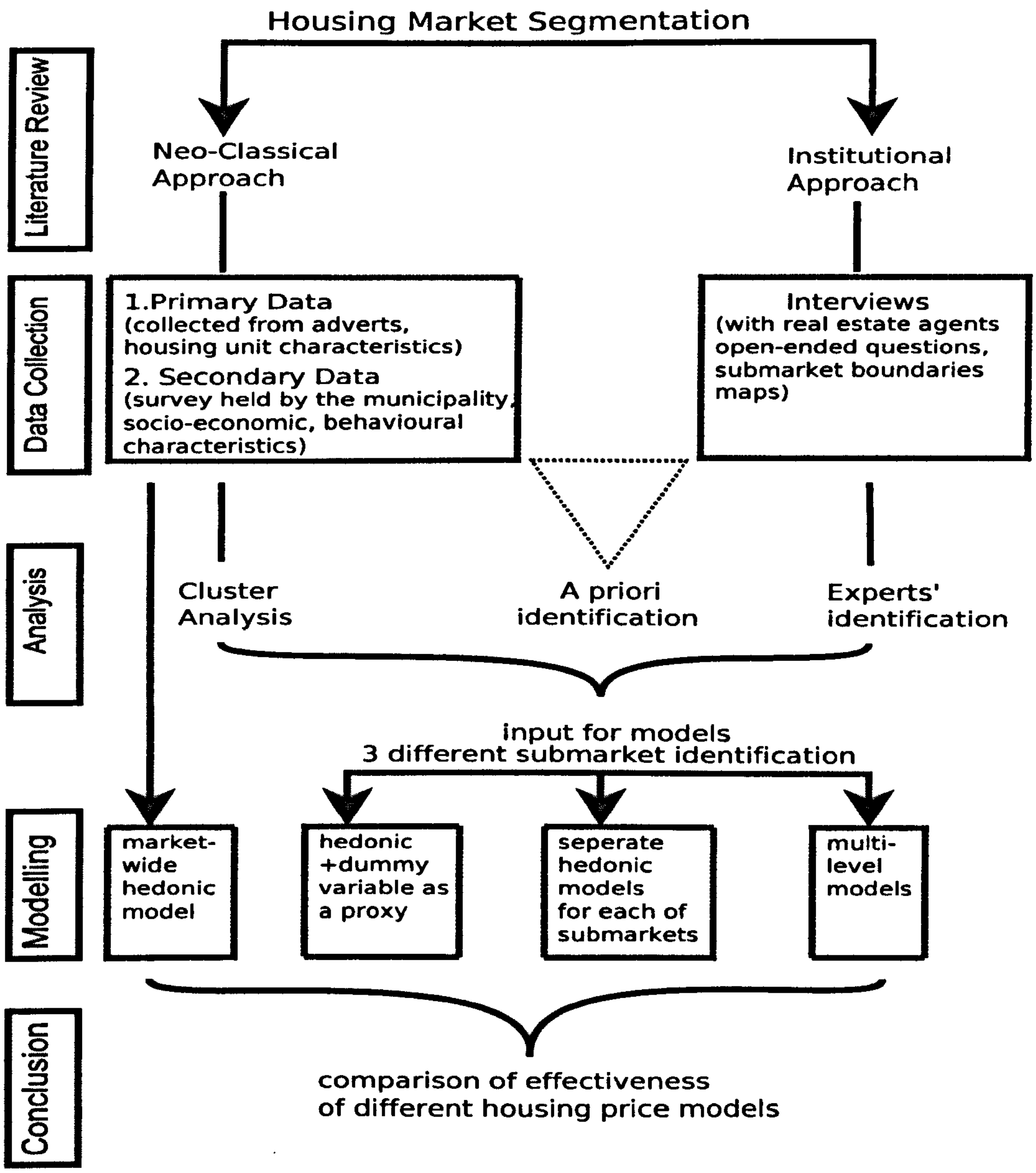

Figure 4.1 Research Design of the Thesis

In the first step of the research process, the theoretical background is examined in order to give information about the link between the housing market literature and the research method. The purpose of the second stage is to capture the data set required not only for the identification of submarkets, but also in order to use it for modelling. In the third step of the research, submarket boundary delineation is accomplished by employing different methods, such as a priori, experts' assumptions and cluster analysis. The next step involves different models that conceptualise the structure of the owner occupied housing market such as the market-wide hedonic model, the hedonic model with a dummy variable as a proxy, the segmented hedonic models for each of submarkets and the multi-level model. Finally, in the last stage of the research, the effectiveness of these models is compared. These steps are discussed more fully below.

Stage 1: Literature Review

The emphasis of this thesis is mainly on the applied quantitative real estate research methods. This applied empirical work is developed in accordance with the neo-classical paradigm, since this approach provides a simplification of the market conditions in order to conceptualise the housing market structure. Such studies focus on the structuring of sophisticated models, employing quantitative techniques which can be used to display and predict market outcomes such as the spatial distribution of price (Leishman, 2003). Although the neo-classical paradigm provides effective tools for conceptualising the housing market, it is criticised by institutional economists that it can not capture real market conditions and in the urban housing context, understates the significance of segmentation. The institutional approach is concerned with the process of the market, habits, formal and informal rules, and cultures. However, in order to operationalise the market structure, a neo-classical paradigm may simplify the modelling of the differences in housing prices. Guy and Henneberry (2002) pointed out that an "institutionalism might provide additional insights into the operation of the property market". So, in this context, quantitative methods form the main research technique of the study. It emphasises disaggregate and fragmentation in market structures. However, in order to capture the real conditions of the market, the institutional insights are taken into consideration as well. In this aspect, qualitative methods are used with the purpose of support to conceptualise the urban housing market system in Istanbul. The intention is that real estate models are made behaviourally rich by using a blend of quantitative and qualitative research methods and techniques (See also Ferrari et al, 2010; Adams et al, 2005b ; Leishman, 2003).

Stage 2: Data Collection

As mentioned in the previous chapter, the main objective of this study is to examine the most suitable way to conceptualise the structure of the owner occupied housing market, and to identify the strengths and the weaknesses of the segmented model structures. In order to construct accurate models, it is essential to use the data sets that represent the whole population in the models. Thus, the data set is not only used in modelling, but also for identifying submarkets, as they will be an input for the models. The primary data set which consists of housing unit characteristics and the sale prices was collected in November 2006 and April 2007 from the advertisements on the websites of two main real estate agencies, Turyap and Remax. The secondary data set which consists of socio-economic, neighbourhood quality and locational characteristics was obtained from the survey held by the Istanbul Greater Municipality in 2005. Another secondary data about earthquake risk was obtained from The Japanese International Cooperation Agency (JICA) report (2002).

Stage 3: Data Analysis

The next step in the research process was to delineate the boundaries of submarkets in the study area. The first way to draw the submarket boundaries is to use cluster analysis, which is a statistical method, on the data set that consists of primary and secondary data. The second way to delineate the submarkets is to apply synthesis analysis to the maps drawn by the interviewees. In addition to cluster analysis and experts' identification, a priori assumptions are introduced to delineate submarkets. These three ways to identify submarket boundaries are essential for the inputs for the spatial extension of models. Apart from these data sets, ten interviews with real estate managers and appraisers were also held in order to have a better understanding of housing market structure.

Stage 4: Modelling

The modelling phase of the research process consists of four sub-stages. The first stage reports the results of the basic, market-wide hedonic model. The second stage employees a hedonic model that includes spatial dummy variables as a proxy for segments. The third stage displays the segmentation effect on housing prices by creating separate hedonic models for each of the segments. Finally, the fourth stage reports a multi-level model that investigates both individual (housing unit) level and contextual (segment) level. The detailed methods are discussed later (See section 4.4).

Stage 5: Comparison of Effectiveness of Models

The last part of the research compares the effectiveness of these housing price models and identifies the strengths and the weaknesses of the segmented model structures. First, in order to investigate whether there is a significant difference between submarkets, Chow test is applied. The second test of investigating the performance of the models is to examine the weighted standard error test that analyse the effectiveness of the market-wide model against segmented model. And finally, prediction accuracy test and root mean square error test (RSME) is applied to find out the forecasting ability of these models.

4.3. Creating the Data Set

As discussed in the first chapter of this thesis, the objective of this study is to examine the best way to conceptualise the structure of owner occupied housing market in Istanbul. In order to compare the performances of the different models, different submarket boundaries are employed in the models. The delineated submarket boundaries are crucial as they affect the explanatory power of the models and also help to capture segmented price differences in the housing market. The details regarding the submarket identification and boundaries are given in Chapter 3.

The database employed in this study was generated by using two data sets. The first dataset (primary data) was gathered from two major real estate agents' websites, and this data set contains 2,175 transactions of single-family homes sold in Istanbul in November 2006 and April 2007. This dataset compiles observations from 348 submarkets constructed from 946 neighbourhoods in 32 districts. The second dataset (secondary data) is derived from a survey that was undertaken by the Istanbul Greater Municipality, and provides information about the socio-economic structure of the neighbourhoods and the satisfaction of inhabitants of the city. The data set is categorized into four groups: housing unit characteristics; socio-economic characteristics, neighbourhood quality characteristics and location characteristics (Table 4.1).

Table 4.1 Categorisation of the Data Set

Property Characteristics	Socio-economic Characteristics	Neighbourhood Quality Characteristics	Locational Characteristics
Living Area	Income	Satisfaction from:	Earthquake Risk
Number of Rooms	Household Size	Schools	Continent
Number of Storeys	Living Period in the Neighbourhood	Health Services	Travel Time to Shopping Areas
Age of the Building	Living Period in Istanbul	Cultural facilities	Travel time to work and Schools
Balcony		Playgrounds	
Garden		Neighbour	
Security Unit		Neighbourhood Quality	
Swimming Pool		Security	
Site		Public Transportation	
		Home	
		Municipality	

*Some of the variables are not employed in the models because of the multi-collinearity problem but all are available for use by each technique.

4.3.1. Housing Unit Characteristics

This data set provides the property characteristics used in hedonic models and the first level variables in multi-level models. This database comprises information on key variables, such as location, price, age, floor area, construction type, number of storeys of the building and the housing unit, elevators, car parks, gardens, balconies, security units and swimming pools. Table 4.2 presents the descriptive statistics for the transactions data provided by two major Turkish real estate agencies, Remax and Turyap.

Table 4.2 Descriptive statistics of housing units for Istanbul transaction data N: 2175

Housing Unit Characteristics	Minimum	Maximum	Mean	Std. Deviation	Type
Price	34013,60	8,000,000	251,082.92	382,467	Numeric (USD)
Age of the Building	0	150	12.22	14.578	Numeric (year)
Living Area	45	1,920	170.08	123.063	Numeric (m^2)
Number of Rooms	1	15	3.21	1.258	Numeric
Total storey	1	27	5.96	3.060	Numeric
Flat	0	1	0.90	0.302	Dummy
Detached House	0	1	0.10	0.300	Dummy
Elevator Existence	0	1	0.64	0.482	Dummy
Garden Existence	0	1	0.79	0.410	Dummy
Balcony Existence	0	1	0.92	0.277	Dummy
Car park Existence	0	1	0.78	0.412	Dummy
Security Unit Existence	0	1	0.46	0.498	Dummy
Swimming pool Existence	0	1	0.19	0.394	Dummy

In order to give a general view of housing characteristics, average values are calculated using the whole data set. As shown in Figure 4.2, the average transaction price for the 2,175 properties is USD 251,082, ranging from USD 34,000 to USD 8,000,000. The average property area has 170 m² of living area with 3.2 rooms.

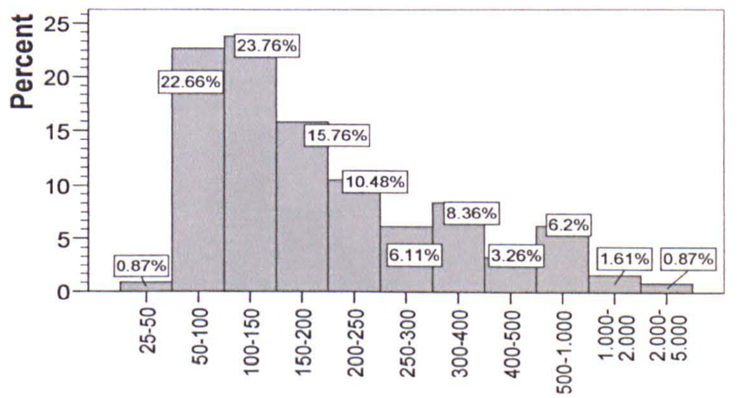

Figure 4.2 Sale Prices for Houses (USD 1,000)

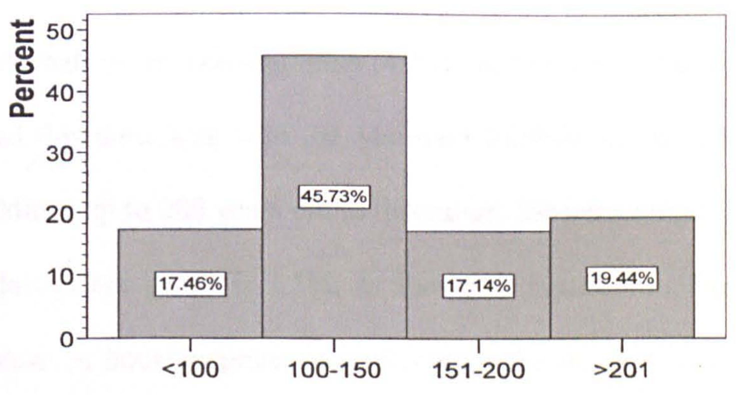

Figure 4.3 Living Area of the Housing Unit

Almost half of the housing units have a floor area between 100 m² and 150 m² and 3 rooms (Figure 4.2 and Figure 4.3). The living area ranges from 45 m² to 1,920 m², whereas the number of rooms ranges from 1 to 15 (Figure 4.4). The average age of the observations is 12 years at the time of the sale (Figure 4.5).

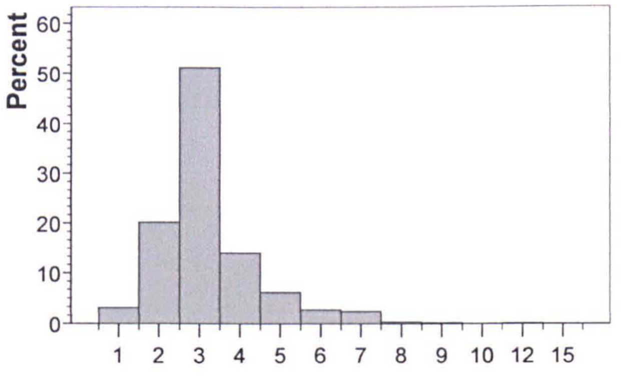

Figure 4.4 Number of Rooms in the Housing Units

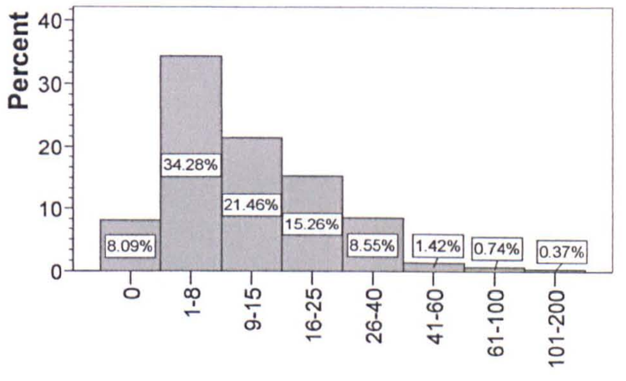

Figure 4.5 Age Groups of the Housing Unit

Approximately half of the housing units (43%) are in the sale range from 0 to 8 years old, and this correlates with the Marmara Earthquake in 1999. Although there are buildings up to 200 years old in this range, the percentage of the 61-200 year old buildings age group is 1.1%, as shown in Figure 4.5. The earthquake and the increase in housing prices, together with the trend of investing in the property market, caused a rapid construction process between 2002 and 2008.

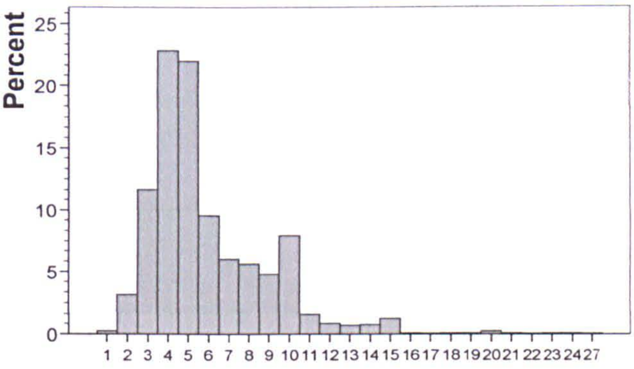

Figure 4.6 Number of Storeys of the Buildings

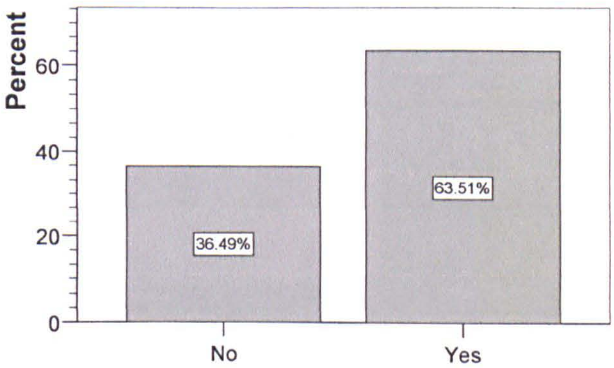

Figure 4.7 Existence of Elevator

The average number of storeys of the buildings where the housing units exist is 6 (Figure 4.6) and 64% of the buildings have elevators (Figure 4.7). 90% of the housing units are flats (Figure 4.8), 92% have a balcony (Figure 4.9), 78% have a car park (Figure 4.10), and 79% have a garden 78% (Figure 4.11).

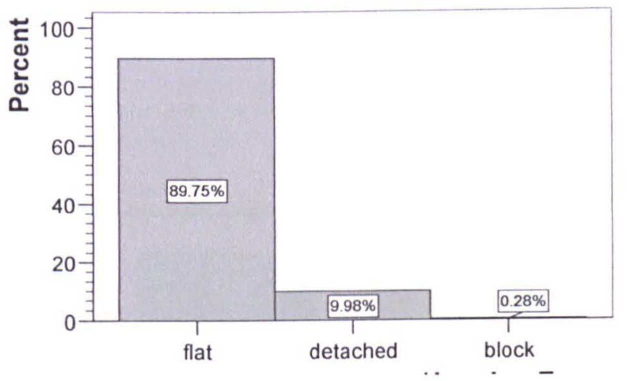

Figure 4.8 Housing Type

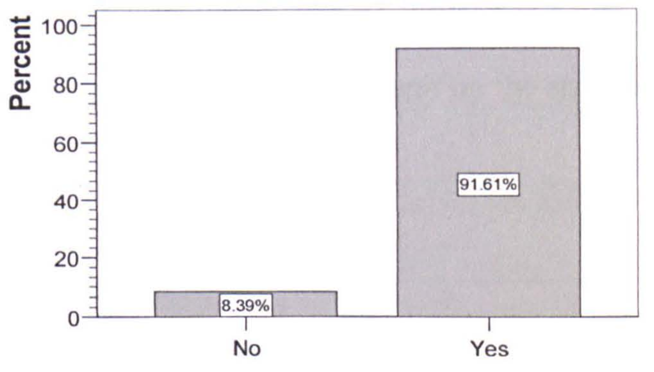

Figure 4.9 Existence of Balcony

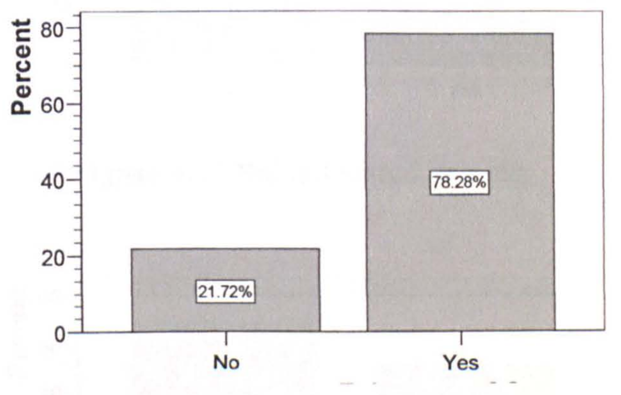

Figure 4.10 Existence of Car park

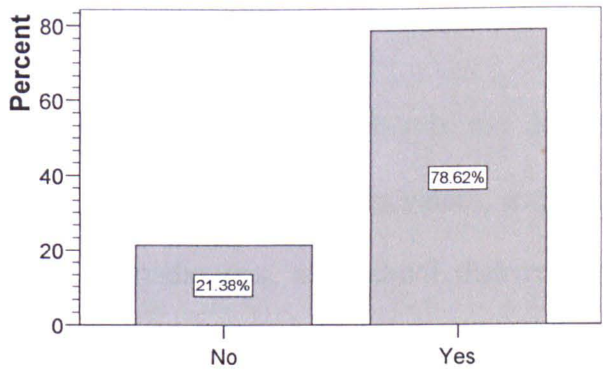

Figure 4.11 Existence of Garden

The percentage of the housing units that are located at a site is 18% (Figure 4.12), 46% of the properties have a security unit on the site, and 19% of them have a swimming-pool.

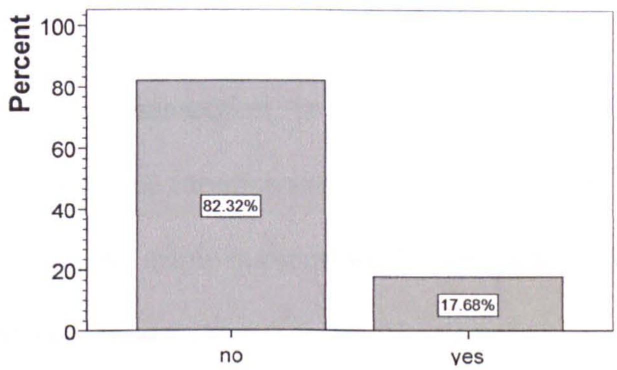

Figure 4.12 Being located in a site

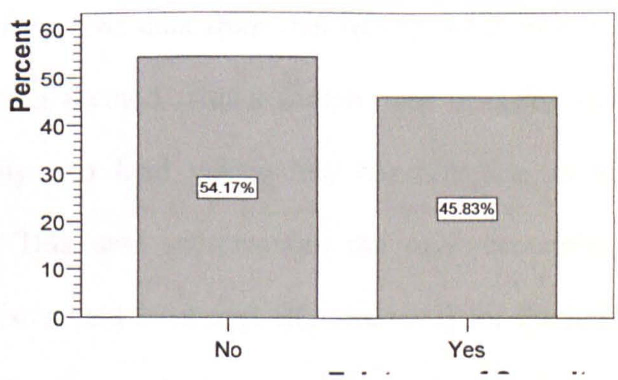

Figure 4.13 Existence of security

4.3.2. Socio-Economic Characteristics of the Neighbourhood

In most of the housing studies, neighbourhoods are defined as areas with homogeneous housing characteristics, property values, socio-economic property characteristics, political jurisdictions, and school districts (Clapp and Wang, 2006). Therefore, like the studies by Watkins (2001) for Glasgow, Goodman and Thibodeau (2003) for Dallas, and Kauko (2004) for Amsterdam, the administrative boundaries are taken into account as the submarket boundaries in this research. In this study, the housing submarkets are constructed using the administrative boundaries of the Istanbul Greater Municipality. This assumption also allows for the identification of the socio-economic structure, neighbourhood quality, and housing price segmentation in Istanbul.

In this research, each transaction is associated with its neighbourhood administrative boundary. The survey was not held in each of the neighbourhoods, and therefore the adjacent neighbourhood to the submarket where the housing unit exists, is taken as the representative neighbourhood. In order to display the socio-economic and neighbourhood quality characteristics of the neighbourhoods, the dataset consists of the survey held in 2005 by the Istanbul Greater Municipality. The data from this survey were collected according to a systematic sampling method with a sample size of 3,863 households and by taking the density and land values into consideration in some of the 946 neighbourhoods. This data set provides the socio-economic, neighbourhood quality characteristics and locational characteristics for the hedonic models and multi-level models. The variables for socio-economic characteristics, such as income, the length of time the inhabitants have lived in Istanbul, the length of time the inhabitants have lived in the neighbourhood, household size and the variables for neighbourhood quality characteristics such as satisfaction from schools, transportation, municipality, health service, cultural facilities, playground facilities, security, neighbours, home, neighbourhood quality and locational characteristics such as travel time to work and schools, travel time to shopping areas, are provided in this survey. This is summarised in Table 4.3, which presents the descriptive statistics for the neighbourhood characteristics provided in the survey of Istanbul Greater Municipality.

The average household income is USD 1,072, ranging from a minimum of USD 333 to a maximum of USD 4,444. The average household size is 3.5 people and ranges from 1 to 6.5. The length of time the inhabitants have lived in Istanbul is 29.5 years whereas the length of time the inhabitants have lived in the same neighbourhood is 13.5 years.

Table 4.3 Descriptive statistics of socio-economic, neighbourhood quality, locational characteristics of neighbourhoods N: 2175

Socio-economic, neighbourhood quality and locational characteristics	Min.	Max.	Mean	Std. Deviation	Type
Average income (USD)	333	4444	1072	811	Numeric
School satisfaction	1	7	4.35	1.29	Ordinal (1-7 on the Likert Scale)
Transportation satisfaction	1	7	4.78	1.11	Ordinal (1-7 on the Likert Scale)
Municipality satisfaction	1	7	4.61	1.26	Ordinal (1-7 on the Likert Scale)
Health service satisfaction	1	7	4.10	1.37	Ordinal (1-7 on the Likert Scale)
Cultural facilities satisfaction	1	7	3.73	1.49	Ordinal (1-7 on the Likert Scale)
Playground facilities satisfaction	1	7	3.78	1.41	Ordinal (1-7 on the Likert Scale)
Security satisfaction	1	7	3.38	1.41	Ordinal (1-7 on the Likert Scale)
Neighbour satisfaction	1	7	5.79	0.79	Ordinal (1-7 on the Likert Scale)
Home satisfaction	1	7	5.94	0.83	Ordinal (1-7 on the Likert Scale)
Neighbourhood quality satisfaction	1	7	5.03	1.21	Ordinal (1-7 on the Likert Scale)
Travel time to work and schools	5	95	28.66	15.19	Numeric (minute)
Travel time for shopping	2	72.5	17.31	11.79	Numeric (minute)
The length of time the inhabitants have lived in Istanbul	3	73	29.51	9.48	Numeric (year)
The length of time the inhabitants have lived in the neighbourhood (year)	1	46	13.41	6.28	Numeric (year)
Household size	1	6.5	3.48	0.67	Numeric (year)

4.3.3.Neighbourhood Quality Characteristics

The survey held by Istanbul Greater Municipality provides a measure of the satisfaction with different kinds of facilities. The respondents were asked to score these facilities on a scale from 1 to 7 with 1 being unsatisfactory, and 7 being satisfactory. According to the results, the places that provide the least satisfaction are security, playground and cultural facilities. On the other hand, health service, school, transportation, and municipality facilities' satisfaction rates are valued as average. The highest satisfaction scores went to neighbourhood quality, neighbour quality and home facilities.

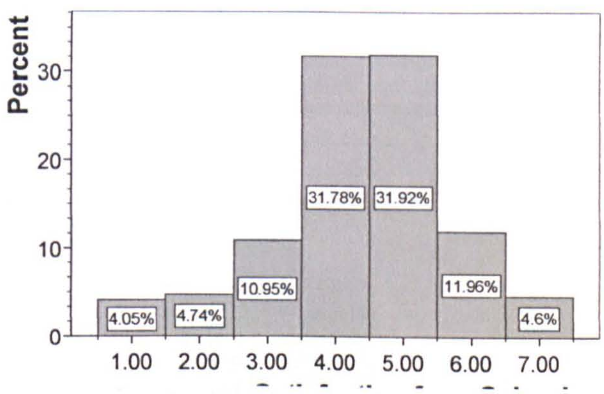

Figure 4.14 Satisfaction from schools

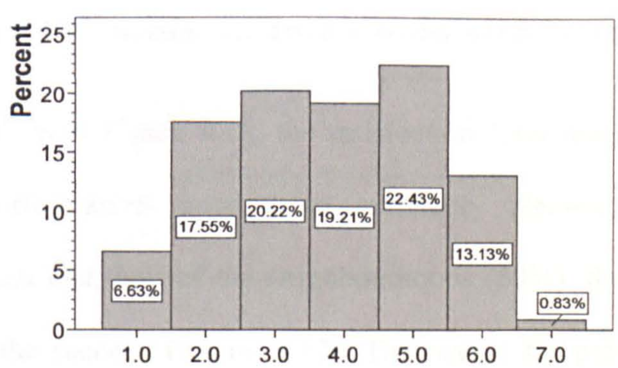

Figure 4.15 Satisfaction from cultural facilities

In half of the neighbourhoods (49%), inhabitants agree that the schools give good education to the pupils (Figure 4.14). Figure 4.15 presents the satisfaction rates for cultural facilities, which show equal performances, apart from extremely pleased (7) and extremely displeased (1).

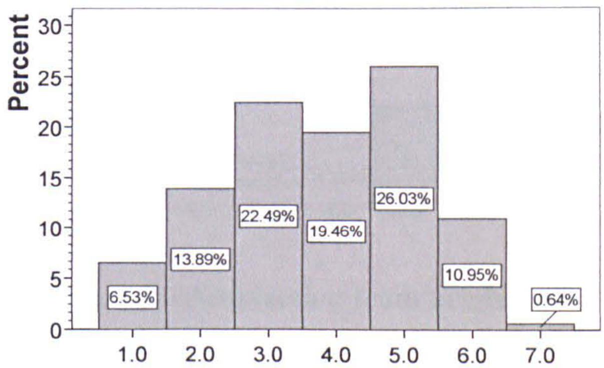

Figure 4.16 Satisfaction from playground facilities

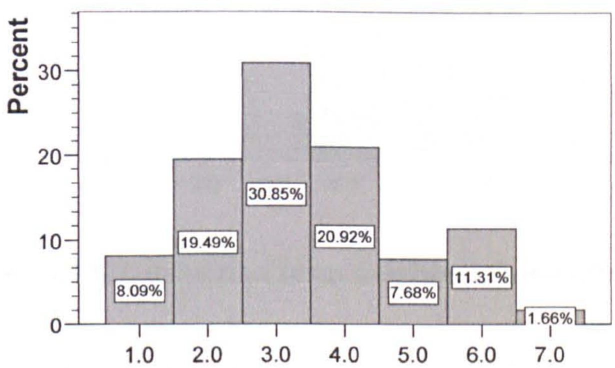

Figure 4.17 Satisfaction from security neighbourhood

As it can be seen from Figure 4.16, the satisfaction from playground facilities shows equal performances apart from extremely pleased and extremely unpleased. In more than half of the neighbourhoods (59%), the inhabitants are displeased with the security (Figure 4.17). The reason for preferring to buy a house in a horizontal, vertical gated community or site is mostly because of security reasons.

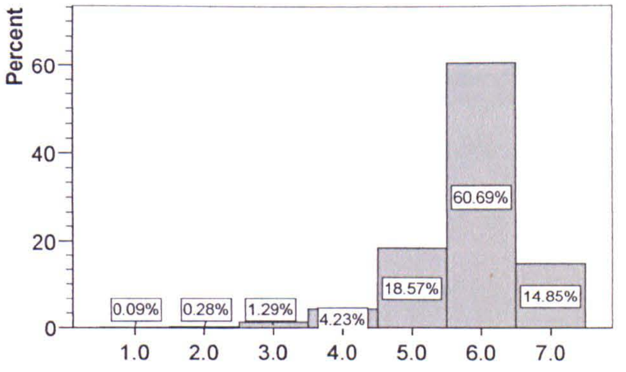

Figure 4.18 Satisfaction from neighbours

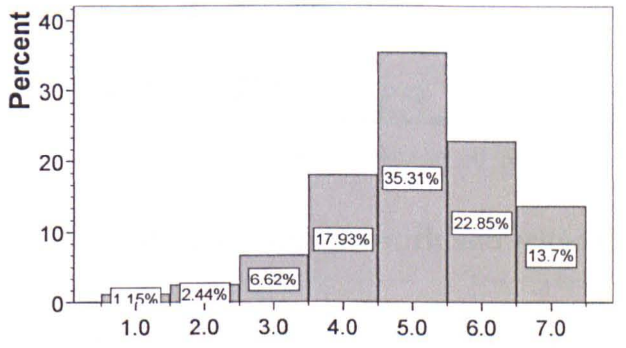

Figure 4.19 Satisfaction from neighbourhood quality

As it can be seen from Figure 4.18, in the majority of the neighbourhoods, 94% of the inhabitants are pleased with their neighbourhoods. This result affirms that neighbour relations are very important in the culture. In most of the neighbourhoods (72%), the inhabitants are pleased with neighbourhood quality (Figure 4.19)

4.3.4. Locational Characteristics

Another important group of determinants of housing prices is locational attributes. According to Orford (1999, p.45), "they are unpriced in the sense that they are not paid for directly through housing purchase. They tend to be spatially concentrated in their impact upon the quality of people's lives and value of their property."

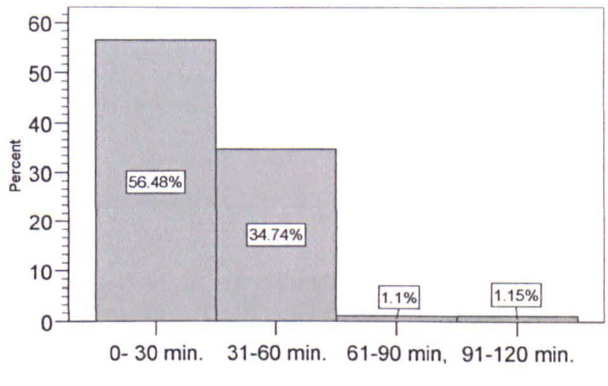

Figure 4.20 Travel time to work and schools

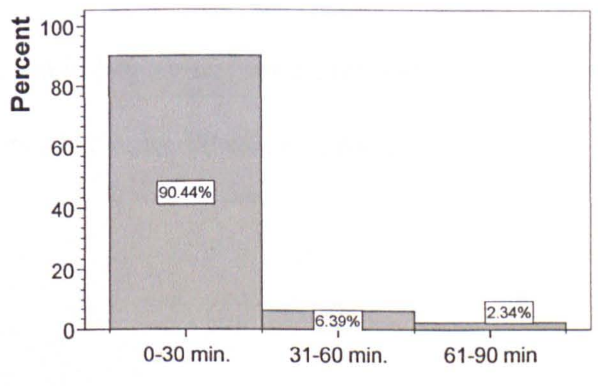

Figure 4.21 Travel time to shopping centres

Travel time for shopping is 17 minutes on average, whereas for jobs and schools it increases to approximately half an hour. Almost half of the travel time to work and schools takes less than half an hour (Figure 4.20). 90% of the travel to shopping centres takes less than half an hour (Figure 4.21). Another locational attribute is the earthquake risk (see evidence from Brookshire et al (1985) and MacDonald et al (1987), Willis and Asgary (1997) and Onder et al (2004)). In all of these studies, it was found that information about earthquake risk can affect the housing markets. According to the data provided from JICA report (2002), in 70% of the neighbourhoods, up to 5% of the buildings will be highly damaged by the expected earthquake (Figure 4.22).

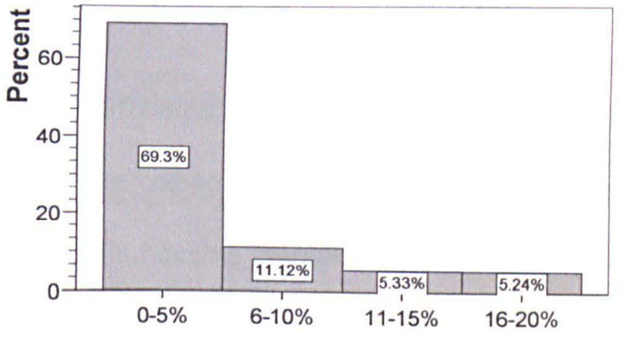

Figure 4.22 Percentage of the buildings that will be highly damaged by an earthquake

The housing unit, socio-economic, neighbourhood and locational variables that are employed in the models are listed in Appendix A.

4.4. Submarket Definition in the Istanbul Housing Market

An essential requirement in analysing urban housing markets is to segment housing market into submarkets in an accurate way. This essential step involves defining submarkets, even though there is little consensus on definition of housing submarkets and identification of submarket boundaries in the academic literature (Watkins, 2001). To define nests of housing units in a common quality level, the geographical areas need to be grouped into market segments with respect to the housing unit quality and demand and supply in the market.

In this section, classification of segmentation methods is displayed. Segmentation methods are categorised in three ways in order to model hedonic price analysis of Istanbul's housing market. An outline, evaluation and mapping of the different methods are provided in each of the three categories.

Segmentation depends on 'clustering, nesting or grouping'. The methods of segmentation can be categorized in two ways: a-priori and post-hoc approaches. The a-priori method is a way of segmentation which depends on the determinations of researchers for the type and number of segments. On the other hand, segmentation is called posts-hoc when the type and number of segments are determined according to the data analyses' results (Wedel and Kamakura, 2000).

As it is indicated in chapter 2, there is a vast literature that is based on spatially or structurally defined submarket specifications, which provide valuable insights in housing price models. However it is proven that for the best performance in the models, submarket definitions should be based on both structural and spatial characteristics (Watkins, 2001). In this study, it is accepted that the identification of housing submarkets are determined by both spatial and structural (nested) factors simultaneously and housing market segmentation is determined in three ways: A priori, experts' views and cluster analysis.

4.4.1. A Priori Submarket Delineation

The first segmentation method is shaped according to a-priori assumptions which are considered by the researcher to be the most 'probable'. Five segments were chosen by taking the housing prices, housing types, location, size, age, income, living period, and neighbourhood quality satisfaction into account. Each of the segments consists of groups. These groups are within a single submarket because they are close substitutes. The probable segmentations are listed as:

- 1st SUBMARKET Waterside house (along bosphorus, literally called "yali"), horizontal gated communities, residences (vertical gated communities), low storey apartments by the shore, detached houses close to the CBDs where A grade offices are located.
- 2nd SUBMARKET: Apartment Blocks constructed after the 1980's (neo-liberal economy), sites (Semi horizontal gated community areas)
- 3rd SUBMARKET: Apartment blocks and detached/attached houses in historical areas.
- 4th SUBMARKET: Built-sell apartment blocks and cooperatives constructed after the 1990's.

- 5th SUBMARKET: Squatter settlements, old summer houses (apartment blocks).

Each of the submarkets are analysed and categorised in different groups in order to provide a better understanding of market dynamics in themselves.

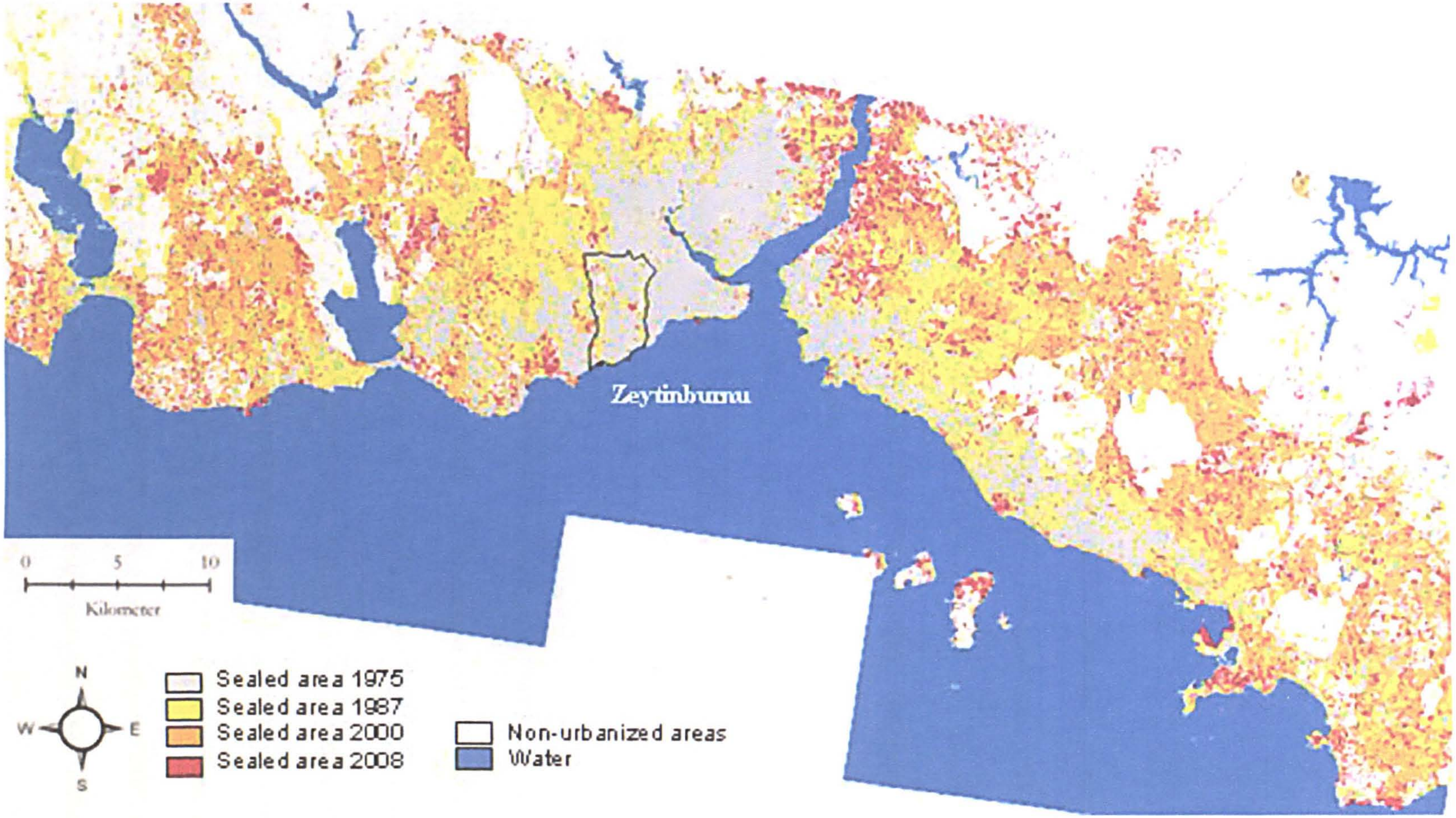

Figure 4.23 Urbanization change in Istanbul from 1975 to 2008 (Source: Breunig et al, 2009)

In this study, the sealed area in 1975 is nominated as the first core of the city; the sealed area in 1987 as the second core of the city; and the sealed area in 2000 as the third core of the city in order to give an idea of the land zone development process in Istanbul.

1st SUBMARKET

The first submarket can be categorized in 4 groups: waterside houses (along the Bosphorus, literally called "yali"), horizontal gated communities, residences (vertical gated communities), low storey apartment blocks located along the shore, detached houses close to the city centres. The first group, waterside houses, is located along the Bosphorus, and they are mainly restored, detached historical timber houses that are 2 or 3 storeys and are located on big plots. The residents are mostly famous people that usually have high- incomes and university degrees.

The second group in the first submarket is gated communities, and is mainly located in the north of the city, on water reserve areas and forest areas. Gated communities were constructed after the 1999 Marmara Earthquake in the third core of the city, which has less earthquake damage risks because of the solid ground formation. These types of developments, horizontal gated communities, consist of attached and detached single housing units with security and social amenities that are surrounded by walls (Baycan and Gulumser, 2004) in order to be separated from squatter settlements. The inhabitants are high- income people with mixed education levels, having strong neighbour relations with the help of the recreational facilities and social clubs.

The third group in the first submarket, which is called vertical gated communities, is residences. These are usually a mix of used buildings with shopping malls, hotels, offices which are located very close to the CBD's and A grade office areas. These kinds of dwellings are preferred by young professionals who are mainly employed in the service sector. Unfortunately, information on prices is not accessible from the real estate agent's websites.

The fourth group in the first submarket are low storey apartment blocks along the shore and detached houses close to the first core (mainly built before 1980's) of the city. These kinds of dwellings are detached or attached houses that are close to the first core of the CBD, the hills of Bosphorus, or close to the sea shore. These dwellings were mainly constructed in the 1960's, but they were renovated or reconstructed by the 1990's and 2000's. The inhabitants of this group are mainly high- income people with a mixed education profile.

1st SUBMARKET
Waterside house (along Bosphorus, literally called as "yali"), gated communities, residences, low storey apartments by the shore, detached houses close to the 1. core of the city

1A
YALI

Average	
Floor area	295.43
Age	24.25
Sale Price (USD)	841,600
Income (USD)	1,374
Living Per. In Istanbul	32.46
Neighbourhood satisfaction	4.38
Travel time to work-schools (min)	24.93

Located along the Bosphorus
Extremely high housing prices
High- income people
High proportion of university degree
Owned by famous people
Restored detached historical timber 2or 3 storey houses located on big plots

1B
GATED COMMUNITIES

average	
Floor area	298.88
Age	5.4292
Sale Price	409,114
Income	1,213
Living Per. In Istanbul	30.343
Neighbourhood satisfaction	5.24
Travel time to work-schools	10.33

Mostly located at the north of the city after 1999 Marmara Earthquake
Extremely high housing prices
High- income people
Mixed education groups
Located on big plots
Have various recreational facilities, social clubs
Most of the houses have their own swimming pools
Strong neighbour relations
Close to the squatter settlements
High security
High-quality infrastructure

<table>
<tr><td>1C
RESIDENCES
<table><tr><td colspan="2">Average</td></tr><tr><td>Floor area</td><td>335</td></tr><tr><td>Age</td><td>6</td></tr><tr><td>Sale Price</td><td>1,020,408</td></tr><tr><td>Income</td><td></td></tr><tr><td>Living Per. In Istanbul</td><td>26.22</td></tr><tr><td>Neighbourhood satisfaction</td><td>5</td></tr><tr><td>Travel time to work-schools</td><td>26.7</td></tr></table></td><td>Located in the CBD's, close to the A grade office areas, usually a part of shopping malls
Extremely high housing prices
High- income people
High proportion of inhabitants with university degrees
Preferred by young professionals
Preferred by service sector employees
Usually information about the prices is not being advertised.</td></tr>
<tr><td>1D. low storey apartments by the shore, detached houses at the first core of the city
<table><tr><td colspan="2">Average</td></tr><tr><td>Floor area</td><td>252.45</td></tr><tr><td>Age</td><td>14.11</td></tr><tr><td>Sale Price</td><td>431,648</td></tr><tr><td>Income</td><td>1,526</td></tr><tr><td>Living Per. In Istanbul</td><td>31.03</td></tr><tr><td>Neighbourhood satisfaction</td><td>5.11</td></tr><tr><td>Travel time to work-schools</td><td>18.30</td></tr></table></td><td>Detached houses located close to the 1st core of the city or at the hills of the Bosphorus
Extremely high housing prices
High- income people
Mixed education groups</td></tr>
</table>

2nd SUBMARKET

The second submarket consists of apartment blocks that were constructed after the 80's (liberal economy), and can be categorized into two groups: built-sell blocks and luxury sites (Semi horizontal gated community areas). The first group of the second submarket consists of built-sell apartment blocks that were constructed by small-medium size developers, mostly after the 1980's (the neo-liberal economy). The current inhabitants are medium income people, usually with a mixed educational profile, and they are located in the first core of the city. Due to the lack of sufficient plots in the first core of the city, it is hard to find greenfields to build new apartments, so developers usually demolish 30 -35 year old buildings.

<table>
<tr><td colspan="2">2nd SUBMARKET
Apartment Blocks constructed after 1983's (neo-liberal economy)</td></tr>
<tr><td>2A
BUILD AND SELL BLOCKS
<table><tr><td colspan="2">Average</td></tr><tr><td>Floor area</td><td>137.34</td></tr><tr><td>Age</td><td>15.32</td></tr><tr><td>Sale Price</td><td>195,707</td></tr><tr><td>Income</td><td>1,552</td></tr><tr><td>Living Per. In Istanbul</td><td>31.09</td></tr><tr><td>Neighbourhood satisfaction</td><td>5.45</td></tr><tr><td>Travel time to work-schools</td><td>14.33</td></tr></table></td><td>Located mainly at the 1st core of the city
High housing prices
Upper middle income
Mixed education groups
Detached apartments blocks on medium size plots
Mostly constructed after 1980's by the liberal economy era
Hard to find greenfields to build a new apartment so usually developers demolish 30 -35 years old buildings
Good infrastructure</td></tr>
</table>

2B SITES (SEMI HORIZONTAL GATED COMMUNITY AREAS)		Semi horizontal gated community areas Mostly constructed after the 1999 Marmara earthquake Usually located at the 2nd and 3rd core of the city High housing prices Upper middle peoples Mixed education groups Good infrastructure Have various recreational facilities and social clubs Trendy for investment
Average		
Floor area	133.33	
Age	11.39	
Sale Price	228,352	
Income	1,812	
Living Per. In Istanbul	30.48	
Neighbourhood satisfaction	5.2	
Travel time to work-schools	16.35	

The second group in the second submarket consists of sites, semi-horizontal gated communities which are located in the second and third cores of the city. These were mostly constructed after the 1999 Marmara Earthquake and are usually in the second core of the city. The inhabitants are middle income people with a mixed education profile. These kinds of settlements have various recreational facilities, social clubs and security units. Since these blocks were constructed after the earthquake with enormous social amenities, they have become very trendy for investors.

3rd SUBMARKET

This consists of two groups: Apartment blocks and detached/attached houses in the first core of the city, especially around historical areas. The first group of the third submarket consists of attached apartment blocks constructed on small plots, mainly located in the first core of the city. These kinds of dwellings were mainly constructed between 1950 and 1980. Usually middle income people and university students settle in these areas. The quality of the construction is not strong enough to prevent earthquake damage that is expected to happen in Istanbul. However, because of the locational advantage and the lack of sufficient plots in these areas, developers prefer to invest in these areas by demolishing old dwelling in order to build new ones. The lack of parking space and traffic congestion are the locational disadvantages of these areas.

The second group in the third submarket consists of attached houses in the historical areas that were mostly constructed before the 1960's, and were made of timber with Greek or Ottoman style architecture. These areas are usually under the treat of deprivation, but after the 2000's, urban regeneration started, during which bohemian people, artists, and academics decided to base themselves in these areas. In contrast, the deprived areas show completely different characteristics, such as 3-4 immigrant families sharing a house with a common kitchen and bathroom, usually in very poor condition.

<table>
<tr><td colspan="2">3rd SUBMARKET
Apartment blocks and detached/attached houses in historical areas.</td></tr>
<tr><td>3A
Apartments blocks in the historical areas
<table>
<tr><td colspan="2">Average</td></tr>
<tr><td>Floor area</td><td>130.32</td></tr>
<tr><td>Age</td><td>25.44</td></tr>
<tr><td>Sale Price</td><td>187,397</td></tr>
<tr><td>Income</td><td>1,156</td></tr>
<tr><td>Living Per. In Istanbul</td><td>29.55</td></tr>
<tr><td>Neighbourhood satisfaction</td><td>4.8</td></tr>
<tr><td>Travel time to work-schools</td><td>20.70</td></tr>
</table></td>
<td>Located at the 1st core of the city
Mostly constructed between 1950-80
High-middle housing prices
Middle income people
Attached apartments located on small plots
Trendy for developers to demolish and rebuild because of the high land prices.
Most of these buildings are not resistant to earthquake, and because of that, the demand decreases
Do not have enough facilities, car parking problem</td></tr>
</table>

<table>
<tr><td></td><td></td></tr>
<tr><td>3B
Attached houses in the historical areas
<table>
<tr><td colspan="2">Average</td></tr>
<tr><td>Floor area</td><td>457.5</td></tr>
<tr><td>Age</td><td>48.25</td></tr>
<tr><td>Sale Price</td><td>289,117</td></tr>
<tr><td>Income</td><td>734.5</td></tr>
<tr><td>Living Per. In Istanbul</td><td>23.53</td></tr>
<tr><td>Neighbourhood satisfaction</td><td>3.66</td></tr>
<tr><td>Travel time to work-schools</td><td>16.6</td></tr>
</table>
</td><td>Located at the first core of the city
Mostly constructed before the 1960's
High-middle housing prices
Middle income people
Were under the treat of deprivation, but after 2004 with the increase in the property prices, urban regeneration activities have started.
The regenerated areas are preferred by bohemian people, artists and academics.
*the exemption : in deprived areas, 3-4 immigrant families share a house, very low- income people
Do not have enough facilities, car parking problem</td></tr>
</table>

4th SUBMARKET

The fourth submarket consists of apartment blocks that were constructed after the 1990's and it can be categorized into two groups: Build-sell apartment blocks and cooperatives. Build and Sell apartment blocks and cooperatives were constructed after the 90's between the two major highways, E5 and E6, and are primarily located in the second core of the city. The residents of these detached apartment blocks, on medium size plots, are low- middle income people, and, unfortunately, there are not enough recreational and social facilities in these areas.

<table>
<tr><td colspan="2">4th SUBMARKET
apartment blocks constructed after 1990's</td></tr>
<tr><td>4A
BUILD-SELL APARTMENT BLOCKS
<table>
<tr><td colspan="2">Average</td></tr>
<tr><td>Floor area</td><td>143.2584</td></tr>
<tr><td>Age</td><td>10.8305</td></tr>
<tr><td>Sale Price</td><td>113,561.2</td></tr>
<tr><td>Income</td><td>1,148.451</td></tr>
<tr><td>Living Per. In Istanbul</td><td>27.851</td></tr>
<tr><td>Neighbourhood satisfaction</td><td>4.5315</td></tr>
<tr><td>Travel time to work-schools</td><td>17.8846</td></tr>
</table></td>
<td>Located at the second core of the city
Constructed after the 1990's between the E5-E6 highways
Middle housing prices
Middle, lower-middle income people
Low proportion of university degree
Detached apartment blocks on medium plots
Do not have enough recreational, social facilities
Weak infrastructure</td></tr>
<tr><td>4B COOPERATIVES
<table>
<tr><td colspan="2">Average</td></tr>
<tr><td>Floor area</td><td>165.4972</td></tr>
<tr><td>Age</td><td>7.2187</td></tr>
<tr><td>Sale Price</td><td>139,422</td></tr>
<tr><td>Income</td><td>1,084.308</td></tr>
<tr><td>Living Per. In Istanbul</td><td>22.1509</td></tr>
<tr><td>Neighbourhood satisfaction</td><td>4.6808</td></tr>
<tr><td>Travel time to work-schools</td><td>15.9808</td></tr>
</table></td>
<td>Located at the second core of the city
Constructed after the 1990's between the E5-E6 highways
Middle housing prices
Middle, lower-middle income people
Low proportion of university degree
Detached apartments on medium plots</td></tr>
</table>

5th SUBMARKET

The 5th submarket includes into 3 groups: legalized squatter settlements, squatter settlements and old summer residential areas. The first group of the 5th submarket, legalized squatter settlements, is constructed in the first core of the city. Although in the 1950's and 60's these areas were peripheral areas, in the

2000's these areas became central areas due to the rapid urbanization process in Istanbul. These areas are ghettos where there are strong familial and neighbour relations. They have a high risk of damage from expected earthquakes in Istanbul. Since land prices in these areas are very high, the Mass Housing Administration (MHA) has started an urban transformation in these areas, mainly forcing the residents to move to the peripheral areas of the city. Although these areas do not have enough infrastructure, inhabitants do not want to move to the periphery of the city since it is far away from the business districts. The second group of the 5th submarket is squatter settlement areas which are located on water reserve areas or forest areas and are mainly constructed in the second or third core of the city. The third group of the fifth submarket is the old summer residential areas which are located on the edges of the city, especially in the western and northern peripheral areas. According to the 1/100.000 plan, which has not been approved yet, these areas are proposed to become new residential areas for an additional 2 million people.

<table>
<tr><td colspan="3">5th SUBMARKET</td></tr>
<tr><td colspan="2">5A
Legalized squatter settlements</td><td rowspan="9">Although they were constructed during the 1950's at the peripheral areas at the moment, these are close to the centre of Istanbul because of the dynamic structure of the city.
These were legalized by local and central governments
Low housing prices
Lower-class
Low proportion of university degree
Strong familial relations
Social clusters like ghettos
High damage risk from earthquakes
Do not have enough facilities
Do not have enough infrastructure</td></tr>
<tr><td colspan="2">Average</td></tr>
<tr><td>Floor area</td><td>140.97</td></tr>
<tr><td>Age</td><td>6.83</td></tr>
<tr><td>Sale Price</td><td>106,950</td></tr>
<tr><td>Income</td><td>902.60</td></tr>
<tr><td>Living Per. In Istanbul</td><td>26.55</td></tr>
<tr><td>Neighbourhood satisfaction</td><td>3.98</td></tr>
<tr><td>Travel time to work-schools</td><td>21.73</td></tr>
</table>

<table>
<tr><td>5B
Squatter settlements
<table><tr><td colspan="2">average</td></tr><tr><td>Floor area</td><td>121.8</td></tr><tr><td>Age</td><td>8.84</td></tr><tr><td>Sale Price</td><td>70,689</td></tr><tr><td>Income</td><td>895.4</td></tr><tr><td>Living Per. In Istanbul</td><td>24.7806</td></tr><tr><td>Neighbourhood satisfaction</td><td>4.5</td></tr><tr><td>Travel time to work-schools</td><td>13.04</td></tr></table></td><td>Located on water reserve areas or forest areas
Low housing prices
Lower income class
Low proportion of university degree
Strong relative relations
Social clusters like ghettos
Do not have enough facilities
Do not have enough infrastructure, in some of the areas there is not infrastructure at all</td></tr>
<tr><td>5C
Old summer residential areas
<table><tr><td colspan="2">average</td></tr><tr><td>Floor area</td><td>186.0993</td></tr><tr><td>Age</td><td>8.2721</td></tr><tr><td>Sale Price</td><td>113,400</td></tr><tr><td>Income</td><td>845.5</td></tr><tr><td>Living Per. In Istanbul</td><td>38.525</td></tr><tr><td>Neighbourhood satisfaction</td><td>5.9</td></tr><tr><td>Travel time to work-schools</td><td>11.75</td></tr></table></td><td>Located at the edges of the city, especially on the west and north peripheral areas.
Low housing prices
Middle lower income
Do not have enough facilities
Do not have enough infrastructure</td></tr>
</table>

4.4.2. Experts' Submarket Delineation

In some of the housing price studies, researchers used experts' identification of submarkets in their work (see Palm (1978), Michaels and Smith (1990) and Bourassa et al, (2003)). Palm (1978), was found that submarkets that were defined by real estate agencies showed better performance than those determined by economic and race related variables. Bourassa et al, (2003) compared a set of submarkets based on geographical areas defined by real estate appraisers with a set of statistically generated submarkets consisting of dwellings that were similar but not necessarily contiguous. They also found out that price predictions are more accurate when based on the housing segmentation defined by real estate appraisers than when based on statistical techniques.

In this study, quantitative models have been widely used to infer characteristics of the urban housing market. Quantitative-based studies have been a common approach in most of the property market research. Although there is published literature on the methods of the quantitative approach, little attention has been paid to housing market studies which evaluate behavioural research and qualitative approaches as well. However, with respect to the complexity of the residential market system, qualitative methods have been used, especially to classify housing market segmentation.

The methodology of this study mainly depends on the neo-classical or new urban economics paradigm, and the aim of this approach is to apply micro-economic theory to urban problems (Rodriguez-Bachiller, 1986). The abstraction process of the new urban economic paradigm helps to operationalize the models. The quantitative methods used in neo-classical models give validity, reliability and objectivity to the research. However, the assumptions of neo-classical economics have been criticised by institutional economists claiming that they do not capture the real property market conditions. "The implication is that the messy real world of property development does not work like the models suggest. Cities and buildings within them are too rigid." (Ball 1998, p.1501)

It has been suggested that quantitative methods with rigid assumptions may not always be the best option to explain the housing market system. However, an institutional or behavioural approach assumes that the housing market system is a result of a network, in which key actors and rules employ qualitative methods. Some of the institutional economists are particularly sceptical about what they describe as an overly restrictive approach to analysis of research property markets. On the other hand, other proponents believe that institutional research provides a complement to, rather than a substitute for, neo-classical analyses (Leishman, 2003).

Philip (1997) argues that "researchers should think beyond the myopic quantitative-qualitative divide when it comes to designing a suitable methodology for their research, and select methods- quantitative, qualitative or a combination of the two-that best satisfy the needs of specific research projects". In this element of the study, a multiple-method research strategy is applied because it is crucial to support the mathematical model with the interviewee's opinion in order to display the urban housing system. Although quantitative models have been widely used to infer the characteristics of an urban housing system, qualitative methods are also used in order to support the input for the models and also for finding contextual models.

Following Michaels and Smith (1990), semi structured interviews were held in November 2007 with ten interviewees who were working in the property market in Istanbul (Table 4.4). They were asked three questions. The first question was to draw the submarkets on the 1/200,000 scale map that displayed all the administrative boundaries of neighbourhoods. An example of submarket delineation by an expert [A2] can be seen in Figure 4.24.

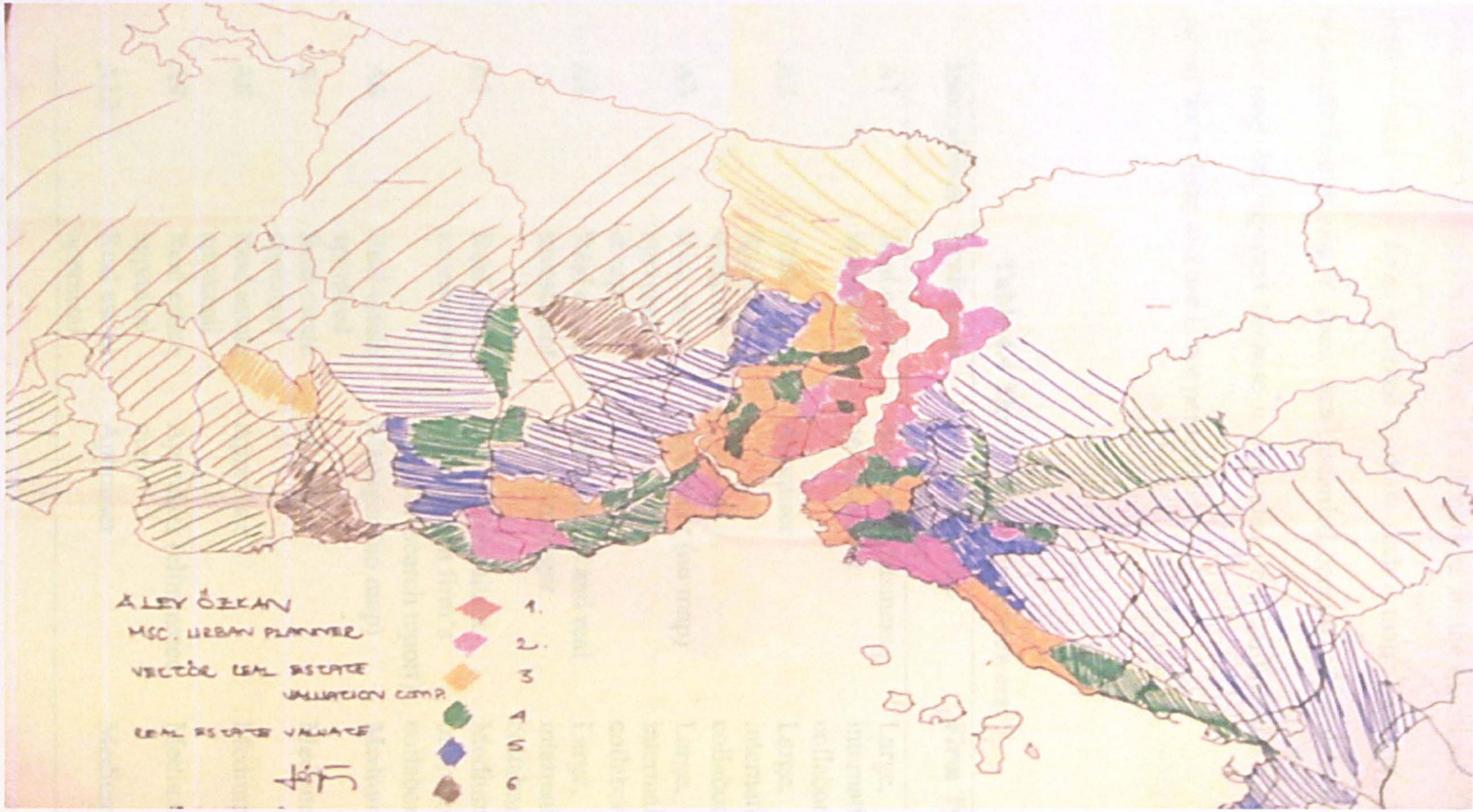

Figure 4.24 An example of the expert's submarket identification.

Most of the interviewees drew approximately 5 to 7 submarkets, although there was no restriction on the number of submarkets in the questions. Out of the 10 interviewees, 8 of them accepted to draw such a map. Two out of eight maps were eliminated; one of them was discarded because of careless work, and the other map was rejected because it depended on a confidential market research report for a client and use is not permitted.

Table 4.4 The Profile of Interviewees

Interviewee	Profession	Position of the interviewee	Firm Type
A1	Real estate investment	Specialist, business development	Large, international collaboration
A2	Real estate appraisal company	Appraiser	Large, international collaboration
A3	Real estate appraisal company	Appraiser (no map)	Large, international collaboration
A4	Real estate investment	Investments and real estate manager	Large, international collaboration
A5	Real estate investment	Senior Consultant (depends on firm's market research report)	Medium, international collaboration
A6	Real estate appraisal	Manager (no map)	Medium
A7	Real estate appraisal	Manager	Medium
A8	Real estate appraisal	Appraiser	Medium
A9	Real estate appraisal	Appraiser (eliminated map)	Medium
A10	Real estate appraisal	Appraiser	Medium

The other two questions were open-ended questions. One of the questions was about the determinants of the housing prices, and the other was about future predictions for the urban housing market in Istanbul. In order to analyse the submarkets that were drawn by interviewees, a synthesis of the six maps was carried out. This synthesis depended on an interpretation analysis which was developed through both visual and discursive analysis. The stage of "generalisation" is an important indicator of syntheses analysis. The result of this analysis was the emergence of a larger consolidated picture: a description of patterns and themes and an identification of a fundamental structure (Gray and Malins, 2004).

This first step of this synthesis analysis process was to prepare a separate map for each of the submarkets. Most of the interviewees overlooked the restricted areas, such as military bases, and they categorized these non-residential areas as submarkets. These submarkets were eliminated and therefore, according to the experts, the total number of submarkets in Istanbul was 5.

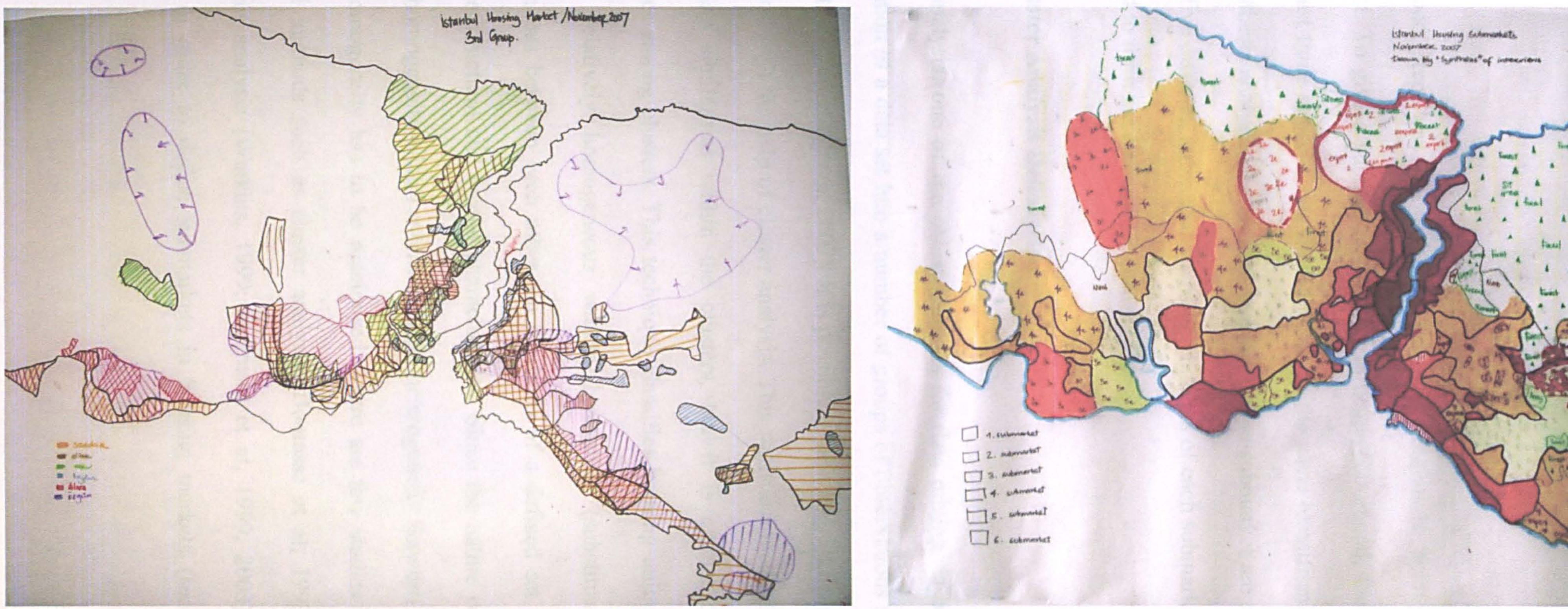

Figure 4.25 The synthesis map of experts' map

The second step was to decide which neighbourhoods belong to which submarket. To give a submarket category to a neighbourhood, the principle is that at least three interviewees should agree on the same identification. In order to do synthesis analysis, the borders of every single submarket are drawn. After creating five different submarket maps, the borders of each submarket were then combined to form the outcome (Figure 4.25).

4.4.3.Cluster Analysis Delineation

Cluster analysis, one of the oldest methods for data mining, is based on the classification of a data set into a number of groups of observations according to an algorithm (Fotheringham, 2007). It is possible to nest homogeneous groups of observation with the help of cluster analysis. This statistical method depends on maximising similarities within the clusters, but it is crucial to minimise similarities among clusters. This technique classifies housing units into groups that are relatively homogeneous within themselves (substitutability) and heterogeneous between each other, on the basis of a defined set of variables which are structural and spatial characteristics. Since the nature of submarket requires homogeneity within submarkets but heterogeneity between submarkets, cluster homogeneity has to be maximised. There are few studies that employ statistical methods such as cluster analysis (Bourassa et al, 1999), principal component analysis (Watkins, 1999; Bourassa et al, 1999, 2003) and factor analysis in order to define submarkets in housing markets (see also Dale-Johnson, 1982).

The study in Maclennan and Tu (1996) used principal component analysis to distinguish submarkets from the housing unit and neighbourhood characteristics in Glasgow. First, they employed principal component analysis to categorise individual variables into group variables. Then these variables were used in cluster analysis in order to determine the submarkets. Borussa et al, similarly used principal component analysis to extract factors and then applied cluster analysis to those scores in order to define submarkets for Melbourne, Australia (1999) and Auckland in New Zealand (2003).

In this study, Ward's hierarchical method is employed because it minimises the sum of squared distance between the cases (within group variance) within the cluster and maximise the between group variance (Wilhelmsson 2004). Since this method is analogous to submarket definition, it is chosen as the statistical tool in determining the submarket boundaries (Bourassa et al. 1999).

In this study, housing unit characteristics such as housing prices, floor area, age of the building and the number of rooms were taken into consideration for the cluster analysis. Some of the neighbourhood characteristics such as income of households, living period of inhabitants in Istanbul, neighbourhood quality and satisfaction from the public transportation facilities were considered in the analysis. In addition to housing unit and neighbourhood characteristics, the risk of an earthquake was also considered as an input for the cluster analysis.

In order to provide analogy among a priori, experts' and cluster analysis, a nominated number of clusters (five) has been accepted as a basis in the cluster analysis. However, the composition of the submarkets was incoherent, for example a neighbourhood in Bosphorus and a squatter neighborhood could be in the same submarket according to cluster analysis with nominated number of clusters. Because of this reason, number of clusters is not predefined in the analysis. According to the hierarchical cluster analysis run by the SPSS program, 12 submarkets are designed that can be found in the Appendix C.

4.5. Comparing Housing Market Segmentation Models

The aim of this section is to examine the existing methodologies that focus on conceptualising housing market structures. The empirical analyses or the techniques used in this study are not new. However, it is a new task to compare the effectiveness or explanatory power of the different models that will provide contribution to housing market modelling research. This contribution is provided by comparing the existing techniques such as hedonic models, hedonic models with submarket dummy variables, separate submarket hedonic models and multi-level models.

This section first considers the empirical analyses used in the housing market literature and then presents a discussion of the statistical methods used to analyse the structure of the urban housing market system in this thesis. Second, an overview of the common methods that are employed in order to conceptualise the structure of an owner occupied housing market, is displayed. The studies are highly selective subset of those available but each was chosen as they exemplify the common approach associated with each technique. These four groups are categorised using the following methods:

1. Hedonic Modelling-Mainstream Approach

2. Combining Hedonic Model and Submarket Dummies

3. Advanced Spatial Modelling Approaches

4. Multi-level Models

4.5.1.Hedonic modelling

Hedonic models have been employed widely in econometric studies of urban housing markets. The theoretical background for hedonic models is well developed within the traditional urban economics and neo-classical economics frameworks, which assume that the city is flat and all employment is located in the Central Business District (CBD) (for more information see Chapter 2). This model was widely accepted after the publication of Rosen (1974), in which he takes demand, supply and competitive equilibrium into consideration with regard to the heterogeneity of the housing market.

A hedonic model consists of an independent variable, which is housing sales price, and dependent variables which are usually housing-unit characteristics, socio-economic characteristic of neighbourhood and locational attributes. Hedonic modelling enables the investigation of an effect of a specific characteristic by holding all other attributes constant. For example, with the help of hedonic models, it is possible to detect "how much a balcony adds to the housing price of a housing unit" or "how much the risk of earthquake reduces the sales price of a housing unit".

$$P = \beta_0 + \sum_{j=1}^{n} \beta_j X_j + \varepsilon$$

The hedonic price function is constructed where P is the vector of the logarithm of the transaction prices, β_0 is the constant, β_j is the coefficient for characteristic j, X_j is the characteristics of j, and ε is the error term. In this study, β_j is the vector consists of housing-unit characteristics, socio-economic characteristics of the neighbourhood, behavioural attributes and locational characteristics. Any of these attributes that are taken into account may increase or reduce the actual price of houses.

4.5.2. Combining Hedonic Model and Submarket Dummies

Hedonic price models show better performance and give higher explanatory power when spatial extensions are included (Gallimore et al, 1996). The simplest form of hedonic models has provided a way of analyzing housing markets. However, a hedonic function is not enough to detect zonal boundaries since it only captures the significance and coefficient of the attributes, explanatory power of the whole market (Kauko, 2003b). A pragmatic way of solving this issue is to add dummy variables in order to detect the spatial effects of segmentation in a housing market.

Hedonic functions with submarket dummy variables are much easier to implement than spatial statistics (Bourrassa et al, 2007). In their study, Bourassa and colleagues used a database of over 4,800 residential sales in Auckland, New Zealand. The models that are considered are of two variations, each with two

OLS (with and without dummy using dummy variable), four geostatistical, and two lattice models. Their results suggest that the geostatistical methods perform better than the simple OLS model, however when submarket dummy variables are added to the OLS model, the predictions are more accurate than the predictions generated with the geo-statistical methods. They conclude that, relative to a simple OLS model, the advantages from incorporating submarket dummy variables are greater than the advantages from using more complicated techniques that attempt to model the structure of errors.

In order to increase accuracy from the hedonic models that incorporate submarkets, it is essential to define and identify the submarkets of the housing market. Controlling for submarkets in hedonic functions assumes either the use of predefined submarket boundaries or the introduction of some statistical method to define them (Bourassa et al, 2007). We use the predefined submarkets identified in three ways discussed previously.

Therefore, submarkets that are identified by the different methods described above are employed as dummy variables in the hedonic models in order to capture the zonal boundaries of the market. This enables researchers to overcome the shortage of the market-wide market models and capture the spatial factors of the market.

4.5.3. Advanced Spatial Modelling Approaches

In addition to hedonic price modelling, the neo-classical economic approach spawned literature that utilises alternative modelling techniques such as simulation models, spatial statistics and multi-level modelling (Jones et al, 2003). Hybrid models in housing market studies include methods such as multi-level models, spatial regression models, simulation models, neural networks, and cellular automata.

A Spatial Auto Regression (SAR) model is an advanced version of a linear regression function that takes spatial auto correlation into account. According to Rosiers and Thèriault (2008), since spatial dependence may not always be modelled adequately using additional geographical variables, a solution for this problem is to include spatial autoregressive (SAR) terms into the hedonic function, which is:

$$Y = X\beta + \delta\, WY + \varepsilon$$

where X is the matrix of independent variables, ε is the error term, β is a vector of regression coefficients, WY is a weighted (W) vector of dependent variables (Y), and δ is the spatial autoregressive parameter which is the degree to which the values at individual locations depend on neighbouring values (Besner, 2002; Fortheringham et al 2007, cited in Des Rosiers and Thèriault, 2008).

4.5.4. Multi-level models

Multi-level modelling enables the separation of effects of both individual characteristics and space characteristics (contextual effects). This method allows the investigation of the way the outcome of individuals in a cluster is affected by space. In other words, this method aims to find out the individual processes which occur in a differentiated space (Courgeau and Baccaini, 1998).

The multi-level approach allows for a contextualized quantitative model, which can take both the place and the individual attributes into account. Multi-level modelling originated from the hedonic models which are used to investigate how housing prices differ by the housing unit characteristics (individual level) and locational characteristics (contextual effects). The advantage of utilising multi-level models instead of hedonic models is that multi-level modelling can defeat the limitations caused by spatial effects. Therefore, one of the drawbacks of the hedonic models (assuming an average for individuals and places) can be solved by multi-level modelling. The specification of this model is shown:

$$Y_{ij} = \alpha_j + \sum \beta_i X_{ij} + (e_{ij} + \mu_j \alpha + \mu_j \beta X_{ij})$$

where Y_{ij} represents the price of house i in place j, e_{ij} represents the random term related with house i in place j and α_j and β_j are place specific parameters,

According to Jones and Bullen (1993), multi-level modelling can be seen as a series of hedonic functions, one for each area. In this study, it was stated that it may be perceived as multi-level modelling, and it is not very different from the "common practice of dummy variable regression with a separate indicator variable for each place" p.1414. They pointed out that, "in contrast to this separate estimation at a single level, multi-level models represent areas as a sample of all areas and treat any area-specific as coming from distribution. Multi-level estimation is therefore not a separate estimation strategy, but it is based on pooling all the information in the data". In addition, multi-level models have a technical advantage which makes it possible to offer considerable insight into the nature of heterogeneity at different levels of analysis (Gould et al, 1997).

The use of hedonic models in housing market studies is a common and practical way of analysing urban housing systems. However, there are some technical difficulties such as heteroscedacity and multi- collinearity in hedonic modelling. In order to reduce these technical difficulties, some alternative models, such as multi-level models have been used in housing market studies. In addition, because it provides a better understanding for both housing unit (individual level) and location (contextual level), multi-level modelling is a useful tool in housing price studies. This technique allows researchers to analyse the data at several levels simultaneously, instead of analysing data at every single level individually. It is common in multi-level modelling, in which two or three levels are taken as basis. An example of a three level model could be housing unit (level 1), neighbourhood (level 2) and district (level 3). In this study, a two-level model is employed to investigate the individual and contextual level, and this is carried out by using housing unit at level 1 and submarket as contextual level variables at level 2.

4.6. Conclusions

Testing the efficacy of the methodology is the main objective of this research. In order to have high performance from the models, it is crucial to provide a data set that includes appropriate variables. The data characteristics adopted in this study contain a wide range of housing unit, socio-economic, neighbourhood and locational characteristics. The attribute selection process was focused on answering the research questions, especially to find out the relationship between space and housing prices.

The data set is not only crucial for modelling but also for identifying submarkets. In order to capture the spatial factors on housing prices, the identification of submarkets plays an essential role in most of the housing research. A priori and cluster analysis identification are determined with the help of the data set provided from different sources, such as real estate agencies and the Istanbul Greater Municipality.

The focus of the study is on the efficiency of housing price models which is mainly dependent to the data set and the techniques that are employed. The application of the four key techniques and the comparison of their performances is discussed in details in the next four chapters.

CHAPTER 5 HEDONIC HOUSING PRICE MODELS

5.1. Introduction

This chapter examines the hedonic price models in housing price analysis. Its aim is to provide a better understanding of urban housing system by examining two different hedonic model approaches. The first hedonic model estimates house prices within Istanbul, but largely ignores neighbourhood differences because it then allows the investigation of the determinants of housing prices in Istanbul. A market-wide hedonic price model is employed by taking the property, socio-economic, neighbourhood and locational characteristics into account. The second model includes neighbourhood dummy variables as a proxy for submarkets within the model. For this purpose, a hedonic model is employed with a dummy variable that represents submarkets, in order to capture the spatial price differences within the market.

Hedonic modelling has provided a better understanding of analysis in housing markets that have complex a composition of different bundles and quantities of physical, environmental and locational attributes (Leishman, 2003). Since the study area is Istanbul, where the housing system is heterogeneous and complex, hedonic price methods can be an appropriate tool for conceptualization of the urban housing market. Therefore, in this chapter, housing price determinants are examined by employing hedonic pricing model in order to capture the heterogeneous physical and socio-economical configuration of the urban housing system.

This chapter is organised into four sections. The next section sets out the methodology of the study. This discussion highlights the limitations of standard hedonic models and, in particular, emphasizes the problems with the treatment of spatial influences on markets' structure. Section three summarizes the results of both the market-wide model and the hedonic model with a dummy that represents submarkets. Finally, the concluding part of this chapter lays out the key findings of these hedonic models.

5.2. Methodology of Hedonic Models

This section compares the performances of different hedonic models. In this context, hedonic models are employed in order to display the spatial distribution of housing price determinants. In addition to this, the methodology for market-wide models and hedonic models with a dummy that represents submarkets is highlighted.

5.3. Methodology of market-wide hedonic models

Housing prices can be modelled using hedonic price functions. The hedonic approach is based on the assumption that a residential unit is composed of a collection of individual components, where each one has an implicit price. The theory of hedonic price as formulated is a problem in which the entire set of implicit prices guides both consumer and producer locational decisions in characteristics of space (Rosen, 1974). The hedonic price model is a method by which the price of the housing unit is delineated by structural, locational, and environmental attributes. This technique is based on statistical analysis that characterises the price of a housing unit as a dependent variable, and the structural, locational, and neighbourhood factors are employed as independent variables in order to investigate the dependent variable that is housing prices. Housing prices are affected not only by the structural characteristics of the housing units, but also by the socio-economic and behavioural environment, neighbourhood quality, and locational factors like amenities and disamenities. It is possible to interpret the implicit price of each attribute from the coefficients that can be derived from the hedonic model function. This also allows for comparisons between the prices that are paid for different qualities of the commodity by examining individual attribute prices and the aggregate prices paid for heterogeneous housing units.

The hedonic price model is based on the assumption that the market contains a heterogeneous housing stock and heterogeneous consumers. Heterogeneity causes variation in house prices within a location, providing housing consumers with a range of housing unit options. In addition to this, housing consumers differ according to socio-economic and behavioural characteristics. Different households with different socio-economic composition have different requirements for housing structures that vary with respect to a range of components like size, number of rooms, and construction type. The heterogeneity of the housing stock and housing buyers denotes that the urban housing system is composed of submarkets, in which each of these will have a different market price for property attributes.

According to Leishman (2003, p.118) it is assumed that in hedonic price functions:

1. Each observation of the complex heterogeneous good (in this case each house) represents a bundle of simpler homogeneous attributes.

2. There is an implicit market for each of the homogeneous attributes such that their respective prices are determined by the interaction of supply and demand for that attribute.

3. The price of an observation on the composite good (housing) is a function of its component attributes and their implicit market prices.

A hedonic price function is typically specified as a regression of housing transaction prices on its characteristics through the housing market system. Such functions consist of a dependent variable which is housing price, and the independent variables that are related to the housing unit. The general hedonic price function depends on the assumption that a linear, additive relationship exists between the price and the goods characteristics (Leishman, 2003).

Hedonic price estimation is often used in housing submarket studies. The most significant implication of heterogeneity in housing market modelling studies is segmentation in the housing market. The urban housing market is most accurately represented as a collection of diverse yet interrelated submarkets

(Rothenberg et al, 1991). In many studies, urban housing markets were investigated by taking submarkets as bases (Goodman and Thibodeau, 1998; Fletcher et al, 2000; Bourassa et al, 2007).

In this section of the chapter, housing price determinants are examined by employing a hedonic pricing model that incorporates neighbourhood administrative boundaries, which can reflect the heterogeneous physical and socio-economical configuration. The variables included in the hedonic function can be grouped in four categories: property characteristics, socio-economic characteristics, neighbourhood quality characteristics, and locational factors.

Property characteristics include price, age, living area, the number of rooms and the total number of storeys of the building. Instead of defining the dependent variable in terms of housing price per square meter and therefore assuming that price is strictly proportional to floor area, housing price variable is employed as an dependent variable. The living area variable, which dominates most hedonic specifications, is most highly correlated with the variables such as number of rooms, housing type and number of storeys. These correlations vary when the sample is segmented. Living area is included only in logarithm form in the models presented in this thesis. Elsewhere in the literature, researchers experiment with other non-linear forms or combining living area with price. Experimentation has not been reported here, indicated little benefit from including this variable modelled in any of these alternations. This form of experimentation merely made the interpretation of the model results more difficult (see Rothenberg et al, 1990).

Other property characteristics are represented with dummy variables, such as the type of the property (flat, detached), the existence of an elevator, balcony and/or garden. In addition to this, the characteristic "site" represents the dummy variable if the housing unit location is in a secured site with a swimming pool and a car park. The problem of multi-collinearity can be avoided by grouping three variables. The other characteristic, "low storey," exists if the building has less than 5 storeys. "Site" and "low storey" variables were taken into account with respect to the preferences of the house buyers in Istanbul. After the 1999 Marmara earthquake, house consumers preferred to live in low storey buildings, at the highly secured, low density sites that also have swimming pools and facilities such as sports centres and social clubs.

Socio-economic characteristics are composed of the average income of the household, the household size and the length of time the inhabitants have lived in Istanbul. The neighbourhood quality characteristics (satisfaction levels) are measured on a 1 to 7 Likert scale, 1 being "appalling" and 7 being "excellent". In order to capture the neighbourhood quality characteristics, the satisfaction from schools, health services, cultural facilities, playground facilities, neighbours, and neighbourhood quality are examined in this study. The locational factors represent the urban structure based on the built and natural environment elements. The travel time to work, schools and shopping areas are examined with the intention of measuring the transportation infrastructure. The earthquake risk percentage measurement has been taken into account and was derived from predictions by the JICA (Japanese Agency for International Cooperation) (JICA, 2002).

The dependent variable is based on the data collected from the real estate agencies, as explained in the data section in chapter 4. The following hedonic price function is employed to estimate the factors affecting housing prices:

$$P = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

where: P is the vector of logarithm of transaction prices; X_1 is the vector of variables for property characteristics; X_2 is the vector of variables for socio-economic characteristics; X_3 is the vector of variables for neighbourhood quality characteristics, and X_4 is the vector of variables for locational factors. β_i ($i = 1, 2, 3, 4$) is the vector of coefficients and ε is the error term. A log-linear functional form was employed because of the econometric problem arising from the occurrence of heteroscedacity in regression. Because the data from 348 neighbourhoods with different characteristics are combined in the analysis, the errors are heteroscedastic. In order to reduce the error variance, a log-linear functional form was selected to improve the efficiency of parameter estimation (Rephann, 1998).

5.4. Methodology of Hedonic Model with a Dummy that Represents Submarkets

Hedonic price function arises from the heterogeneity of the housing market system. The heterogeneous structure of the market consists of the variation in housing prices within a specific location and housing quality, providing the homebuyer with a variety of dwelling choices (Tu, 2003). The differences in housing prices arise from the supply and demand side of the market, and this diversity causes segments.

In market-wide hedonic models, it is not possible to capture the effect of the different submarkets on housing prices, but this can be overcome by the introduction of dummy variables that represent the submarkets which are employed in the hedonic models. The hedonic price function is a tool that displays how each of the attributes of a dwelling affects its sales price. A market-wide hedonic function can give information on the significance of the direction and coefficient of the effect of the value factors as well as the accuracy and explanatory power within the total sample of observations. However, a disadvantage of market-wide hedonic functions is that they can not detect spatial factors or the effects of segments (Kauko, 2002).

The purpose of employing submarket dummy variables in hedonic models is to capture spatial effects. Submarket dummy variables are employed in hedonic price models to test if adding membership contributes to the estimation of housing price, and secondly to see if submarkets are significantly different from each other (Bates, 2006). The use of submarket dummy variables in the model helps to relieve these two issues. Studies by Bourassa (1999), Bates (2006), Alkay (2008) show that the addition of submarket dummies into hedonic functions can substantially improve the fit of the model, as shown by the increase in explanatory power, R^2.

In conclusion, the following hedonic price function is employed in this study in order to estimate the factors affecting housing prices:

$$P= \beta_0 + \beta_1 X_1+ \beta_2 X_2+\beta_3 X_3+ \beta_4 X_4+ \beta_5 X_5 +\varepsilon$$

where: P is the vector of logarithm of transaction prices; X_1 is the vector of variables for property characteristics; X_2 is the vector of variables for socio-economic characteristics; X_3 is the vector of variables for neighbourhood quality characteristics, X_4 is the vector of variables for locational factors and X_5 is the vector of variables for submarket . β_i (i = 1, 2, 3, 4, 5) is the vector of coefficients and ε is the error term. Like the market-wide model, a log-linear functional form was employed because of the econometric problem arising from the heteroscedacity problem. The submarket dummy variables in the hedonic models are determined according to a priori, experts' and cluster analysis identification. The model results are displayed in Table 5.5.

5.5. Results of Market-wide Hedonic Model

The first step in the testing procedure, as outlined in chapter 4, requires the estimation of a hedonic model for the entire city-wide housing market. The model presented in Table 5.1 is similar in performance to those reported elsewhere in the hedonic modelling literature. Housing prices are explained by a range of housing unit, socio-economic, neighbourhood and locational variables. In the hedonic functions, most variables are entered in the form of dummies which show the existence or absence characteristics. For example, the variable Garden uses a value of 1 to indicate the existence of a garden, and 0 to indicate that the housing unit does not have a garden. Furthermore, some of the variables are entered in the likert scale. For instance, satisfaction from schools uses a range of values from 1 which indicates very poor to 7 which indicates excellent. The rest of the variables are entered as their actual values. See App A for a full list of variables and variable definitions.

A logarithmic functional form is employed in this study due to the heteroscedacity problem that was explained in the previous section. Interpretation of hedonic models utilizes regression parameters, namely the coefficient of multiple determinations which give the level of statistical explanation (R^2) (Adair et al, 1996). For this study, the R^2 term is the fundamental parameter that provides information about explanatory power, whereas the rest of the coefficients of the variables provide the degree of impact on housing prices.

The results of the market-wide hedonic price model are presented in Table 5.1. The overall R^2 is 0.608 which is good compared to the others reported in the literature (Malpezzi, 2003; Rothenberg et al, 1991). After deleting observations with missing values reduces the sample size was 1,517. The following discussion is primarily on the explanation of the significant variables. This follows the practice employed widely in the literature (see Goodman and Thibodeau 1998, Watkins 1998, Fletcher 2000, Bourassa 2007).

In terms of the property characteristics, the living area in a housing unit has the largest impact on housing price. A 1% increase in the living area of the housing unit will change the logarithm of the housing price by 0.0000645. The second most important variable among the property characteristics is being located in a site, and this variable has been crucial since the 1999 Marmara Earthquake. High- income level households have moved toward the peripheral areas of Istanbul, because these areas have less risk of earthquake damage due to a solid ground formation. This tendency caused the formation of gated communities with their own security, social and recreational facilities and these movements of the high- income group have been followed by the middle income group. Filtering has been assumed as shifts of households across dwelling qualities and changes in dwelling qualities (Rothenberg et al, 1991). The middle income household group has preferred to live in sites that are similar to the gated communities where there is a high quality of life perceived.

Table 5.1 The results of the market-wide model

Variables	Coefficients	t
(Constant)		1.688
Property characteristics		
Living area	1.150	38.207*
Age	0.054	5.130*
Low storey	0.025	2.209*
Site	0.086	5.399*
Garden	-0.015	-1.150
Socio-economic characteristics		
Living period in Istanbul	0.302	5.712*
Average income	0.170	5.797*
House hold size	-0.062	-0.841
Neighbourhood quality characteristics		
Neighbour satisfaction	0.159	1.977
School satisfaction	0.032	-0.848
Locational characteristics		
Travel time to job, schools	0.004	0.155
Earthquake risk	-0.122	-6.364*
Continent	0.003	0.209
Dependent variable: Housing price		
R^2		0.608
Adjusted R^2		0.605
F		179.396
Sample size		1517

* denotes that coefficient estimates are significant at 1 percent level

The tendency to live in gated communities or sites is not only because of the high quality of life and the existence of social and recreational facilities, but also because of the lower earthquake risk. Before the 1999 Marmara Earthquake, the regulatory system did not include rules regarding the high load bearing capacity for the construction of new buildings. This new regulation system and the changing preferences of home purchasers drove the supply side to construct structurally higher load-bearing capacity buildings on more solid ground formations. A 1% increase in the earthquake risk percentage in a neighbourhood will have a significant impact on house prices. Since the Marmara Earthquake in 1999, inhabitants also prefer to live in low storey buildings as it is perceived that these will be damaged less by a future earthquake. As a result of this, most of the gated communities have detached houses.

In comparison to most studies on housing prices, age of the housing unit has an unusual effect. A 1% increase in age will increase housing price. Similar results for Istanbul were found by Ozus et al (2007), and Onder et al (2004). It is argued that as the average age of housing units in a neighbourhood increases, it is expected that there will be more social and recreational facilities and public investments in things such as schools. This result is also related to the variable "Living Period in Istanbul (the length of time the inhabitants have lived in the city)" in the socio-economic characteristics group, because as the length of time the inhabitants have lived in Istanbul increases, so does the housing value. Not only public facilities, but also class concerns of the home buyers' causes such a change. The original inhabitants of Istanbul seek to avoid the ghetto areas where new migrants locate. As income increases, the housing values rise, too.

Interestingly, despite the insights of access-space theory, the travel time to work does not affect values significantly for the case of Istanbul. The reason for this unexpected result may be due to the poly-centric structure of Istanbul. This finding is similar to others where there has been a rise in the spatial pull of several of the sub-centres in Los Angeles County (Richardson et al, 1990), which has a poly-centric urban pattern like Istanbul.

5.6. Results of Hedonic Model with a Dummy that Represents Submarkets

In this section, hedonic models with a priori submarket dummy variable, experts' submarket variable and cluster analysis submarket dummy variable are displayed. The results of the hedonic models using OLS with submarket variables are reported in Table 5.2, Table 5.3 and 5.4.

5.6.1.Hedonic models with A priori Submarket dummy variables

The submarkets added in this model are determined according to a priori assumptions. Table 5.2 contains an example of hedonic regression results using OLS with a priori submarket dummy variables. The variables such as living area, age of the building, being located in a site, the length of time the inhabitants have lived, the average income of the households and the earthquake risk of the neighbourhood show that they have the same impact on housing prices as they did in the market-wide hedonic model. In addition to these variables, neighbour satisfaction and being located in Europe can also affect housing prices.

Table 5.2 Hedonic models with A priori Submarket dummy variables

Variables	Coefficients	t
Constant		2.575
Property characteristics		
Living area	1.054	36.552*
Age	0.020	2.030*
Low storey	-0.011	-1.091
Site	0.086	5.892*
Garden	0.009	0.694
Socio-economic characteristics		
Living period in Istanbul	0.127	2.548*
Average income	0.067	2.327*
House hold size	-0.068	-0.992
Neighbourhood quality characteristics		
Neighbour satisfaction	0.154	2.104*
School satisfaction	-0.043	-1.242
Locational characteristics		
Travel time to job, schools	0.007	0.317
Earthquake risk	-0.040	-2.188*
Continent	0.039	-3.388*
A priori Submarket identifications		
1st Submarket	0.102	6.769*
3rd Submarket	0.050	2.742*
4th Submarket	-0.155	-10.908*
5th Submarket	-0.138	-6.438*
Dependent variable: Housing price		
R^2		0.678
Adjusted R^2		0.674
F		219.51
Sample size		1515

* denotes that coefficient estimates are significant at 1 percent level

The R^2 statistics increase from 0.608 (see Table 5.1) to 0.678 (Table 5.2) when four submarkets are added to the model. As a general guide steps were taken to ensure that cross correlation benchmark was 0.4 (see Mark and Goldberg, 1984). Therefore the second submarket is excluded from the model. The issue with dummy variables is colinearity rather than multi-colinearity. One of the submarkets should always be excluded and then the coefficients on remaining submarket dummies interpreted relative to the submarket that has been excluded. The positive coefficient on submarket 1 and 3 indicates that these submarkets are more expensive than the excluded submarket. The negative coefficients on submarket 4 and 5 indicate that these submarkets are less expensive than the excluded submarket.

The existence of submarkets has a very strong impact on the housing prices. Out of four submarkets, two of them are positively related to sales price. Among the significant variables, the living area variable has the strongest impact on housing prices. This is also seen in market-wide hedonic models. A 1% increase in the living area of the housing unit will change the logarithm of the housing price by 0.004554. In addition to these variables, the living period in Istanbul (the length of time the inhabitants have lived in the city), being located in a site, and the average income are significant variables in the model. In addition to these variables, neighbour satisfaction increases housing prices. Increased neighbour satisfaction causes an increase in the housing prices, and this is because the neighbourhood is strongly related to the customs and life style of Turkish culture. Inhabitants tend to have strong relations with their neighbours and, as surveyors pointed out:

A proverb says "ask about your neighbours then buy the house". Home buyers want to live with the people who have same profile. The economic profile can be predicted by the price that anyone pays for the house to buy. However, it is not that easy to predict the social or educational profile of the people. Therefore, inhabitants sometimes have problems with their neighbours, since they have different tastes and life styles [A2]. Especially high- income people with higher education degrees prefer to live together. They sometimes gather to buy land and construct their homes in order to live together and have their own house designs [A1].

Previous studies also have showed that individuals prefer to live near others like themselves, and decisions about whether or not to move and where to locate are influenced by a perception of the behaviour and characteristics of the current and potential neighbours (Ioannides, 2002).

In addition to all these variables, being located in Europe is another significant variable. Since the historical urban development started on the European side of Istanbul, there are more public, private investments and office areas, universities in this part of the city. Therefore, to be located in the European part of the city has a significant impact on housing prices.

In this section, the results of the model with a priori submarket dummy variables have been displayed. It can be stated that the existence of the submarkets in the models improves the explanation of the market-wide model.

5.6.2.Hedonic models with Experts' Submarket dummy variables

Table 5.3 contains an example of hedonic regression results using OLS with expert submarket dummy variables. The logarithms of living area, being located in a site, the length of time the inhabitants have lived and the average income of the households are positively related to the logarithm of sale price.

Table 5.3 Hedonic models with Experts' Submarket dummy variables

Variables	Coefficients	t
Constant		2.600
Property characteristics		
Living area	1.0279	41.68*
Age	-0.013	-1.47
Low storey	0.016	1.77
Garden	-0.002	-0.18
Site	0.064	5.11*
Socio-economic characteristics		
Living period in Istanbul	0.191	5.77*
Average income	0.060	2.42*
Neighbourhood quality characteristics		
School satisfaction	-0.057	-1.99
Neighbour satisfaction	0.035	0.51
Locational characteristics		
Continent	-0.0087	-0.90
Experts' Submarket identification		
1st Submarket	0.109	7.39*
3rd Submarket	-0.123	-9.41*
4th Submarket	-0.213	-15.37*
5th Submarket	-0.197	-7.45*
Dependent variable: Housing price		

R^2	0.682
Adjusted R^2	0.679
F	272.02
Sample size	1793

* denotes that coefficient estimates are significant at 1 percent level

The R^2 statistics increases from 0.608 to 0.682 when four submarkets are added to the model. The second submarket is excluded from the model due to the collinearity problem. The positive coefficient on submarket 1 indicates that this submarket is more expensive than the excluded submarket. The negative coefficients on submarket 3,4 and 5 indicate that these submarkets are less expensive than the excluded submarket. The existence of submarkets has a very strong impact on the housing prices. Out of four submarkets, one of them is positively related to sale price. The third, forth and fifth submarkets are negatively related to the housing prices. Apart from the second submarket, household size, travel time to work and schools, and earthquake risk are excluded from the model due to the multi-collinearity problem. Among the significant variables, the living area has the strongest impact on housing prices as it was seen in the market-wide hedonic models. A 1% increase in the living area of the housing unit will change the logarithm of the housing price by 0.004441. In addition to these variables, the living period in Istanbul (the length of time the inhabitants have lived in the city) and average income are the significant variables in the model. A 1% increase in the length of time the inhabitants have lived there will change the logarithm of the housing price by 0.00082. Furthermore, a 1% increase in the average income of the household will change the logarithm of the housing price by 0.00025.

It is usual practice for a 5% cut-off to be adopted in regression analysis. In this study 1% cut off is used as a benchmark. In most of the cases 5% level would not make a difference. However in the interesting case of school satisfaction would make a difference. Although not significant at 1% cut-off level, the school variable has a counterintuitive result at 5% cut-off level because of the local reasons. Unlike UK or USA, especially public schools do not influence the decision of homebuyers in Turkey. Usually high and upper middle income class tend to choose private schools for their children although they have to commute long distances. Most of the private schools are located on the suburb of the city in order to provide facilities. Therefore the quality of schools does not have a significant effect on housing prices in Turkey.

This section displayed the results of the model with submarket dummy variables, as identified by experts. From this analysis, it can be stated that the existence of the submarkets in the models improves the explanatory power of the market-wide model.

5.6.3.Hedonic models with Cluster Analysis Submarket dummy variables

Table 5.4 contains an example of hedonic regression results using OLS with submarket dummy variables that are determined according to cluster analysis. The logarithms of living area, age of the building, being located in a site, the length of time the inhabitants have lived, and the average income of the households are positively related to the logarithm of sale price. On the other hand, earthquake risk is negatively related to the logarithm of sale price.

Table 5.4 Hedonic models with Cluster Analysis Submarket dummy variables

Variables	Coefficients	t
(Constant)	1.379	
Property characteristics		
Living area	1.110	37.479*
Age	0.033	3.204*
Low storey	0.009	0.785
Site	0.074	4.652*
Garden	-0.017	-1.342
Socio-economic characteristics		
Living period in Istanbul	0.239	4.515*
Average income	0.290	8.104*
Neighbourhood quality characteristics		
Neighbour satisfaction	0.088	1.049
School satisfaction	0.159	3.587*
Locational characteristics		
Travel time to job, schools	0.046	1.773
Earthquake risk	-0.099	-4.626*
Continent	-0.007	-0.589
Cluster Analysis Submarket identifications		
2nd Submarket	-0.026	-0.257
3rd Submarket	0.034	1.380
4th Submarket	0.553	6.432*
5th Submarket	0.066	2.004*
6th Submarket	0.020	1.253
7th Submarket	0.222	8.682*
8th Submarket	-0.116	-2.377*
9th Submarket	0.002	0.066
11th Submarket	0.147	1.281
12th Submarket	0.251	1.803

Dependent variable: Housing price

R^2	0.641
Adjusted R^2	0.636
F	120.769
Sample size	1509

* denotes that coefficient estimates are significant at 1 percent level

The R^2 statistics increases from 0.608 to 0.641 when ten submarkets are added to the model. The first and the tenth submarkets are excluded from the model due to the collinearity problem. The positive coefficient on submarket 3,4,5,6,7,9,11,12 indicates that these submarkets are more expensive than the excluded submarket. The negative coefficient on submarket 8 indicates that this submarkets are less expensive than the excluded submarkets. Out of ten submarkets, three submarkets are significant and have very strong impacts on the housing prices. In addition to the exclusion of the first and the tenth submarket due to the multi-collinearity problem, the household size is also excluded from the model to avoid the same problem. Among the significant variables, the living area variable has the strongest impact on housing prices as it was in market-wide hedonic models. A 1% increase in the logarithm of living area of the housing unit will change the logarithm of the housing price by 0.004791. In addition to these variables, the living period in Istanbul (the length of time the inhabitants have lived in the city) and average income are the significant variables in the model. A 1% increase in the length of time that the inhabitants have lived in Istanbul will change the logarithm of the housing price by 0.00103. Furthermore, a 1% increase in the average income of the household will change the logarithm of the housing price by 0.00125. Being located in a site is positively related with the housing prices since these sites provide many facilities and security. Earthquake risk is negatively related with housing prices because a 1% increase in the logarithm of earthquake risk of the neighbourhood will change the logarithm of housing price by -0.00042.

According to the model, school satisfaction has a significant variable and is positively related with housing prices. In developed countries, good public schools have significant effects on housing prices (Goodman and Thibodeau, 1998). However, in a developing country like Turkey, public schools do not affect the housing prices. On the other hand, private schools have positive impacts on the housing prices and sales. As a surveyor stated:

"In Omerli Kasaba (a gated community that is located in Umraniye, at the north part of Istanbul), The Australia College was established in the site. Since it is one of the best high schools in Istanbul, Australia College affected the sales of the houses. This is because parents prefer for their children to spend less time in traffic and have a good education [A5]."

This section displayed the result of the model with submarket dummy variables, which are determined by cluster analysis. It can be stated that the existence of the submarkets in the models improves the explanation of the market-wide model.

5.7. Conclusions

The aim of this chapter was to investigate the market-wide hedonic model and the contributions of submarket dummy variables toward the improvement of the housing price models.

Table 5.5 Hedonic Models without and with submarket variables

Variables	Market-wide	A priori	Expert	Cluster
Constant	1.688	2.575	2.655	1.379
Living area	1.150*	1.054*	1.0279*	1.110*
Age	0.054*	0.020*	-0.013	0.033*
Low storey	0.025*	-0.011	0.016	0.009
Site	0.086*	0.086*	0.064*	0.074*
Garden	-0.015	0.009	-0.002	-0.017
Living period in Istanbul	0.302*	0.127*	0.191*	0.239*
Average income	0.170*	0.067*	0.060*	0.290*
House hold size	-0.062	-0.068		
Neighbour satisfaction	0.159	0.154*	0.035	0.088
School satisfaction	0.032	-0.043	-0.057	0.159
Travel time to job, schools	0.004	0.007		0.046
Earthquake risk	-0.122*	-0.040*		-0.099*
Continent	0.003	0.039*	-0.0087	-0.007
Submarkets				
		[A1] 0.102*	[E1] 0.109*	[C1]
		[A2]	[E2]	[C2] -0.026
		[A3] 0.050*	[E3] -0.123*	[C3] 0.034
		[A4] -0.155*	[E4] -0.213*	[C4] 0.553*
		[A5] -0.138*	[E5] -0.197*	[C5] 0.066
				[C6] 0.020
				[C7] 0.222*
				[C8] -0.116*
				[C9] 0.002
				[C10]
				[C11] 0.147
				[C12] 0.251
R^2	0.608	0.678	0.682	0.641

It was found that by adding submarkets to the models, the existence of submarkets is a significant step toward a deeper understanding of differences in housing price. In addition to this, it was also found that the existence of submarkets improves the fit of the models, as shown by the increase in R^2.

As it can be seen from Table 5.5, for the market-wide model, R^2 is 0.608. When the submarkets, which are determined by a priori assumptions, are added, the explanatory power R^2 increases to 0.678. The R^2 increases even further to 0.682 when the submarkets that are identified by experts are included in the hedonic models. The R^2 increases from 0.608 to 0.641 when the submarkets that are delineated according to cluster analysis are added to the models. Empirically, experts' identification is better able to explain the spatial distribution of housing prices than other a priori and cluster analysis geographic specification (Table 5.5).

CHAPTER 6 SEGMENTED HEDONIC MODELS

6.1. Introduction

The previous chapter captured segmentation by including a series of dummy variables with a hedonic framework. The weakness of this approach is that it does not allow attribute values (e.g. the implicit price of a garden) to vary with locational context. This seems inappropriate given that some attributes such as car park will be important in some context, such as city centre, but not in others. This chapter introduces an approach that seeks to address this limitation. In this section we explore the use of submarket-specific hedonic equation.

This chapter involves three further sections. The next section summarizes the nature of housing market segmentation and submarket. Section two gives information about the methodology of hedonic models for separate submarkets. Section three summarizes the results of the hedonic models and finally concluding key findings are displayed.

6.2. Methods for Developing Hedonic Models for Separate Submarket

Hedonic price models can provide an insight on the house sale price structure with a set of different attributes, including housing-unit and socio-economic characteristics (see chapter 2). Another way to analyse the housing market segmentation is to investigate each of the separate submarkets that are identified either by using real estate agents or researchers, or by employing statistical methods such as cluster analysis. The division of the data into different segments enables the examination of the differences among submarkets, therefore making it possible to determine which characteristics are significant in each of the segments. For example, the five submarkets which are determined by real estate agents do show different characteristics. In order to display the diversity among submarkets, separate hedonic equations are introduced for each of submarket.

In order to divide the data into homogeneous segments, an analysis of the housing market structure is required. However, a homogeneous segment which represents a submarket is a potential source of erroneous results in a hedonic model. Because of the fact that there is an inverse relationship between the sample size and standard errors, the hedonic prices are estimated less accurately if a market is segmented into submarkets. In addition to this, when a market is segmented into homogeneous submarkets, some variables will be excluded from the function because of the multi-collinearity problem. It is a well known fact that too much homogeneity may not be a good thing in practice (Bourassa, 2003). However, homogeneity should be provided within a submarket but also heterogeneity should be provided among submarkets. These two goals may, in fact, create a dilemma because some of the variables used in the model may drop out of the function due to multi-collinearity. Even with fewer variables, it is functional to be able to find out the different characteristics for each of submarkets. In this study, five a-priori submarkets, five submarkets that are delineated by real estate agencies, and two submarkets determined by cluster analysis are analysed separately in order to find out how submarkets differ (See Chapter 4 for details).

6.3. Results of Hedonic Model for Separate Submarket

6.3.1. Hedonic Models for A Priori Submarkets

In Table 6.1, column 1 shows an example of hedonic regression result using for the a-priori submarket 1. The variables which are taken into consideration explain 0.58 of the house price variation in a-priori submarket 1 [A1]. The variables such as being located at a low-storey, satisfaction from neighbourhood quality, schools, playgrounds, public transportation facilities, health services and cultural facilities are excluded from the model due to the multi-collinearity problem.

The living area and the age of the building are positively related to the sale price of housing units. A 1% increase in the living area of the housing unit will change the logarithm of the housing price by 0.00519. The second most important variable is age which is positively related with the housing prices. As it was shown in the market-wide model in chapter 5, the age of the housing unit has an unusual sign. A 1% increase in age of the building will change the logarithm of the housing price by 0.00033.

Table 6.1 Comparison of Submarket Hedonic Models

Variables	[A1]	[A2]	[A3]	[A4]	[A5]	[E1]	[E2]	[E3]	[E4]	[E5]	[C1]	[C7]
Constant	2.266	2.099	2.457	2.623	3.222	3.47	2.854	1.830	2.467	1.782	0.825	4.842
	1.202*	1.074*	1.107*	0.917*	0.925*	1.164*	1.162*	1.052*	0.911*	1.36*	1.153*	1.236*
Living area	(19.88)	(17.82)	(13.66)	(21.19)	(8.92)	(15.73)	(26.43)	(16.8)	(20.14)	(15.3)	(24.93)	(11.6)
	0.078*	-0.008			-0.025		-0.034*					-0.29
Age	(2.99)	(0.51)			(-0.77)		(-2.24)					(-0.53)
		0.04*	-0.03	0.019	-0.026			0.020			0.002	
Low storey		(2.13)	(-1.10)	(1.21)	(-0.72)			(0.96)			(0.113)	
	0.055	0.087*	0.045			0.05	0.034*					0.013
Elevator	(1.99)	(4.19)	(1.53)			(0.14)	(2.01)					(0.20)
	0.038	0.117*	0.538*	0.070*	0.146*				0.084*	0.31	0.004	-0.057
Site	(1.16)	(4.07)	(4.13)	(3.47)	(3.70)	-0.049			(4.37)	(3.92)	(0.167)	(-0.84)
	-0.065	0.047	0.034	-0.005	0.073		0.008	-0.006	-0.030		-0.019	0.04
Balcony	(-1.40)	(1.79)	(0.93)	(0.13)	(1.37)	-0.001	(0.32)	(-0.14)	(-1.14)		(-0.59)	(0.39)
	-0.022	0.002	-0.019	0.077*	0.06	0.017	-0.018	0.038	0.046*			0.022
Garden	(-0.55)	(0.13)	(-0.65)	(3.72)	(1.62)	(0.36)	(-1.04)	(1.74)	(2.23)		0.002	(0.21)
Living period in	0.175	0.272*	0.060	0.028	-0.056	-0.058	-0.083		0.160*	0.54		-0.41
Istanbul	(1.43)	(3.56)	(0.59)	(0.43)	(-0.36)	(-0.26)	(-1.14)		(2.98)	(2.42)		(-1.93)
	0.100	-0.007	0.121	0.061		-0.079	0.054	0.131	0.203*	-0.163	0.508*	-0.323
Average income	(1.61)	(-0.16)	(1.20)	(1.48)		(-0.87)	(1.52)	(1.21)	(6.03)	(-0.75)	(9.675)	(-1.54)
	0.021			0.527*					-0.068		0.429*	
Neighbour satisfaction	(0.10)			(4.20)					(-0.79)		(3.12)	

Variables	[A1]	[A2]	[A3]	[A4]	[A5]	[E1]	[E2]	[E3]	[E4]	[E5]	[C1]	[C7]
School satisfaction								0.285* (3.90)			-0.167 (-1.42)	
Playground satisfaction												
Transportation satisfaction		0.293* (2.61)					-0.089 (-0.97)					
Health Service satisfaction												
Security satisfaction	-0.112 (-1.42)											
Travel time to job, schools	-0.016 (-0.31)	0.166* (3.18)	-0.03 (-0.42)		-0.103 (-1.51)	-0.17* (-2.8)	0.160* (4.69)	0.110 (1.95)	-0.101* (-2.55)		0.180* (5.053)	-0.37* (-2.87)
Earthquake risk	-0.087 (-1.99)	-0.121* (-3.64)	0.001 (0.01)	0.004 (0.08)	-0.076 (-0.52)	-0.088 (-1.55)	0.047 (1.47)	0.015 (0.43)	-0.073* (-2.50)		-0.089 (-2.76)	
Continent	-0.001 (-0.03)			-0.083* (-4.83)			-0.006 (-0.29)					
R^2	0.577	0.602	0.627	0.632	0.63	0.61	0.615	0.548	0.671	0.38	0.557	0.69
Adjusted R^2	0.561	0.591	0.605	0.622	0.60	0.593	0.607	0.534	0.662	0.30	0.550	0.66
F statistics	35.777	52.435	28.418	63.851	21.183	33.59	74.645	41.238	69.902	4.665	75.587	20.769
N	354	428	179	409	121	202	573	316	351	60	672	90

Hedonic Model for A Priori Submarket 2 [A2]

Column 2 shows an example of the results from hedonic regression for the a-priori submarket 2. The variables which are taken into consideration explain 0.60 of the house price variation in a-priori submarket 2 [A2]. The variables that are excluded from the model due to the multi-collinearity problem are the satisfaction from neighbourhood quality, neighbours, schools, playgrounds, health services, cultural facilities, security and continent where the housing unit locates.

The living area housing unit, being located in the low-storey building, existence of elevator, being located in a site, living period in Istanbul, satisfaction from transportation, travel time to jobs and schools are positively related to the housing prices. The earthquake risk is negatively related to the sale of housing unit.

A 1% increase in the living area of the housing unit will change the logarithm of the housing price by 0.0046. On the other hand, the coefficient for travel time to work is positive and statistically significant like in the researches such as Cho et al (2005) and Espey et al (2007) because they found that an increase in travel time to work increases housing demand in peripheral areas in the city. Similarly, in this study, an increase in travel time to work increases housing prices in second submarket [A2] which is located at the second core of the city. This surprising result can be explained by the fact that different users have different preferences in location preference. In addition to the life style, preferences, the traffic congestion and transportation system may cause this unusual effect for travel time on housing prices.

Kadir Topbas, the mayor of the Greater Istanbul Municipality, pointed out that: "The most crucial problem of Istanbul is the traffic congestion. Only 5.5% of the transportation system consists of railways. On the other hand highway transportation covers 92% of the total transportation system that mostly consists of private cars" (Dundar, 2007).

Furthermore, the lack of the integration of sea-railway transportation system and poor conditions in the quality of public transportation cause this major problem of Istanbul. Approximately 420,000 vehicles cross the Bosporus each day from two existing bridges (Gercek, 2009). People prefer to use their own cars even to travel from one continent to other. According to the Master Plan, the envisaged the number of working people is estimated to be about 6 million in 2010, of which 68% will be working on the European side (Gercek et al, 2004). The traffic congestion mainly depends on the fact that people have to travel from the Asian to the European side for their jobs and/or studies.

The effect of travel time to work is not only related to the traffic congestion but also to the life style of the inhabitants. In another study, it was stated that middle-income households have a higher percentage, preferring the periphery than lower-income households, possibly because they can afford higher travel costs. Another reason behind the locational preference is to be close to relatives, except for the young who want to be close to jobs. (Dokmeci and Berkoz, 2000).

Consequently, the reason for the unexpected sign for travel time to work may arise because of different preferences of house buyers.

As the length of time that the inhabitants have lived in Istanbul increases, so do the housing values (see also chapter 5). The inhabitants who live in Istanbul for a long time avoid the ghetto areas where new migrants locate. A 1% increase in the logarithm of length of time that the inhabitants have lived in Istanbul will change the logarithm of the housing price by 0.00112. The earthquake risk is negatively related to the sale of housing unit. A 1% increase in the risk of earthquake will change the logarithm of the housing price by -0.00051. Other significant variables in the submarket [A2] are being located in a site, the existence of elevator, and being in a low storey building.

Hedonic Model for A Priori Submarket 3 [A3]

Column 3 contains an example of the results from hedonic regression for the a-priori submarket 3. The variables which are taken into consideration explain 0.627 of the house price variation in a priori submarket 3 [A3]. Satisfaction from neighbourhood quality, neighbours, schools, playgrounds, health services, cultural facilities, security, continent where the housing unit locates, are excluded from the model due to the multi-collinearity problem.

A 1% increase in the living area of the housing unit will change the logarithm of the housing price by 0.0039. The other significant variables in the submarket 3 [A3] is being located in a site, because they provide many facilities such as green areas, playgrounds and security units.

Hedonic Model for A Priori Submarket 4 [À4]

Column 4 contains an example of hedonic regression result for the a priori submarket 4. The variables which are taken into consideration explain 0.632 of the house price variation in a priori submarket 4 [A4]. The age of the building that the housing unit locates, the existence of elevator, the satisfaction from schools, playgrounds, health services, cultural facilities, security and travel time to work and schools, are all excluded from this model due to the multi-collinearity problem.

As it was shown in the Table 6.1, it can be seen that the living area of the housing unit has the strongest impact on housing prices. A 1% increase in the living area of the housing unit will change the logarithm of the housing price by 0.0039. The rest of the variables that rank according to their importance are neighbour satisfaction, being located at Asian side of Istanbul, being located in a site, and the existence of garden.

Hedonic Model for A Priori Submarket 5 [A5]

Column 5 contains results from an example of hedonic regression for the a-priori submarket 5 [A5], and the variables which are taken into consideration explain 0.63 of the house price variation. In this model, the existence of elevator, satisfaction from neighbourhood quality, schools, playgrounds, public transportation facilities, security and cultural facilities are excluded from due to the multi-collinearity problem.

The living area and being located in a site are positively related to the sale price of housing units. A 1% increase in the living area of the housing unit changes the logarithm of the housing price by 0.0038.

6.3.2.Hedonic Models for Expert Submarkets

Hedonic Model for Expert Submarket 1 [E1]

Column 6 contains an example of hedonic regression results for the expert's submarket 1. The variables which are taken into consideration explain 0.61 of the house price variation in an expert submarket 1 [E1]. Again, several variables had to be excluded to reduce the multi-collinearity problem, and these are the age of the building that the housing unit locates, being located in a low-storey building, satisfaction from neighbourhood quality, schools, playgrounds, public transportation facilities, cultural facilities, security and the existence of health services.

The living area is positively related to the sale price of housing units whereas travel time to work in negatively related to the sale price of housing units. A 1% increase in the living area of the housing unit will increase the logarithm of the housing price by 0.00512. On the other hand, a 1% increase in travel time to work and schools will decrease the logarithm of the housing price by 0.00076.

Hedonic Model for Expert Submarket 2 [E2]

Column 7 contains an example of hedonic regression result for the expert submarket 2. The variables which are taken into consideration explain 0.615 of the house price variation in an expert submarket 2 [E2]. In this case, the variables that were excluded due to the multi-collinearity problem were being located in a low-storey building, being located in a site, existence of balcony, garden, satisfaction from neighbourhood quality, neighbours, schools, playgrounds, cultural facilities, security and health.

From this table, it can be seen that the significant factors that affect housing prices are the living area of the housing unit, travel time to work and schools, age of the building that housing unit located, and the existence of elevator. A 1% increase in the living area of the housing unit will increase the logarithm of the housing price by 0.00502. A 1% increase in the travel time to work and schools will increase the logarithm of the housing price by 0.00069. A 1% increase in the age of the housing unit will decrease the logarithm of the housing price by 0.00015.

Hedonic Model for Expert Submarket 3 [E3]

Column 8 contains an example of hedonic regression result for the expert submarket 3. The variables which are taken into consideration explain 0.548 of the house price variation in an expert's submarket 3 [E3]. Being located in a low-storey building, being located in a site, existence of balcony, garden, satisfaction from neighbourhood quality, neighbours, schools, playgrounds, cultural facilities, security and health services are excluded from the model due to the multi-collinearity problem.

A 1% increase in the living area of the housing unit will increase the logarithm of the housing price by 0.00455. Another factor which is positively related with housing price is school satisfaction. A 1% increase in the satisfaction from the schools will increase the logarithm of the housing price by 0.0012.

Hedonic Model for Expert Submarket 4 [E4]

Column 9 contains an example of hedonic regression result for the expert submarket 4. The variables which are taken into consideration explain 0.671 of the house price variation in an expert submarket 4 [E4]. In this case, the variables that were excluded to avoid the multi-collinearity problem were the age of the building that housing unit locates, being located in a low-storey building, existence of elevator, satisfaction from neighbourhood quality, schools, playgrounds, public transportation facilities, cultural facilities, security and health services.

Living area of the housing unit, average income of the households, being located in a site, the length of time that the inhabitants live in Istanbul, existence of garden are the factor that are positively related to the housing prices. The travel time to work and schools and the earthquake risk are characteristics that are negatively related with housing prices. A 1% increase in the logarithm of living area of the housing unit will increase the logarithm of the housing price by 0.00394. A 1% increase in the logarithm of average income of the household will increase the logarithm of the housing price by 0.00088. A 1% increase in the logarithm of length of time that inhabitants live in Istanbul will increase the logarithm of the housing prices by 0.00069. A 1% increase in the logarithm of travel time to work and schools will decrease the logarithm of the housing prices by 0.00044. A 1% increase in the logarithm of earthquake risk will decrease the logarithm of the housing prices by 0.00032.

Hedonic Model for Expert Submarket 5 [E5]

Column 10 presents the results from an example of hedonic regression for the expert submarket 5. The variables which are taken into consideration explain 0.38 of the house price variation in an expert submarket 5 [E5]. The variables such as living area of the housing unit, age of the building that housing unit locates, being located in a low-storey building, existence of elevator, satisfaction from neighbourhood quality, schools, playgrounds, public transportation facilities, cultural facilities, health services, security, earthquake risk, continent are excluded from the model due to the multi-collinearity problem.

The poorest fit is observed in by the [E5] model. In order to overcome the multi-collinearity problem most of the variables are excluded from the model. Unfortunately, the R^2 value is low due to the multi-collinearity problem. According to the results of this model, living area of the housing unit, being located in a site is positively related and the earthquake risk is negatively related to the housing prices. A 1% increase in the logarithm of living area of the housing unit will increase the logarithm of the housing price by 0.0058. A 1% increase in the logarithm of earthquake risk will decrease the logarithm of the housing prices by 0.0022.

6.3.3. Hedonic Models for Cluster Submarkets

Hedonic Model for Cluster Submarket 1 [C1]

Column 11 contains an example of hedonic regression result for the cluster analysis submarket 1. The variables which are taken into consideration explain 0.55 of the house price variation in cluster submarket 1 [C1]. Here, the variables that are excluded from the model due to the multi-collinearity problem are the age of the building that the housing unit locates, being located in a low-storey building, existence of elevator, length of time that inhabitants lived in Istanbul, satisfaction from neighbourhood quality, playgrounds, public transportation facilities, health services, security and continent.

As it can be seen from Table 6.1, it is evident that the factors that are positively related to the housing prices are the living area of the housing unit, the average income of the households, satisfaction from the neighbours, and travel time to work and schools. On the other hand, the earthquake risk is negatively related with the housing prices. A 1% increase in the logarithm of living area of the housing unit will increase the logarithm of the housing price by 0.00498. A 1% increase in the income of the household will increase the logarithm of the housing price by 0.00219. A 1% increase in the satisfaction from the neighbour will increase the logarithm of the housing price by 0.0019. A 1% increase travel time to work and schools will increase the logarithm of the housing price by 0.00078. A 1% increase earthquake risk will decrease the logarithm of the housing price by -0.00038.

Hedonic Model for Cluster Submarket 7 [C7]

Column 12 contains an example of hedonic regression result for the cluster analysis submarket 7. The variables which are taken into consideration explain 0.70 of the house price variation in a cluster submarket 7 [C7]. The variables such age of the building that housing unit locates, being located in a low-storey building, satisfaction from neighbourhood quality, schools, playgrounds, public transportation facilities, health services, security and continent are excluded from the model due to the multi-collinearity problem.

The living area of the housing unit is positively related to the housing prices. The variables that are negatively related with the housing prices are the length of time that inhabitants lived in Istanbul, and travel time to work and schools. A 1% increase in the logarithm of living area of the housing unit will increase the logarithm of the housing price by 0.00538. A 1% increase travel time to work and schools will decrease the logarithm of the housing price by 0.00078.

6.4. Conclusions

In many housing market studies it has been argued that the complex structure of the local housing system can undermine the accuracy of regression-based valuations (Watkins, 1999). This problem can be overcome by segmenting the housing market and taking the different submarkets into considerations in the models. This approach can be carried out by employing a-priori, experts' assumptions and cluster analysis to identify housing units with similar characteristics. By modelling each of the segments, it is provided to determine the factors that affect the housing prices so that the differences within the submarkets can be displayed. As shown in Table 6.1, different submarkets show different performances. Submarkets equations achieve R^2 estimates ranging from 0.69 for the [C7] model, to 0.38 for the [E5] model. Although most of the variables were excluded from the equations because of the multi-collinearity, the results provide some insight into the nature of the submarkets, in that they can provide information about which variables are key determinants of different submarkets. The significant variables differ between submarkets, however, the living area, being located in a site, travel time to work and schools, earthquake risk are the significant variables are the common determinants in the most of the submarkets. The living area and being located in a site are positively related with the housing prices whereas the earthquake risk is negatively related to the housing prices. The travel time to work and schools is positively related to housing prices in the [A2], [E2], [C1] submarkets however it is negatively related in the [E1], [E4], [C7] submarkets. Although it has not been discussed here, Appendix B contains a summary of the additional tests required to establish submarket existence. These Chow and Weighted Standard Error results suggest that the a priori model reduces the standard error by more than 20% and is superior to the expert (15%) and Cluster (less than 5%) models.

Overall, the chow test results show that there are significant differences among submarkets. The test findings show that segmented markets provide improvement in the models. According to the results of the weighted standard error test, submarket dummy variable as a proxy in the model improves the performance of the model. Unlike cluster analysis based submarkets, a priori and expert submarket stratification reduce standard error of the model more than 10%.

CHAPTER 7 MULTI-LEVEL MODEL OF HOUSING SUBMARKET

7.1. Introduction

The analysis so far has examined various methods for evaluating housing price differences and produced models of house prices at the different spatial levels in Istanbul. The first hedonic model estimates house prices within Istanbul, but largely ignores neighbourhood differences. The second model includes neighbourhood dummy variables as a proxy for segments within the model, whereas the third model consists of separate equations for each of the segments. Those methods suggest that using spatial attributes in hedonic models will reduce standard error. The focus of the research now shifts to analyzing a multi-level model which includes segments and their interactions with each other and other spatial influences.

In the first three stages of the study, hedonic models were employed and OLS technique was used as the method. The traditional hedonic model assumes that effects of structural attributes on housing prices are fixed across the housing market, and therefore each property will have the same marginal implicit prices. Beyond this, there is no interaction or relationships between the structure of a house and it's location within a city, which contradicts with urban economic theory (Orford, 1999). Although hedonic model is a useful tool for understanding housing markets, technical constraints such as spatial auto-correlation, spatial heterogeneity, ecological fallacy and atomic fallacy make it difficult to get accurate results. For example, in a hedonic price function, it is assumed that the observations are chosen randomly. The OLS estimator can be biased in housing price studies due to the similarity between characteristics in the submarkets (Malpezzi, 2003). The reason for this bias is due to the homogenous structure of the submarkets, where housing and neighbourhood characteristics tend to have similar features. It might be expected that housing units in one submarket will be similar to each other when compared to housing units in another submarket. On the one hand this is a desirable requirement for an accurate way to define submarkets, but on the other hand it causes some technical limitations, for instance spatial auto-correlation.

To overcome these technical problems of hedonic models, a multi-level modelling approach may provide solutions. In addition to its superiority, multi-level models are also more statistically efficient than adding dummy variables to the regression models (Leishman, 2009). Moreover, multi-level models can provide a better understanding of the effects of both individuals and the context. In the last few years, social science researchers have concerned themselves with tracing the connections between individuals and contextual settings. Therefore, this approach provides a way to find out how and for which types of individuals contextual effects matters (Duncan et al, 1998). Both the individuals and the contexts can be captured within the same model by using a multi-level approach.

With these general considerations as a corollary framework, it can be noted that multi-level modelling may be an alternative method to examine housing price differences. Therefore, the purpose of this chapter is to lay out a framework of a multi-level approach and construct a multi-level model in order to display both the individual and contextual effects on housing prices. The chapter is organised into four parts. The next section explores the origins of a theoretical understanding of how a multi-level approach works and then, in the third section data structure is examined and in the forth section the model results are displayed. This provides the basis for comparative analysis of different kinds of models. The final section considers the potential significance of the multi-level modelling as an analytical tool in housing market studies.

7.2. Multi-Level Modelling Methodology

Many kinds of data used in the social sciences have a hierarchical formation. Most of the research in housing studies overlooks the hierarchical or clustered structure of the data, and this may cause failure or flaws in the results of these models. However, these kinds of drawbacks can be overcome with the help of multi-level modelling, which can analyze hierarchical data structures or variables at different levels. This method provides an analysis of the individual-level dependent variables by using combinations of individual- and group-level independent variables and also analyzes the complex data that have a hierarchical structure. Multi-level models are also known in the literature as contextual models, hierarchical linear models, hierarchical linear regression, random coefficients models, hierarchical mixed linear models, or Bayesian linear models.

Usually in social science studies, the hierarchical structure of data consists of lower and upper levels. The lower level consists of individuals or properties which are grouped in higher levels with respect to the context. Due to the fact that multi-level analysis involves individuals that are nested in a contextual level, this method often attempts to examine how the individual level (micro level) outcomes are affected by both the individual level and the group level (macro level or contextual level) variables. The contextual level can cover the geographical perspectives; such as countries, regions, towns, districts, neighbourhoods; organizational perspectives, such as classrooms, schools, doctors, hospitals; and social/economic/cultural/behavioural perspectives, such as race, religious groups, socio-economic classes, and smoking/non-smoking people.

With respect to the fact that individuals nest in contextual perspectives, this statistical method helps to specify effects of contextual subjects on individual-level outcomes. Thus, it becomes possible to display the different relationships between the dependent and independent variables within different contextual groups. These kinds of relationships are referred as contextual effects and these are the effects that a space has on individuals. On the other hand, compositional effects are the effects that the characteristics of individuals in different geographical levels have. In this context, Blalock (1984, p.354) stated that "the essential feature of all contextual-effects models is an allowance for macro processes that are presumed to have an impact on the individual actor over and above the effects of any individual-level variables that may be operating". In conclusion, this method analyzes data consistent with the contextual level and covers the deficit of models that overlook hierarchical formation.

7.2.1.The Structure of Multi-level Modelling

Multi-level modelling is developed from hierarchical approaches that can include both fixed and random effects, which can be modelled at each level of the hierarchy. Fixed effects refer to the "permanent" or "unchanging/ constant/ fixed" part of the equations, so that one estimate is derived for the whole sample, whereas random effects refer to the "allowed to vary" part so that there is potential for different results to occur within the sample (Jones and Bullen, 1993).

Multi-level modelling can be considered a modified version of hedonic price modelling since it has the same structure, consisting of fixed and random effects. In comparison to hedonic price modelling, multi-level modelling is a more sophisticated version; the use of dummy variables in a hedonic function allows that function to obtain place parameters, each of which is viewed as consisting of an average value plus a random component (Fotheringham et al, 2007). In a hedonic model, the function consists of a random part, where the equation is the error term of the function, and fixed parts, where the equation involves the relationship between the independent and the dependent variables. This can be illustrated in the figure below:

Response= intercept+ (slope*predictor)+residual

fixed effects (intercept, slope*predictor) — random effects (residual)

(Jones and Bullen, 1993)

Similary, a hedonic function can be abstracted as follows:

Independent variable= fixed effects + random effects

As it can be seen from the equations, the two constant parameters, the intercept and the slope, form the fixed part of the equation whereas the residuals form the random part.

Multi-level models are derived from the hedonic models specified only at the individual level. Hedonic price models are employed in order to find out the effects of housing unit characteristics and locational attributes on housing prices. However, the statistical constraints originated from locational effects have drawn inaccurate inferences. These limitations caused by spatial effects are trying to be overcome by multi-level models rather than hedonic models. The stages of a multi-level model construction from a hedonic model are as follows:

$$Y_i = \alpha + \Sigma\beta_i X_i + \varepsilon_i \qquad (1)$$

where the subscript i refers to an individual house, Y_i represents the price of the house i. α and β are the parameters to be estimated, ε is the error term and X_i is an attribute of the house i, at the individual level.

On the other hand, at the place or aggregate level, the model should be like:

$Y_j = \gamma + \Sigma\delta_j X_j + \varepsilon_j$ (2)

in which where Y_j price of a group of houses at the place j, γ and δ are the parameters to be estimated, ε_j represents the level of the random term at the place level.

The formulation of a simple multi-level model is pointed out by Jones and Bullen (1993) as above:

- Price of house i= typical price across region+ fixed effect for size of house i+ random term for house i. Whereas, formulation of a two level model consists of individual housing units, i, nested in area j is demonstrated as follows:
- Price of house i in area j= typical price across region +fixed effect for size of house i in area j + random term for size of house in area j + random term for area j + random term for house i

Similarly, in multi-level modelling, the individual level and aggregate level functions are combined together in order to capture both individual and contextual circumstances:

$Y_{ij} = \alpha_j + \Sigma\beta_j X_{ij} + e_{ij}$

where Y_{ij} represents the price of house i in place j, e_{ij} represents the random term related with house i in place j and α_j and β_j are place specific parameters,

$\alpha_j = \alpha + \mu_j\alpha$

and

$\beta_j = \beta_i + \mu_j\beta$

To make it clear, it can be assumed that, β_j, the average price of a detached house in place j, is a function of the market-wide average price of houses β_i plus, $\mu_j\beta$ which is a varying difference for each of the places.

Therefore, the final version of a multi-level is:

$$Y_{ij} = \alpha_j + \Sigma\beta_i X_{ij} + (e_{ij} + \mu_j\alpha + \mu_j\beta X_{ij}) \qquad (3)$$

From all of these expressions, it can be concluded that multi-level modelling is a more sophisticated form of a hedonic model, which includes spatial dummy variables proxy for segments.

In addition to being more sophisticated than hedonic modelling, multi-level modelling allows the use of both individuals and groups of individuals in the same model, which avoids flouting the assumption of independent cases, since standard error of any results can be affected by the clustered nature of the data (Gorard, 2003). Furthermore, multi-level modelling allows analyzing the within group and between group variation and to what extend these variables belong to individual or group variables.

7.2.2.Technical Advantages of Multi-level Modelling

The multi-level model approach provides significant contributions and improvements for analysing hierarchical data since it allows researchers to overcome technical limitations, such as ecological fallacy, atomic fallacy, spatial auto-correlation and spatial heterogeneity. One of the technical benefits of the multi-level approach is to conquer ecological fallacy which is a consequence of the relationship between two variables at the group level. This occurs when the average characteristics of individuals within a group are taken as a basis to make inferences. For example, if low- income neighbourhoods are found to be less satisfied with schools, it would be an ecological fallacy to make the assumption that satisfaction with schools is less in high- income neighbourhoods. Perhaps the people who are less satisfied with schools are wealthy people in these neighbourhoods. Group attributes may lead to the observation of a relationship that is coincidental. This type of incorrect inference leads to ecological fallacy, which occurs when individual behaviour is inferred from aggregated measures (Courgeau and Baccaini, 1998).

Another technical limitation that a multi-level approach defeats is atomic fallacy, also known as individualistic fallacy. This technical drawback is a consequence of associations between two variables at the individual level which may differ from the associations between similar variables measured at the group level (Roux, 2002). "Modelling spatial behaviour purely at the individual level is prone to the atomistic fallacy, missing the context" in which individual behaviour occurs (Alker, 1969), whereas modelling behaviour at the aggregate level is prone to the ecological fallacy where results might not apply to individual behaviour (Fotheringham et al, 2007, p.103). Prior to the development of a multi-level approach, researchers had two options, either risking ecological fallacy of transferring aggregate results to individuals or studying only the individual level and committing the atomistic fallacy of ignoring the context (Jones,1991). Therefore, multi-level modelling helps include both an individual model and a contextual model at the same time.

In addition to ecological and atomic fallacies, another technical benefit of a multi-level approach is spatial autocorrelation, which can be defined as the coincidence of value similarity with locational similarity (Anselin 2001). These similarities, along with the characteristics of the space, lead positive spatial auto-correlation, which is created by any systematic pattern of a variable over space. According to Basu and Thibodeau (1998), one of the two reasons for spatial-autocorrelation is the tendency of neighbourhoods to develop at the same time. Because of that fact, neighbourhood properties have similar structural characteristics, such as architectural design, age, dwelling type and size. Another cause of spatial autocorrelation is the locational attributes that inhabitants share, such as public schools, parks and public transportation. Apart from these reasons, the socio-economic structure of the inhabitants living in the same neighbourhood usually has similar characteristics, such as income, household size and education.

Another technical advantage of this method is that this approach recognizes the clustering of individuals within higher-level units, such as submarkets. In addition to this, they avoid violating the assumption of independence of observations that traditional ordinary least squares commit while analyzing hierarchical data (Garner and Raudenbush, 1991). Although spatial auto-correlation is one of the major problems in hedonic price models, it is a not a serious problem for multi-level modelling. According to Bullen (1997), hedonic price analysis can lead to significantly biased estimates of standard error due to the assumption that there is no residual autocorrelation within the submarkets. The residuals produced by hedonic price functions are usually spatially correlated and, because of these spatial effects, the coefficients of the model may be inaccurate. To ignore spatial auto-correlation and to treat the properties as independent observations may result in mis-estimated precision, inaccurate standard errors, and/or confidence limits and tests (Jones and Bullen, 1993). In order to overcome this bias and model the spatial structures, "alternative contextual specifications" were developed by expanding the fixed and random terms of traditional hedonic specification in order to realize the spatial expanded specification and multi-level specification (Orford, 1999). Thus, multi-level modelling is a solution to displaying the different geographical areas effects on individuals. Moreover, this approach can be an alternative method that examines the variation of the dependent variable at the contextual and the individual level effects.

7.2.3.Multi-level modelling in housing studies

Multi-level analysis has found extensive utility in various study areas. It has been employed in the fields of health (Romano et al, 2005; Roux and Aiello 2005; Grady S 2006, Datta et al, 2006; Boyle and Williams, 2001); education (Gorard 2003; Cohen et al 2000); and sociology, human geography (Boyle and Shen 1997; Engstrom et al, 2008; Eikemo et al 2008; Ballas and Tranmer, 2008). Although multi-level analysis originally developed in the fields of public health, education, and sociology, it has received increasing attention in housing studies, especially studies of housing prices (Jones 1991, Jones and Bullen 1993, 1994; Bullen 1997, Orford 2002, 2007; Leishman 2007; Bramley et al, 2008). For example:

In her study, Bullen (1997) employed a two-level model for the housing price in the Hampshire area. GIS was also used in order to support the findings of the multi-level model results. The property attributes at level 1 and place attributes at level 2 are examined to find out micro-level and macro-level sources of variation and construct a model to vary according to the context.

Jones and Bullen (1993) investigated the variations in domestic property prices in Southern England by taking spatial patterns into account at the macro level and by taking the attributes of individual properties into account at the micro level. They estimated three-level models and one two-level model in order to examine the potential of multi-level modelling for empirical descriptions of housing prices. This study concludes that a multi-level approach is an essential tool since the inclusion of housing attributes at the micro level has an effect on the relationships and the magnitude of effects at the macro level.

Orford (2000) aimed to model the dynamics of a local housing market in his study by using a multi-level approach. This allowed the compositional effects of the housing stock and the contextual effects of submarkets to be modelled simultaneously. Both structural and locational attributes were taken into account, both of which interacted at the appropriate geographical levels. He concluded that "by simultaneously modelling the spatial structures at all levels, the specification represents an holistic view of the housing market, one that is more comparable to conceptual than the standard single-level specification" (Orford, 2000, p.1670).

Another significant research in housing prices employing multi-level model is "hedonic methods and the housing market as a multi-level spatial system" (Leishman, 2007). The paper investigates submarket boundary stability and changes in Glasgow by using hedonic, multi-level and GIS approaches. Leishman concluded that multi-level modelling is a reliable method for capturing and modelling the changing spatial dynamics of intra-urban housing prices.

Similar to the studies mentioned above, several types of multi-level models are in use or being developed in housing studies. According to Diprete and Forristal (1994) these models can be grouped into two forms:

- A micro-level (individual level) model in which the coefficients are expressed as functions of macro-level variables.

- A macro-level (contextual level) model in which the micro-level dependent variable is expressed by both micro and macro variables. These kinds of models usually involve the interactions between the micro and macro variables.

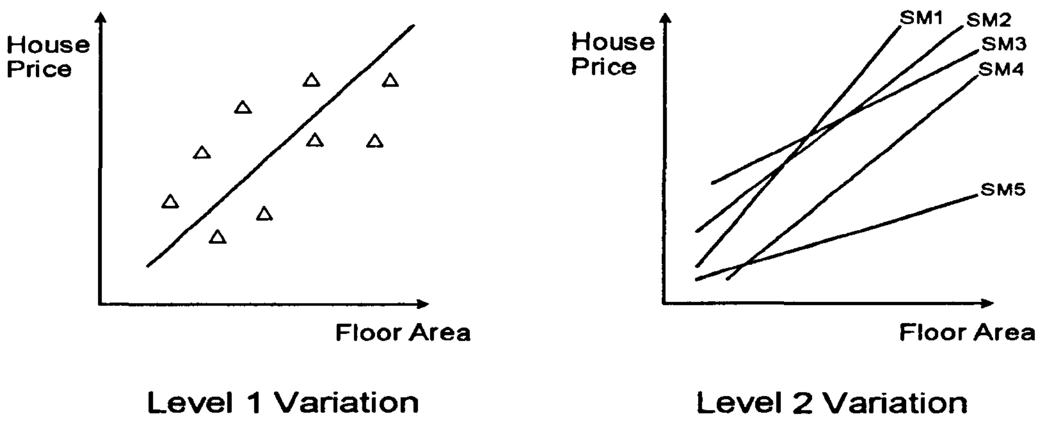

Figure 7.1 Two-level variations

As it can be seen from the figures above, multi-level models allow analyses at several levels simultaneously, rather than analysing every single level of the data individually. In this study, a two-level model is employed to investigate the individual (micro) and contextual (macro, group) level. A two-level model is employed by using housing unit at level 1, and the residential segregation submarket as contextual level variables at level 2.

These multi-level models are designed so that housing units are nested within the submarkets (neighbourhoods of varying segregation levels) in which they reside. Multi-level models are used to determine how housing unit variables differ with increasing levels of residential segregation and/or how the effect of residential segregation differs at individual (micro) levels. Moreover, multi-level analyses allow for the examination of within and between submarket variability that is explained by housing unit level.

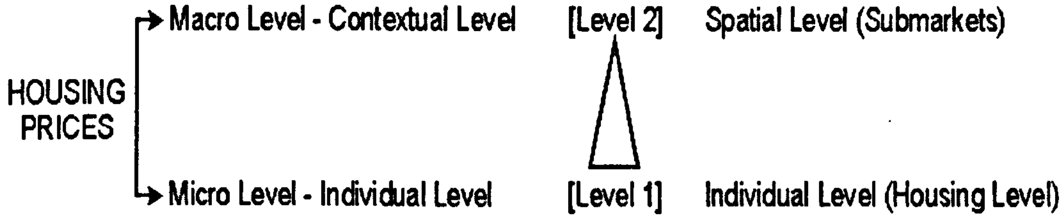

Figure 7.2 Two-level models

A key issue in investigating submarket effects on housing prices is separating the effects of submarket characteristics (context, group level) from the effects of housing unit characteristics (individual-level) that housing units located in certain types of areas may share (composition) (Figure 7.2). Because submarkets can be thought of as groups or contexts with housing units nested within them, multi-level modelling is used to investigate how spatial factors (submarket factors), individual-level factors, and their interactions influence housing prices.

A two-level model which allows grouping of houses' outcomes within submarkets includes residuals at the housing unit level and submarket level. Since submarket residuals represent overlooked submarket characteristics that affect housing unit prices, it is possible to specify residual components at each level in the hierarchy.

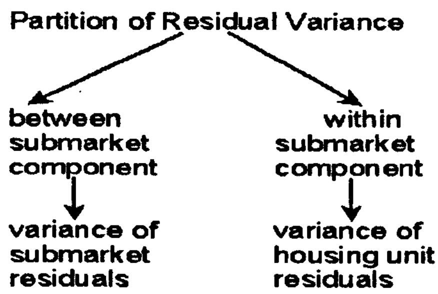

Figure 7.3 Partition of residual variance

As it can be seen from Figure 7.3, the residual variance is composed of the variance of submarket residuals which are between submarket components and the variance of housing unit residuals which are within submarket components. Consequently, multi-level models allow the individual estimation of variance between housing units within the same submarket. This can be seen in Figure 7.4.

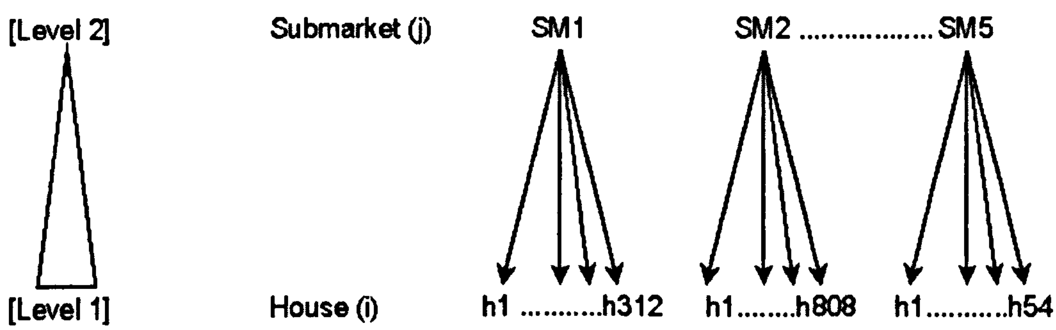

Figure 7.4 Two-level Hierarchical Data Structure

In conclusion, multi-level modelling can be a useful tool for investigating housing submarkets in order to specify the effects of physical, social, locational, economical, behavioural and institutional contexts on housing unit level outcomes. This specification is crucial because of the fact that housing prices interact with the above parameters of the spatial areas like neighbourhoods, districts, regions, and also the characteristics of those spatial areas that are in turn influenced by the housing units. In general, the housing units are conceptualised as a hierarchical system of spatial areas, such as neighbourhoods, districts, regions or submarkets. Taking the hierarchical systems into consideration enables the constructing of models that capture the interaction between variables that characterise housing units and variables that characterise groups (spatial areas).

The aim of the research presented here is to construct a two-level multi-level model that captures both the individual level and the contextual level characteristics. By using a multi-level modelling framework that examines the variation in housing prices at the different levels simultaneously, it will be possible to display the individual and contextual effects at the same time.

7.3. Data Structure

To demonstrate the potential of the multi-level approach, it is desirable that the data sets contain information on individual house prices and attributes which are structured by space (Jones and Bullen, 1993). Based on a multi-level dataset of 2,175 housing units nested within different sizes of submarkets according to the a priori, experts' and cluster analysis assumptions, the description of the variables used in this study is as follows. First, a number of individual variables which are also called compositional effects consist of housing unit characteristics. The housing unit attributes used in the multi-level model as level 1 are: age of the building, floor area of the housing unit, being located in a low-storey building and being located in a site. At the second level of the multi-level model, submarket characteristics which are also called contextual effects are used. At the submarket level, the variables are income of the household, living period in Istanbul, neighbour satisfaction and the earthquake risk. The description of the variables used in the multi-level model is displayed in Table 7.1

Table 7.1 Variables used in multi level modelling

Variable used	Description of variable
Price	The price of the housing unit in USD
HOUSING UNIT LEVEL	
Age	The age of the building
Living area	The floor area of the housing unit
Low-storey	If the storey on which housing unit is situated is lower than 5
Site	If the building is in a site with swimming pool, car park and security unit
SUBMARKET LEVEL	
Average income	The average income of inhabitants in the neighbourhoods
Living period in Istanbul	The length of time the inhabitants have lived in Istanbul(year)
Neighbour satisfaction	The satisfaction score for neighbours (1 very poor to 7 excellent)
Earthquake risk	The % of the buildings that will be highly damaged

The data set is analysed in the specialized multi-level modelling software package STATA.

The data set used in this study comprises two levels of observation. A multi-level approach can be employed to investigate whether housing prices reflect different characteristics of housing units (compositional effects) in different submarkets or whether there are property characteristics, socio-economic characteristics, behavioural characteristics, locational characteristics of places that cause differences in housing prices (contextual effects).

On the other hand, by employing multi-level modelling, it is possible to find out "How much of the variability in housing prices is attributable to submarket level factors and how much to housing unit level factors?" On the basis of these models, it is possible to estimate the proportion of the overall variation in housing prices that is attributable to submarkets, that is, the intra-class correlation (Ballas and Tranmer, 2008).

7.4. Model Results

This section presents the results of three multi-level models of housing prices. Firstly, a priori submarket identification is taken into account as the contextual level of the model. Secondly, experts' identification on submarket borders is taken as basis for the contextual level. Finally, cluster analysis' submarket identification is used as the contextual level of the model.

As can be seen in Table 7.2, the results of the variance component of submarket level due to a priori identification and housing unit level are displayed. The estimated variance of the housing price differences at the submarket level is 0.09 and the standard error term is 0.034. The estimated variance of housing prices at the housing unit level is 0.17 and the standard error term is 0.909. The estimated intra-submarket correlation (* 100) is 0.23 % and therefore the individual level which is housing unit level *(100) is 0.77 %.

Table 7.2 Variance component estimates for a priori submarket level

2 level model	Estimated Variance	Standard Error	Intra class correlation
Submarket (A priori)	0.0961	0.0346763	0.23
Housing Unit	0.1785	0.909417	0.77

In Table 7.3, multi-level random coefficient estimation according to a priori submarket identification is demonstrated. The fixed effects estimates suggest that the most important factor influencing housing prices is the floor area of the housing unit. This is followed by living period of the inhabitants in Istanbul. The third most important variable is being in a site. The other significant variables in order of importance are the income of the household, the earthquake risk of the neighbourhood and the age of the building.

The random effects estimates suggest that random coefficients for living area size of the housing unit, neighbour satisfaction, and living period of inhabitants in İstanbul are significant. Meanwhile, the random coefficient for being in a low storey building is statistically insignificant.

Table 7.3 Multi-level random coefficient estimation (submarket: a priori identification)

Variable	Coefficient	Standard Error	z statistic	
constant	2.3292	0.115	20.21	*
living area	1.0592	0.045	23.19	*
low storey	-.0.0247	0.013	-0.18	
age	0.0295	0.009	3.18	*
site	0.092	0.014	6.56	*
income	0.0722	0.024	2.94	*
neighbour satisfaction	0.1812	0.108	1.66	
living period in Istanbul	0.1743	0.063	2.74	*
earthquake risk	-0.0721	0.017	-4.07	*
sd(constant)	0.00024	0.063		
Wald chi2	669.5			
LR test	400.93			
N	1695			
Groups	5			

Note: * denotes significant at 1%

Table 7.4 shows the results of the variance component of submarket level according to experts' identification and housing unit levels are displayed. The estimated variance of the housing price differences at the submarket level is 0.12 and the standard error term is 0.045. The estimated variance of housing prices at the housing unit level is 0.17 and the standard error term is 0.971. The estimated intra-submarket correlation (*100) is 0.34% and therefore the individual level which is the housing unit level (*100) is 0.66%.

Table 7.4 Variance component estimates for experts' submarket level

2 level model	Estimated Variance	Standard Error	Intra class correlation
Submarket (experts's)	0.126	0.0454	0.34
Housing Unit	0.1746	0.9714	0.66

In the random coefficient multi-level models, the likelihood ratio tests are carried out to analyse the validity of estimating the model separately for the submarkets. Like hedonic price models, multi-level models are not estimated using ordinary least squares, but rather by using maximum restricted likelihood. A multi-level model is a combination of fixed and random effects. Fixed effects are similar to the variable coefficients of an OLS hedonic model whereas the random effects are group-specific intercepts (Leishman, 2009). The fixed effects are giving information about the market wide level and each of the submarkets has independent random effects on all of the variables. The fixed effect estimates relate to the market-wide constant and housing unit level variables, such as living area size of the housing unit, age of the building, being locating in a low storey building, being in a secured site (with swimming pool and car park) and submarket level variables such as income of the household, neighbour satisfaction, living period of inhabitants in Istanbul, and earthquake risk. The significant variables at the 5% level are living area size, living period of inhabitants in Istanbul and being in a site.

The random coefficient model shown in Table 7.5 allows spatial variation of all coefficients. The submarket borders are determined by the identification of experts. Estimates show that the most important factor influencing housing prices is the living area size of the housing unit. This is followed by the living period of the inhabitants in Istanbul. The third most important variable is being in a site. The rest of the variables, such as age of the building, being in a low storey building, income of the household, neighbour satisfaction, and earthquake risk are statistically insignificant.

Table 7.5 Multi-level random coefficient estimation (submarket: experts' identification)

Variable	Coefficient	Standard Error	z statistic	
constant	2.84	0.227	12.48	*
living area	1.03	0.036	28.62	*
low storey	0.035	0.020	1.72	
age	0.001	0.015	0.09	
site	0.068	0.019	3.55	*
income	-0.047	0.078	-0.61	
neighbour satisfaction	0.076	0.143	0.53	
living period in Istanbul	0.131	0.060	2.17	*
earthquake risk	-0.001	0.018	-0.10	*
sd(constant)	0.405	0.187		
Wald chi2	896.95			
LR test	448.77			
N	1695			
Groups	5			

Note: * denotes significant at 1%

The random effects estimates suggest that random coefficients for income of the household, being in a low storey building, and living period of inhabitants in Istanbul are significant. Meanwhile, the random coefficients for living area size of the housing unit, age of the building, being in a site, neighbour satisfaction, and earthquake risk are statistically insignificant.

Table 7.6 Variance component estimates for cluster submarket level

2 level model	Estimated Variance	Standard Error	Intra class correlation
Submarket (cluster)	0.132033	0.037396	0.34
Housing Unit	0.1820813	2.762246	0.66

Table 7.6 shows the results of the variance component of submarket level according to cluster identification and housing unit levels are displayed. The estimated variance of the housing price differences at the submarket level is 0.13 and the standard error term is 0.037. The estimated variance of housing prices at the housing unit level is 0.18 and the standard error term is 2.76. The estimated intra-submarket correlation (*100) is 0.34% and therefore the individual level which is the housing unit level (*100) is 0.66%.

The random coefficient model shown in Table 7.7 is employed according to the identification of cluster analysis. Estimates show that the most important factor influencing housing prices are, in order of importance, living area of the housing unit, income of the household, living period of inhabitants in Istanbul, earthquake risk, and being in a site.

Table 7.7 Multi-level random coefficient estimation (submarket: cluster identification)

Variable	Coefficient	Standard Error	z statistic	
constant	1.72	0.165	10.42	*
living area	1.040	0.028	36.23	*
low storey	0.046	0.023	1.98	
age	0.047	0.030	1.53	
site	0.081	0.034	2.4	*
income	0.257	0.040	6.31	*
neighbour satisfaction	0.115	0.073	1.56	
living period in Istanbul	0.273	0.048	5.66	*
earthquake risk	-0.096	0.037	-2.6	*
sd(constant)	0.128	0.058		
Wald chi2	1517.62			
LR test	319.14			
N	1540			
Groups	12			

Note: * denotes significant at 1%

The random effects estimates suggest that random coefficients for age of the building and being in a site are significant. Meanwhile, the random coefficients for income of the household, being in a low storey building, living area of the housing unit, and earthquake risk are statistically insignificant.

7.5. Conclusions

It has been argued by proponents of the method that multi-level models overcome many of the technical weaknesses exhibited by hedonic models. In this context, multi-level models' contribution to the social sciences is considerable as they can provide a better understanding of complex data. The recognition of the hierarchical structures of data leads researchers to analyse according to levels, such as individuals in level 1, clusters in level 2. For example, individuals are classified as level 1, households are classified as level 2 and neighbourhoods are classified level 3. It is possible to analyse different levels simultaneously in order to find out the importance, significance of each level either individuals or contexts. This advantage of multi-level models is crucial for researchers as it enables them to find out both individual and contextual effects on dependent variables.

Multi-level models are composed of random and fixed effects used to specify the effects of social, spatial, organizational context on individual structure, such as the effects of submarkets on housing units. Housing price research aims to investigate the relationship between the housing unit and the physical, social, economical, and behavioural characteristics. This can be achieved by analysing the model parameter with respect to the contextual aspects. Despite the advantages mentioned in this chapter, it is not possible to compare the performance of the multi-level model focus is using the same diagnostic tests employed when OLS estimator used. This is examined in the next chapter where the focus is on the accuracy of price estimators.

CHAPTER 8 CONCLUSIONS

8.1. Introduction

This study shows that different models in conceptualising the housing market have different strengths. But experts' submarket specification tend to be a better tool in explaining the spatial distribution of house prices than other means, such as a priori and cluster analysis geographic specifications. It is hoped that these results, along with future research, may lead to the conclusion that a better understanding of housing markets for policy makers, planners and developers will follow them taking housing market segmentation into account.

There is a vast literature that explores the structure and operation of urban housing systems. This literature tends to focus on the North American, Western European and South East Asian markets. There have been few studies of Turkish markets, as the relative immaturity of the housing research community, and the absence of suitable data has prohibited this sort of research. This situation has begun to change. In recent years, researchers have produced hedonic studies of the Istanbul housing system (Onder et al, 2004, Ozus et al, 2007, Alkay 2008). These papers have produced valuable insights to the determination of house prices. The analysis, however, has tended to provide only preliminary explorations of spatial market segmentation for a highly segmented city: Istanbul. This thesis seeks to build on the existing studies of the Istanbul market especially by developing models of house prices that capture submarket-level price differences. The thesis also has a more general goal. To date, although submarket existence is widely accepted, there is little consensus about how best to incorporate submarkets in to house price models. This is, perhaps, because the existing literature uses different modelling strategies applied in varying market context and at different points in time. It is difficult, under these circumstances, to discern the most effective approach. The thesis shows that both hedonic and multi-level models are performing more accurate results when the expert identified submarket dummies are employed.

8.2. Theoretical Argument

Housing market theory presents a conceptual and operational means for the investigation of segmentation. For almost four decades, theories about the dynamics of local urban housing markets have been on the agenda of housing economic studies. The housing market segmentation concept was based on the idea of a simple model of a mono-centric city. The fundamentals of mono-centric city theory derive from the "new urban economics" approach which is developed from Richardo's classic rent theory. In 1960's theoretical work on new urban economics is developed from Richardo's classic rent theory into bid rent theory by Alonso, 1964; Mills, 1967; Muth, 1969; Olsen, 1969. The bid rent theory based on the tradeoffs which house consumers make decision between the transportation cost or accessibility and market value or economic rent. In this context, market value or economic rent of property depends on the distance to CBD of a mono-centric city. These models incorporate a utility function of the households in response to the changes in costs of transportation and income level. Within this approach, housing is not taken into consideration as a bundle of homogeneous services. However a new approach in housing economics has emerged and housing services are seen as a bunch of attributes of housing characteristics, neighbourhood level and, land characteristics (Richardson, 1971; Kain and Quigley, 1975) (see also chapter 2). Indeed the concept of this approach is fundamental to the hedonic price models that conceptualise housing prices as a function of supply and demand in a market equation (Rosen, 1974). With such hedonic approaches, housing is considered in terms of heterogeneous services which are represented by combination of housing unit characteristics, neighbourhood characteristics.

Although land and neighbourhood characteristics, and sometimes accessibility and public services, are included in hedonic price functions, the neo-classical economic approach literature restricts housing markets are investigated at the aggregate level. Since housing markets are treated at an aggregate or market-wide level with the factors that drive housing markets differentiated in terms of physical characteristics of housing units, socio-economic characteristics of inhabitants, neighbourhood characteristics, and "segmentation arising from economic/income, ethnic/religious or physical/locational related reasons" (Adair et al, 1996, p. 68,69). Even though accounting for segmentation does not conflict with the logic of neo-classical economic approach, the consequences of housing market segmentation are debated in the literature (Kauko, 2005). Several researchers argued that segmentation so the submarkets are overlooked in the basic hedonic price functions, and therefore these models do not capture the spatial factors that affect housing prices (Bourassa et al, 1999; Rotherberg et al, 1991; Goodman and Thibodeau 1998). In this respect, "it is hypothesized that submarkets can be identified through the use of hedonic modelling by stratifying the market into increasingly homogeneous subsets" (Adair et al, 1996, p.69). In parallel with this approach, the housing market is not considered a particular homogeneous entity by institutional theory. In this context, configuration of segments is related with institutional aspects such as key actors, land owners, developers, planners, real estate agencies.

There are several studies that investigate hedonic models by taking housing submarkets into account, such as Munro (1986), Maclennan and Tu (1996), Watkins (1999, 2001), and Pyrce and Evans (2007). They all indicate that hedonic models with submarket dummy variable as a proxy have higher level of statistical explanatory power than those models at the market-wide level. This study maintained that hedonic models with submarket dummy variable as a proxy has a better performance. Another method which provides valuable insights into theory is multi-level modelling that is "a more empirically and conceptually appealing specification of the hedonic models" Orford, (2000, p.1643). Property market researchers tend to focus on determining the most efficient method for definition and identification of housing segments (Munro, 1986; Fletcher, 2000; Watkins, 2001; Jones, 2004). These kind of studies shed valuable insights into a theoretical and empirical basis for housing submarket modelling. However, this thesis is concerned with a further problem. It seeks to compare alternative approaches to modelling neighbourhood (segments-specific) differences in house prices. This work is the first that compares the effectiveness of market-wide hedonic model, submarkets within a standard hedonic models and multi-level model all using a single dataset and study area. By examining the performance of the different models, it was found that there are significant differences among the submarket. Another valuable finding related with theory was that experts' submarket specification is better able to explain the spatial distribution of house prices than other a priori or statistical geographic specifications. Thus this results point out that institutional approach research provides a complement to neo-classical analyses (Guy and Henneberry, 2002). In order to bridge conceptual and operational framework of local urban housing models, institutional factors are employed as a complement in the hedonic and multi-level models. This research is therefore contributes to the literature by exploring a hybrid model that bridges the strong points of both neo-classical approach and institutional approach.

8.3. Modelling Housing Markets

Previous studies have sought to empirically determine the best way of identifying housing submarkets (Watkins, 2001; Bourassa et al, 2003; Goodman and Thibodeau, 2003). They have not however been concerned with how these submarkets might be incorporated in to different models of hedonic price. The content of this research was to understand the spatial distribution of housing prices. The main aim of the thesis was to compare the effectiveness of different models of house prices that captures segmented price difference in Istanbul. In this context, this research considered three questions about the structure of urban local housing market. First, what is the best way to examine the conceptualisation the structure of the owner occupied housing market? Second, what are the strengths and weaknesses of segmented model structures? Thirdly, how is the relationship between locations and housing prices most effectively.

This thesis mainly focused on quantitative applied methods developed in accordance with accepted neo-classical economic theory. Although quantitative methods are very useful tool for conceptualising the housing markets, they are not efficient enough in capturing the institutional effects. In order to provide a complement to neo-classical analyses, interviews with real estate agent experts were held. The output of the interviews was used in delineating the submarkets and also explaining the model results.

In this research, housing price determinants were examined by employing different types of models at submarket level that are consisted of neighbourhood administrative boundaries which can reflect the heterogeneous physical and socio-economical configuration. At the first stage, a market-wide hedonic price model was employed by taking into property characteristics, socio-economic characteristics, neighbourhood quality characteristics and locational characteristics. The dataset used for this hedonic model is composed of two dataset. The data of property characteristics was provided from two major real estate agent's websites and this data set contains 2,175 transactions of all single-family homes sold in Istanbul in November 2006 and in April 2007. This dataset was composed of the observation from 348 neighbourhoods out of 946 neighbourhoods in 32 districts. The second dataset provides information about the socio-economic and the neighbourhood quality characteristics. This dataset is derived from a survey that was undertaken by Istanbul Greater Municipality. The data of the locational characteristics such as travel time to work, schools and shopping areas (or centres) are taken from the second data set. The earthquake risk percentage measurement which is one of the most important locational characteristics is taken into account from predictions by the JICA (Japanese Agency for International Cooperation) (JICA, 2002). The results of the hedonic model suggest that the housing price is determined by four types of characteristics: property, socio-economic, neighbourhood quality and locational characteristics.

At the second stage of the study hedonic models were employed, which includes submarket dummy variables as a proxy for segments. The submarkets are determined based on a priori, expert and cluster analysis geographic specification. At the third stage separate hedonic models for each of the submarkets were estimated in order to find out the differences among the segments. The variables used in the second and third stage are same with the ones on the market-wide hedonic models.

The fourth stage reported a multi-level model that investigates both individual (housing unit) level and contextual (submarket) level. In multi-level modelling, submarkets, determined by a priori, expert and cluster analysis specification, were employed for two-level models. At the fifth stage, the results of the multi-level models were then compared to those generated by different forms of the hedonic model. The comparative analysis focused on the estimated coefficients, significance and explanatory power of the models.

The test procedure of this study involves calculating the forecasting ability of the models, the predictive accuracy and root mean square error (RSME) tests to establish the relative effectiveness of different models of house prices.

Empirical results have been presented on four ways. These results are market-wide hedonic model, hedonic model with submarket dummy variable as a proxy, separate hedonic housing price function for each of the submarkets, multi-level model.

Market-wide Hedonic Model

The overall R^2 of the market-wide model is 0.608 which is good compared to the others reported in the literature in social science. Among the property characteristics, living area, being located in a low storey building, being in a secured site (with swimming pool and car park), are found to have a positive impact on housing value. On the contrary to most studies on housing prices, age has a counterintuitive sign. Such similar results for Istanbul were found by Ozus et al (2007) and Onder et al (2004). Among the socio-economic characteristics, the length of time the inhabitants have lived in Istanbul, average income of the household and neighbour satisfaction, as a variable in the behaviour characteristics, have positive impacts on housing value. As expected, earthquake risk as a locational variable with a negative impact.

Hedonic Models with a Submarket Dummy Variable

In chapter five, submarkets are added into the market-wide models as a dummy variable in order to involve the spatial effects. This will be providing a better understanding of spatial distribution of housing prices. It was find out that adding submarket dummy variable improves the fit of the models. The explanatory power of the market-wide model was 0.608 whereas; in the model with a priori submarket specification R^2 was 0.678; in the model with experts' submarket specification R^2 was 0.682; in the model with cluster submarket specification R^2 was 0.641. The model with experts' specification dummy variable has the highest explanatory power. The mutual significant variables of these models are the living area of the housing unit, being located in a site, and living period of the inhabitants in Istanbul and average income of the household. These variables are positively related with the housing prices.

Separate Hedonic Housing Price Models

Separate hedonic housing price models were established for two reasons. One of the reasons was to understand the differences among the submarkets and present specific characteristics of segments. The other reason was to provide input for testing the effectiveness of the models. Separate submarkets functions achieve R^2 estimates ranging from 0.70 to 0.38. The mutual significant variables were the living area, being located in a site, travel time to work and schools, earthquake risk are the significant variables are the common determinants in the most of the submarkets. The living area and being located in a site are positively related with the housing prices whereas the earthquake risk is negatively related to the housing prices. The travel time to work and schools is positively or negatively related to housing prices from one submarket to another.

Multi-level Model Results

With regard to the aim of the study, two-level models are constructed which capture the effects of both housing unit level and submarket level characteristics. Like the hedonic models, submarkets were stratified a priori, experts and cluster analysis. The mutual significant variables of these models at the housing unit are, the living area of the housing unit, being located in a site whereas at the submarket level the mutual significant variables are living period of the inhabitants in Istanbul and average income of the household. These parameters are analogous to the hedonic functions and they are positively related to the housing prices.

8.4. Comparing the Effectiveness of Models

Since the aim of the study is to compare the effectiveness of different models of house prices, not only the results in terms of the individual characteristics within the models are important but also the overall performance of the model is essential. Because of the differences in the methods of estimation (mainly OLS but maximum likelihood in the case of multi-level model) among the models, the goodness-of-fit of the models cannot be compared by examining the R^2 (Fletcher et al, 2000). The overall performances of the models are therefore investigated on the basis of prediction accuracy test and a root mean square error.

Since the comparisons of predict accuracy are crucial for discriminating among empirical models of housing prices, predictive accuracy test is employed for this study. The predictive accuracy test helps to measure the difference between the actual and the predicted price. In this study, the predictive accuracy test is calculated by taking the difference between the actual price and the predicted price forecasted with the help of hedonic models and multi-level models.

The predictive performance of the hedonic and multi-level models is summarized in Table 8.1 The percentage of cases predicted within 20% and 10% is taken as benchmark (see also Fletcher et al (1999), Goodman and Thibodeau (2008), Costello et al (2010) for use of this method). The empirical results indicate that the submarket –as a dummy variable identified by experts- existence yields significant gains in prediction accuracy both in hedonic and multi-level models. The relatively market-wide hedonic model has a strong predictive performance when stratified by submarkets defined by real estate agents.

The stratified model identified by experts can be used to predict more than 40% of cases within 20% accuracy, and almost 22% of cases within 10% accuracy. It is interesting that, the a priori and cluster stratified models do not achieve as strong a predictive performance, though it is still a significant improvement over the market-wide model. The multi-level model identified by expert submarket has the strongest predictive performance with more than 40% of cases predicted within 20% accuracy and 22% within 10% accuracy.

Table 8.1 Comparison of predictive accuracy

Model	% of cases predicted within 20% accuracy	% of cases predicted within 10% accuracy
Market-wide hedonic model	34.43	18.71
Hedonic model identified by a priori submarket	29.93	16.50
Hedonic model identified by expert submarket	41.79	21.83
Hedonic model identified by cluster analysis submarket	31.58	16.41
Hedonic model A priori 1	4.6	3
Hedonic model A priori 2	46.6	25.6
Hedonic model A priori 3	5.64	1.20
Hedonic model A priori 4	51.67	31.27
Hedonic model A priori 5	18.85	10.96
Hedonic model Expert 1	7.2	4.84
Hedonic model Expert 2	9.85	5.86
Hedonic model Expert 3	31.89	11.93
Hedonic model Expert 4	18.87	7.37
Hedonic model Expert 5	0	0
Hedonic model Cluster 1	26.5	13
Hedonic model Cluster 7	0	0
Multi-level model identified by a priori submarket	27.26	14.57
Multi-level model identified by expert submarket	41.83	21.83
Multi-level model identified by cluster analysis	33.01	17.19

The predictive accuracy test calculates the difference between the actual and the predicted price of the housing prices. Being estimated by maximum restricted likelihood, the performance of the multi-level models cannot be compared in T test and weighted standard error. Multi-level models and hedonic models are tested for their predictive power in the predictive accuracy test. According to the test results, hedonic and multi-level models with experts' submarket dummy variable can predict more than 40% of cases within 20% accuracy. However, hedonic and multi-level models with a priori and cluster submarket dummy variable can predict around 30% of cases within 20% accuracy. As it can be seen from Table 8.1, for the hedonic model Expert 5 [E5], hedonic model Cluster 7 [C7] % of cases predicted within 20% and 10% accuracy is 0. The reason for this unexpected result may because of the sample size. Since [E5] has 71 and [C7] has 60 transactions (see Table 6.1), these submarkets can not perform a good performance in predicting. Similarly, RMSE test results indicate that hedonic and multi-level models with experts' submarket dummy variable show better performance than other models.

Root Mean Square Error Test

To evaluate the prediction accuracy of models the Root Mean Square Error (RMSE) is calculated and compared. The model with a lower RMSE is considered to be a relatively superior model.

$$\text{RMSE}=\sqrt{\frac{\sum_{i=1}^{n}\left(P_i-\hat{P}_i\right)^2}{n}}$$

P_i = is the actual house price

$\hat{P}_i$ = is the estimated house price

n : is the of observations

Table 8.2 Comparison of Root Mean Square Error Test

Model	**RMSE**	**Percent Reduction in RMSE (%)**
Market-wide hedonic model	0.2003	
Hedonic model with a priori submarket dummy	0.1819	9.19
Hedonic model with expert submarket dummy	0.1803	10
Hedonic model with cluster analysis submarket dummy	0.1927	3.8
Hedonic model A priori 1	0.23332	-16.5
Hedonic model A priori 2	0.14478	27.8
Hedonic model A priori 3	0.16975	15.3
Hedonic model A priori 4	0.13556	32.3
Hedonic model A priori 5	0.14744	26.4
Hedonic model Expert 1	0.23215	-15.9
Hedonic model Expert 2	0.16966	15.3
Hedonic model Expert 3	0.1729	13.6
Hedonic model Expert 4	0.12776	36.2
Hedonic model Expert 5	0.14132	29.4
Hedonic model Cluster 1	0.18386	8.23
Hedonic model Cluster 7	0.23843	19
Multi-level model identified by a priori submarket	0.1885	5.89
Multi-level model identified by expert submarket	0.1815	9.38
Multi-level model identified by cluster analysis	0.1893	5.49

As it can be seen from the Table 8.2, RMSE of hedonic and multi-level models, that employ the submarkets identified by a priori, experts and cluster analysis dummy variables, are relatively superior model for house price prediction. For both multi-level and hedonic models with submarket dummy variables, expert identified submarkets show better performances. Apart from 1st a priori submarket and 1st expert submarket, all the hedonic models of the each of submarkets are superior than market-wide models. It is interesting that both a priori [A1] and experts' 1st submarket [E1] hedonic models show slightly poorer results in comparison to the market-wide model. As it is mentioned in Chapter 4, 1st submarket is consist of waterside houses (along the Bosphorus, literally called "yali"), horizontal gated communities, residences (vertical gated communities), low storey apartment blocks located along the shore, detached houses close to the city centres. The price of housing units located in the 1st submarket are mainly determined by the interior design details such as high roof, housekeeping service, swimming pool in the house, sea or forest view. From all of the tests, it can be seen that hedonic with submarket dummy variables and multi-level models with experts' identified submarkets dummy variable yields better performance than market-wide hedonic models.

8.5. Implications for Planning Policy

This research is the first study in Turkey that displays the spatial distribution of housing prices with regard to a wide framework that is consist of housing unit, socio-economic, neighbourhood quality and locational characteristics. This research examines the housing price differences as defined through both neo-classical and institutional approaches and employs submarkets to conceptualise the housing market. These models contribute to planners for creating housing policies that are essential in housing market. The comparison of different models demonstrates that entire market is not sufficient in analysing urban local housing system.

The results of the models suggest some advantages to the current planning practice. First, the results of the hedonic and multi-level models give information about the house-buyers preferences. This allows planners have a better understanding of supply and demand relationships in the housing market (See Maclennan et al, 1987). Second, the segmented approach in housing models can capture the spatial distribution of household preferences. The hedonic functions for each of the submarkets allow displaying the variation within the market. For example, the results of the separate hedonic models, analysed in chapter 6, provides information about the distinction among the submarkets, sharp changes in housing supply and demand. This may help planners to produce different strategies for different submarkets. Since Istanbul is a highly segmented city, particular strategies for specific segments are essential for an applicable plan rather than a unique housing policy system for the entire city.

Not only planning practice but also supply side of the market can benefit from the findings of this study. Because of the fact that the results display the demand side preferences, this study can be used as a guide to improve the understanding within the supply side, developers and investors. In addition to supply side and investors, policy makers and urban planners can use the results in order to analyze housing market behaviour. Plans based on researches and analytical tools can be more effective in implementing the plan decisions, policies and also provide attraction of supply side collaboration with local governments.

8.6. Further Research

During the research process, a number of issues were identified that require further investigations. These include questions about the improvement of conceptualising the urban housing markets. Further studies might include analyses of a wider framework that marries insights from with different approaches including behavioural and institutional.

More specifically, the methodology used in this study could be applied in different cities. It is not rational to generalise from a single case study which has also a dynamic and unstable structure. The methods used in this study can be applied in other cities with different submarket structure both in developing and developed countries. For example, a mono-centric city with a lower population may have a different submarket structure; therefore the models should display different performances. This can allow comparing how political, socio-economic and spatial background matter in urban housing system. On the other hand, it will be possible to find out if these models are applicable to different spatial areas with different characteristics.

Another methodology can depend on non-mainstream economics theoretical approach. For example Self Organising Map (SOM) can be employed in order to produce the patterns that based on the input variables form clusters on the map and reflect the segmentation. In addition to this advantage, the choice of input variables allows for socio-economic and environmental comparisons between different locations and gives the opportunity to link the results to the price dependent criteria for segmentation (Kauko 2002). Another non-mainstream technique that can be employed in the further studies may be cellular automata. For example, Meen and Meen, (2003b) is focused on local housing market models by employing cellular automata. They argued that this technique can be useful to explain empirical phenomena in local housing markets, such as multiple equilibria and hot spots, increasing returns and segregation (Gibb and Hoesli, 2003).

In addition, a larger dataset with more spatial information such as post-codes can be used in order to find out the spatial pattern of the residuals. As discussed in chapter 4, sometimes regression coefficients do not remain fixed over space in regression models where the cases are geographical locations (Brunsdon, 1998). GWR (Geographically weighted regression) and GIS techniques could be used to systematically examine the weaknesses of the different modelling approaches and to analyse the housing market structure spatially. A high quality data of a high spatial resolution allows producing detailed results at small scales like street level by using the spatial tools (Orford, 1999) such as GWR or GIS. An address-point data allows producing models that can generate a detailed pattern of urban housing market system. It is critical to capture local level locational characteristics such as streets, view, amenities and disamenities in order to have a better understanding of housing markets.

Finally, since property markets have dynamic structure, it is essential to display the drivers of the market that change over time. The data set used in this study is a set of 2175 single houses sold in Istanbul, in the period time between 2006 November and 2007 April. Since Istanbul is a dynamic city, the employment of time series models to display changes over time could be more effective way in exploring the operation of housing markets. In the last decade, Istanbul property market has experienced an earthquake, a national and a global economic crisis. Once stability over time is provided, the results of the models may show different attitudes.

8.7. Key Findings

The aim of this study was to display the effectiveness of different segmented house price structure in Istanbul. The objective of the study was achieved through four stage methodology. As it was stated in the previous section, it is not rational to generalise from a single study area and single time. However it was found out from the four different models that to take submarkets into account improves the effectiveness of the models. It was pointed out that "*housing submarkets matter*" in explaining the structure of the urban housing market system. From the four-stage methodology it is found out that different models have different effectiveness. However the submarket aggregation plays an important role in the improvement of the models. "*Models were performing better with the expert identified submarket dummies are employed*". Experts have a better, realistic and more detailed information about submarkets rather than a priori or statistical tools.

Although hedonic model is a useful tool to understand housing markets, technical constraints such as spatial auto-correlation, spatial heterogeneity, ecological fallacy and atomic fallacy make it difficult to get accurate results. To overcome the problems of hedonic models, multi-level modelling approach may be a solution. Multi-level modelling can be an alternative method to capture and model the housing system. The recognition of hierarchical structure of the data leads researchers to analyze according to levels such as housing unit level and submarket level.

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APPENDIX A

Description of Variables

Table A1 Description of Variables that are employed in the Models

Variable used	Description of variable
Price	The price of the housing unit in USD
Age	The age of the building
Living area	The floor area of the housing unit
Room	Number of rooms in the housing unit
Total storey	The total storey of the building
Low-storey	If the building that housing unit is situated is lower than 5
Flat	If the housing unit is a flat? Yes or no
Detached	If the housing unit is a detached building? Yes or no
Elevator	Does the building have an elevator? Yes or no
Balcony	Does the building have a balcony? Yes or no
Garden	Does the building have garden? Yes or No
Security	Does the building have a security unit? Yes or No
Car park	Does the building have a car par? Yes or No
Swimming Pool	Does the building have a swimming pool? Yes or No
Site	If the building is in a site with swimming pool, car park and security unit
School satisfaction	The satisfaction score for schools (1 very poor to 7 excellent)
Health service satisfaction	The satisfaction score for health services (1 very poor to 7 excellent)
Cultural facilities satisfaction	The satisfaction score for cultural facilities (1 very poor to 7 excellent)

Municipality satisfaction	The satisfaction score for municipality services (1 very poor to 7 excellent)
Home satisfaction	The satisfaction score for home (1 very poor to 7 excellent)
Security satisfaction	The satisfaction score for security (1 very poor to 7 excellent)
Playground facilities satisfaction	The satisfaction score for playground facilities (1 very poor to 7 excellent)
Neighbour satisfaction	The satisfaction score for neighbours (1 very poor to 7 excellent)
Neighbourhood quality satisfaction	The satisfaction score for neighbourhood quality (1 very poor to 7 excellent)
Average income	The average income of inhabitants in the neighbourhoods
Household size	Household size
Living period in Istanbul	The length of time the inhabitants have lived in Istanbul(year)
Living period in the neighbourhood	The length of time the inhabitants have lived in Istanbul (year)
Travel time to work and schools	Travel time to work and schools
Travel time for shopping	Travel time to shopping centres/areas
Earthquake risk	The % of the buildings that will be highly damaged
Continent	Europe: 1, Asian: 0

APPENDIX B

The Chow and the Weighted Standard Error Test Results

There are two ways to test the effectiveness of the segmented hedonic price models. The first means to examine the performance of the model is the Chow test which investigates whether there is a significant difference between a pair of regression equations under the null hypothesis that two models are equivalent (Day, 2003). The second test of investigating the effectiveness of the models is to examine the weighted standard error test in order to test whether the price differences observed pass Schare and Struyk's common sense test (Watkins, 2001). In addition to the Chow and the weighted standard error (WSE) test, the predictive accuracy test and root mean square error test *(RSME) is applied* to find out the forecasting ability of these models in Chapter 8.

The Chow Test

The submarkets which are identified according to a priori, experts and cluster analysis are tested by using Chow test. The performance of hedonic models for each of the submarkets is examined by using Chow Test which compares the sum of squares of residuals for the submarket models. By applying the Chow test, it is aimed to find out whether significant differences exist among submarkets.

The theory underlying this test is as follows (Munro ,1986):

"If there are two submarkets with sizes n_1 *and* n_2, two regression functions can be estimated:

$$Y = a^1 + B_1^1 X_1 + ... + B_k^1 X_k \qquad (1)$$

$$Y = a^2 + B_1^2 X_1 + ... + B_k^2 X_k$$

If $a^1 = a^2,\ B_1^1 = B_1^2, ..., B_k^1 = B_k^2$ (2)"

Then, it is valid to estimate one regression for the whole sample. Testing for the validity of joining the samples using a standard test for linear restrictions on regression parameters where functions (2) provide k+1 linear restrictions whereby the test statistic for the null hypothesis that coefficients are the same is calculated (Dunse and Jones, 1997).

Therefore, the formula for F test is as follows, (Munro 1986)

$$F = \frac{(RRSS - URSS)/k+1}{URSS/(n_1 + n_2 - 2k - 2)} \qquad (3)$$

RRSS= unrestricted residual sum of squares

URSS= restricted residual sum of squares.

Table B.1 F Test Results For A Priori-Experts Identified Spatial Submarkets

Pooled Segments	Chow
A priori 1 with a priori 2	6.56
A priori 1 with a priori 3	2.55
A priori 1 with a priori 4	16.58
A priori 1 with a priori 5	66.31
A priori 2 with a priori 3	4.84
A priori 2 with a priori 4	25.14
A priori 2 with a priori 5	18.68
A priori 3 with a priori 4	32.71
A priori 3 with a priori 5	8.92
A priori 4 with a priori 5	5.54
Expert 1 expert 2	11.73
Expert 1 expert 3	22.7
Expert 1 expert 4	7.86
Expert 1 expert 5	49.91
Expert 2 expert 3	36.38
Expert 2 expert 4	30.71
Expert 2 expert 5	135.36
Expert 3 expert 4	4.8
Expert 3 expert 5	45.6
Expert 4 expert 5	126.60

*Chow test is not applied for the submarkets that are determined by cluster analysis since it self was conducted by employing the method of grouping the observations which are closest together

The Chow test results, presented in Table B.1, suggest that submarkets exist. The calculated F statistics show significant evidence of an improvement by use of segmented approach. According to the results significant house price differentials exist between all of the segments. The results imply that as the parameters of the models are not equal, there is no need to pool segments. There is clear evidence of submarket existence and that show housing prices vary across Istanbul. This is confirmed by the weighted standard error test results, which are discussed in section

The Weighted Standard Error Test

The second stage for testing the effectiveness of the models involves testing the market-wide model against segmented model of the housing market. The standard errors of the submarket models are compared with geometric mean of the standard error of the market-wide. The formula for combined standard errors of the segmented models is as follows:

$$S^c = \sqrt{\sum_{j=1}^{n} \frac{(n_j - k_j - 1)SE_j^2}{\sum_i (n_i - k_i - 1)}} \qquad (4)$$

n_j: the number of the observations in the j^{th} submarket, and k is the number of explanatory variables in the i^{th} submarket.

The comparison of standard errors requires some a priori estimation of what should be considered to be significant reduction. Dale-Johnson (1982) selected a benchmark of 5% whereas Munro (1986), Dunse and Jones (1997) and Watkins (2001) take 10% as the significant benchmark. In this study, also the 10% threshold is adopted.

Table B.2 Weighted Standard Error Test

Stratification Scheme	Standard error	% Reduction
Market-wide model	0.20030	
A priori identification scheme	0.15716	21.53 %
Experts' identification scheme	0.16894	15.65 %
Cluster analysis identification scheme	0.19072	4.77 %

Out of the three alternative submarket specifications, a priori and experts' submarket identification pass the weighted standard error test. As it can be seen in Table B.2, there is evidence that housing prices vary across space and to investigate housing prices by taking submarkets into consideration in modelling provides better performance than the market-wide market. The submarkets determined by cluster analysis can not pass the 10% reduction benchmark due to the technical limitations of the cluster analysis. Out of twelve clusters, only two nests are appropriate for running a regression function because of the problems such as sample size, correlation among the variables. In order to solve these problems, factor analysis is employed for reducing the number of variables. However no further statistics were computed because some of the variables had zero variance.

The greatest reduction in standard error is achieved by a priori identified submarkets. The cluster analysis segmentation performs poorest, achieving a reduction of around 5% compared with the 16% achieved by the submarkets identified by experts.

The hedonic model approach assumes that house prices are determined by the value of each the individual physical and spatial characteristics of the housing unit rather than perceiving a housing unit as providing homogeneous "housing services" at a single price, as in the access-space model (Watkins, 2001). In addition to the characteristics of the residential unit, the spatial attributes determine the housing prices. The model's accuracy for predicting market values can be significantly improved by incorporating the spatial relationships in hedonic equations, and this can also reduce estimation errors for submarkets (Basu and Thibodeau, 1998; Bourassa et al, 2007). This can be achieved by three approaches, the first one being the inclusion of the distance or neighbourhood quality variable into the model (So et al, 1997; Watkins, 1998). The second approach is to employ a neighbourhood dummy variable as a proxy for submarkets like in Rothenberg et al (1991), Gallimore et al (1996) and Ozus et al (2007). These two approaches are displayed in Chapter 5. The third method is based on estimating a separate equation for each submarket which is explained in this chapter. Hedonic modelling is employed to each of the submarkets in order to determine the spatial variation of the impact of the housing unit, socio-economic, neighbourhood and locational characteristic variables on housing prices in segments in the housing market. The estimation of separate submarket hedonic models are essential for testing the submarket existence. In the next chapter, these hedonic function results will allow to check whether there are significant differences in the implicit prices of the variables (using a chow test) and whether there is a substantial reduction in the error (using the WSE).

As it was stated the aim of this study is to examine alternative methods to find out which approach provides greatest accuracy and minimize error. In order to increase the performance of the models and improve the accuracy for predicting housing price, spatial relationships are taken into consideration (Basu and Thibodeau, 1998). Thus, to achieve improvements in the models, submarkets are employed in the standard models and hedonic models are constructed at the submarket levels. As part of this process, different approaches have been replicated to define and identify submarkets. This allows comparing the best of this with both the standard models and new approaches specifically multi-level models. Therefore, the effectiveness and the performance of the models were compared by the Chow test and the weighted standard error (WSE) test, the predictive accuracy test and root mean square error (RSME) test.

According to the Chow test results, there are significant differences among the submarkets. All of the specifications provide evidence of existence of significant price difference. The results of weighted standard error test show that a priori and experts' submarket specifications perform better than cluster analysis specification. Due to the fact that multi-level models are estimated by maximum restricted likelihood, the performance of the multi-level models cannot be compared in T test and weighted standard error.

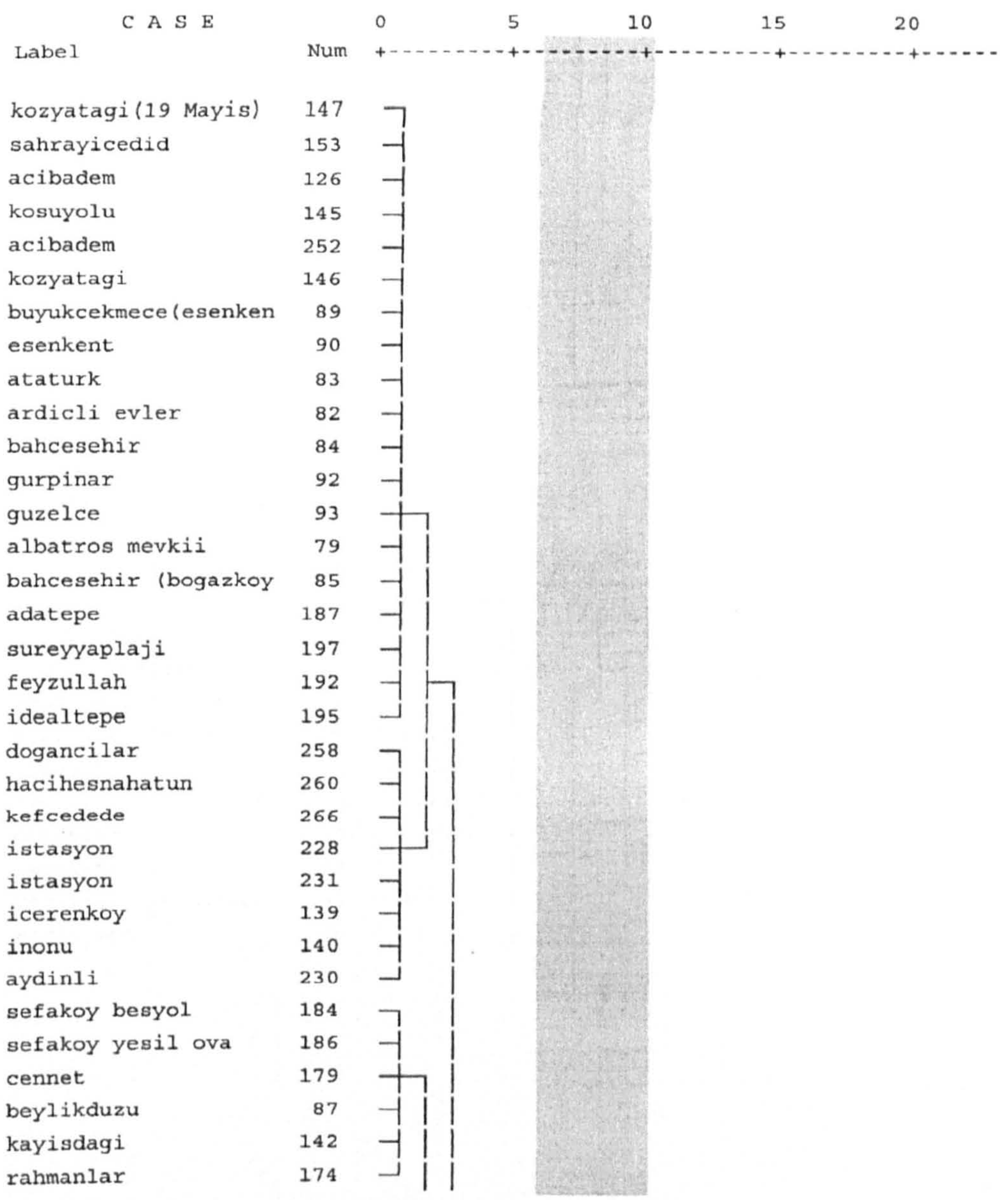
However, it is possible to compare hedonic models and multi-level models by the predictive accuracy test which calculates the difference between the actual and the predicted housing prices. The results show that the hedonic and multi-level models with experts' submarket dummy variable can predict more accurately than the models with a priori and cluster analysis stratified submarkets. Similarly, the root mean square error test results indicate that the hedonic and multi-level models with experts' submarket dummy variable show better performance than other models. These test results show that both the hedonic and multi-level models with experts' stratified submarkets dummy variable yields better performance than market-wide hedonic models.

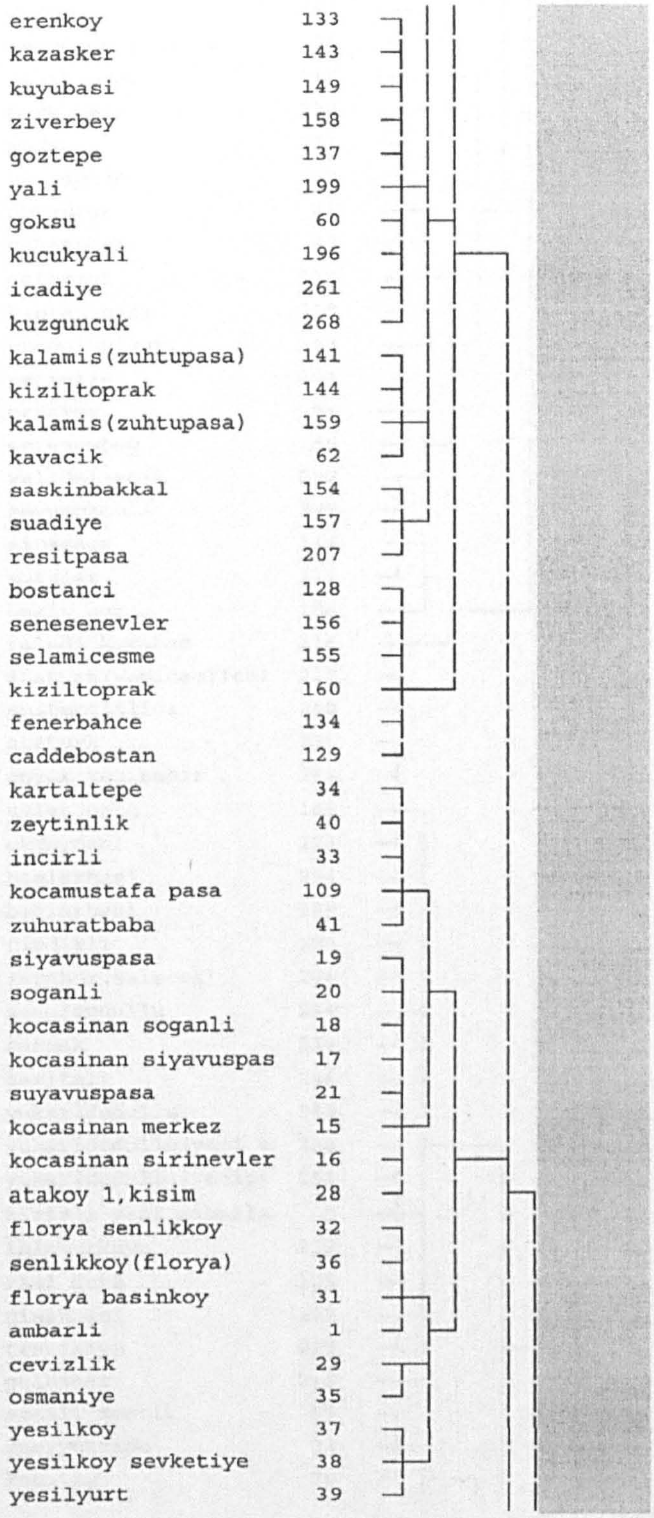
APPENDIX C

* * * * * H I E R A R C H I C A L   C L U S T E R   A N A L Y S I S * * * *

Dendrogram using Complete Linkage

Rescaled Distance Cluster Combine

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kuzguncuk 268
kalamis(zuhtupasa) 141
kiziltoprak 144
kalamis(zuhtupasa) 159
kavacik 62
saskinbakkal 154
suadiye 157
resitpasa 207
bostanci 128
senesenevler 156
selamicesme 155
kiziltoprak 160
fenerbahce 134
caddebostan 129
kartaltepe 34
zeytinlik 40
incirli 33
kocamustafa pasa 109
zuhuratbaba 41
siyavuspasa 19
soganli 20
kocasinan soganli 18
kocasinan siyavuspas 17
suyavuspasa 21
kocasinan merkez 15
kocasinan sirinevler 16
atakoy 1,kisim 28
florya senlikkoy 32
senlikkoy(florya) 36
florya basinkoy 31
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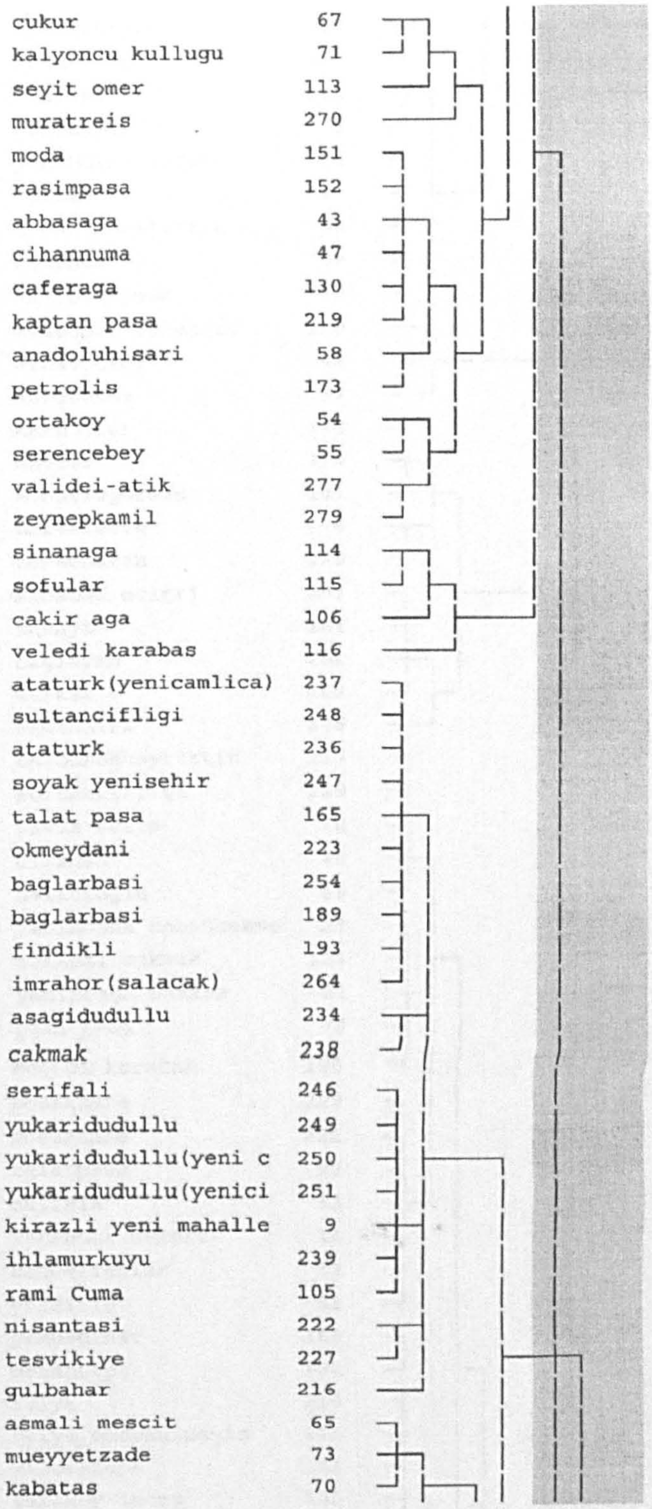
cevizlik 29
osmaniye 35
yesilkoy 37
yesilkoy sevketiye 38
yesilyurt 39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kaptan pasa 219
anadoluhisari 58
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ortakoy 54
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baglarbasi 189
findikli 193
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cakmak 238
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kirazli yeni mahalle 9
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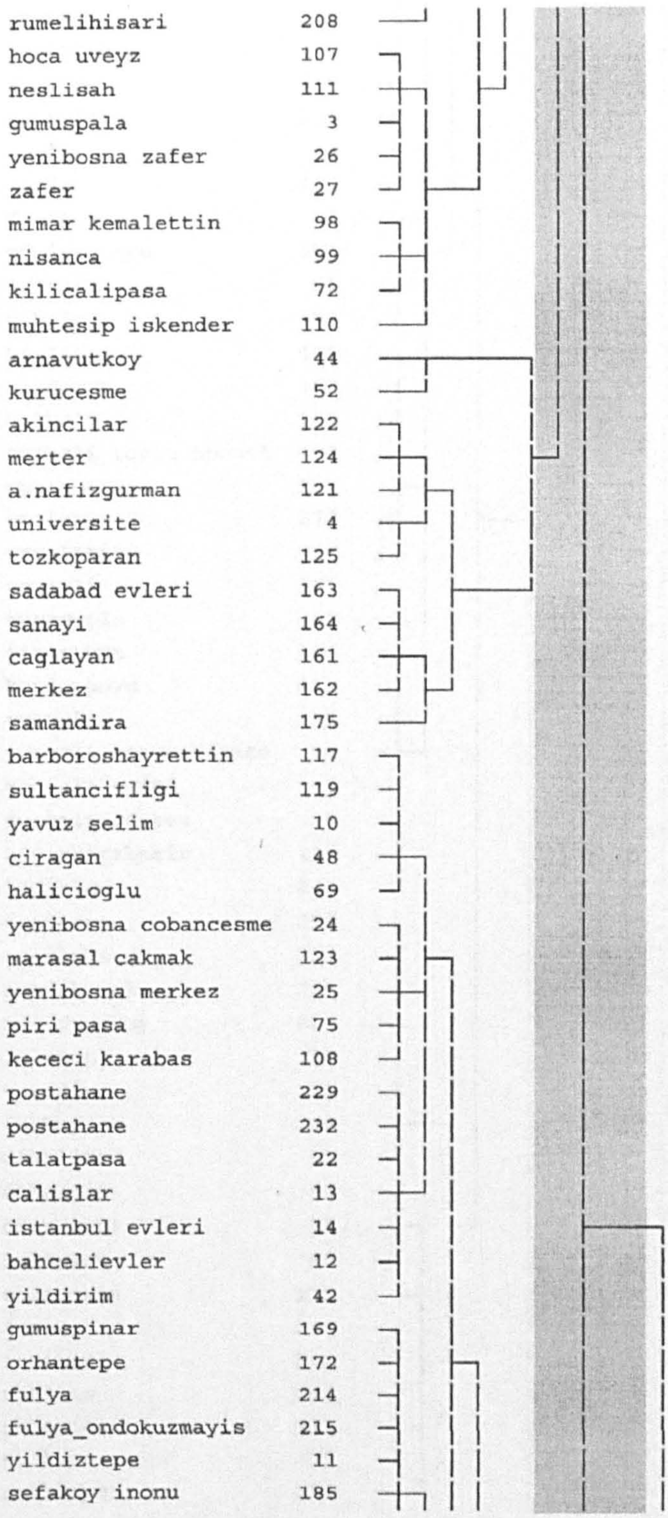
kabatas 70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yavuz selim 10
ciragan 48
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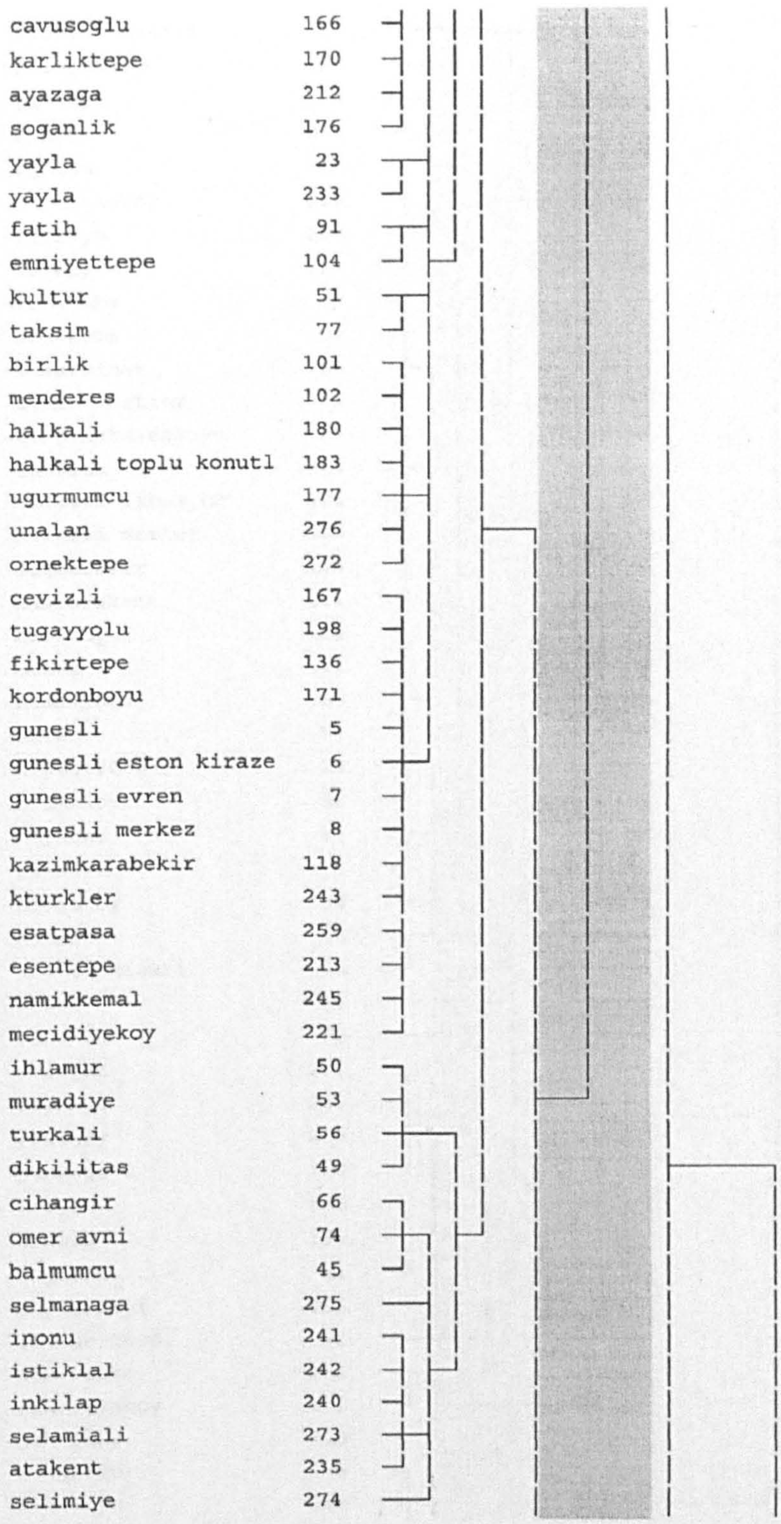
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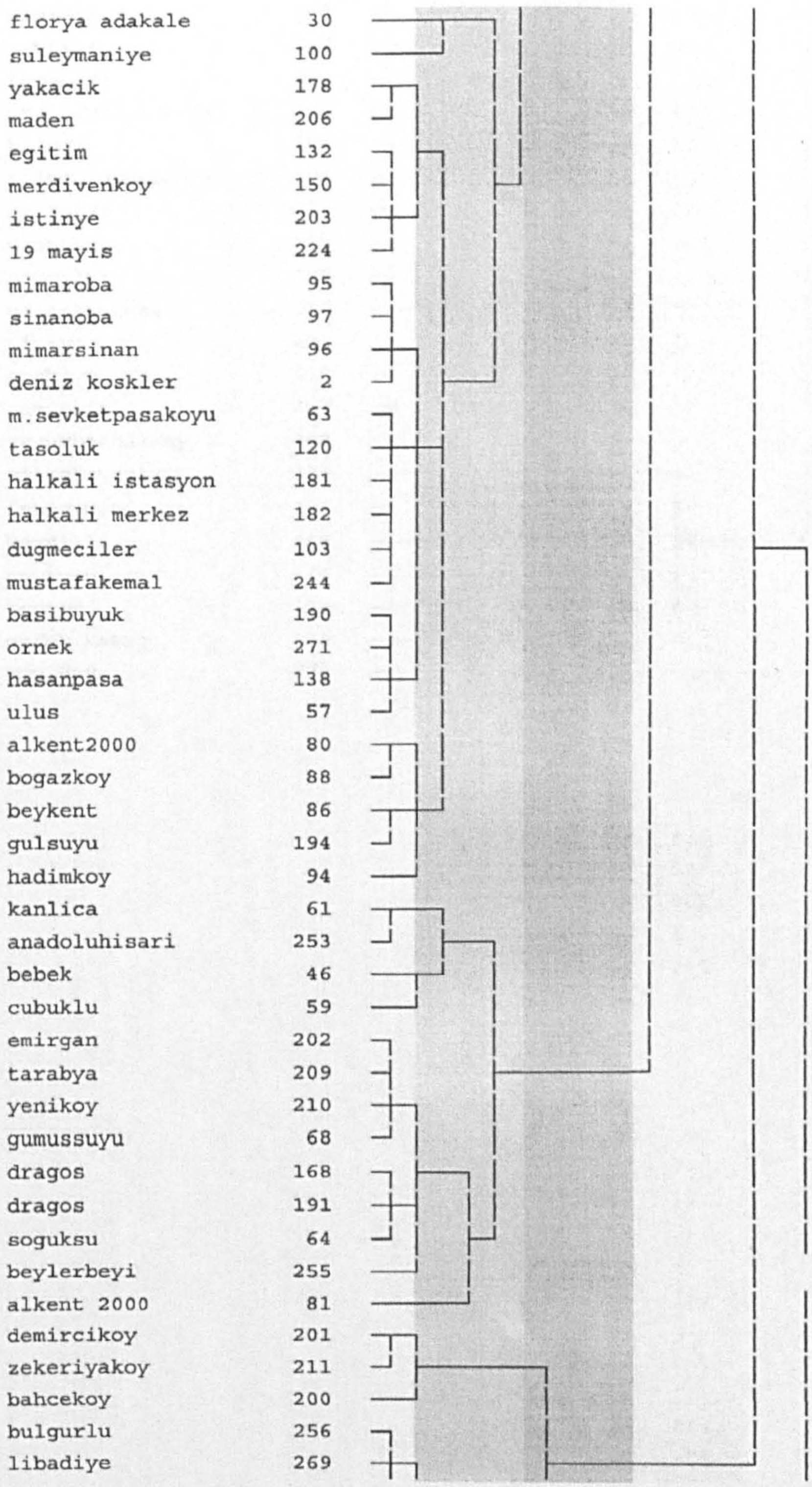
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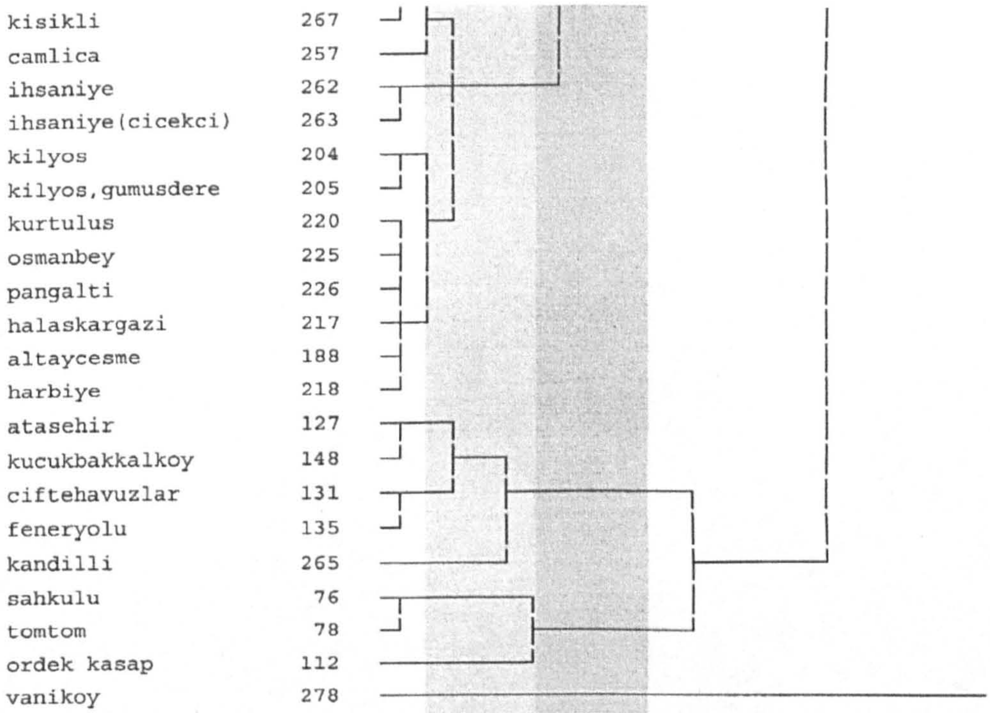
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kandilli 265
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tomtom 78
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