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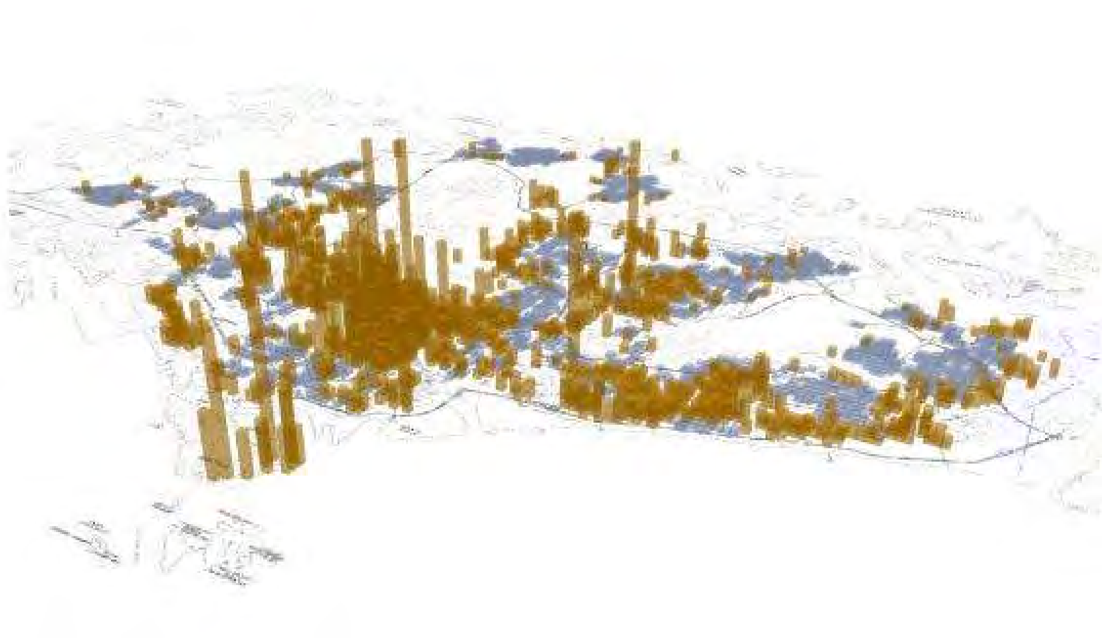

Housing Market of University of Thessaly students in the city of Volos

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To my family

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I sincerely thank my Professor Dr. Paschalis Arvanitidis for being an excellent mentor who motivated me through his efficient actions and positive reinforcement. I am grateful to my professors and colleges from the Postgraduate Program in European Regional Development Studies of the department of planning and regional development of University of Thessaly for sharing their knowledge with me. Finally, I want to express my gratitude for the love and moral support of my family.

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ABSTRACT

Hedonic price models have been used in housing the last 20 years and have found many applications. The student population in the city of Volos makes rental income from students an important income source for many property owners. This study presents two hedonic models for student housing of students of University of Thessaly in the city of Volos, with monthly paid rent as dependent variable. Implicit values for selected structural and locational characteristics were estimated and data was collected by questionnaires. Common independent variables generated the expected signs. Proximity to points of interest such as the sea or the city center affects positively the monthly paid rent. There is a clear preference for apartments on student's choices and despite the fact that location plays an important role on monthly paid rent, amenities in the apartment seem to influence more than any other factor the rent students are willing to pay for their house.

Key Words: Student housing, hedonic price model, city of Volos.

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Περίληψη

Τα ηδονικά μοντέλα τιμών χρησιμοποιούνται ευρύτατα στην αγορά κατοικίας τα τελευταία 20 έτη και τυγχάνουν πολλών εφαρμογών. Ο πληθυσμός των φοιτητών στην πόλη του Βόλου έχει δημιουργήσει μία σημαντική αγορά φοιτητικής κατοικίας, που αποτελεί σπουδαία πηγή εισοδήματος για τους ιδιοκτήτες ακινήτων. Σε αυτή την μελέτη αναπτύσσονται δύο μοντέλα ηδονικών τιμών για την αγορά κατοικίας των φοιτητών του Πανεπιστημίου Θεσσαλίας στην πόλη του Βόλου, λαμβάνοντας ως εξαρτημένη μεταβλητή το μηνιαία καταβληθέν ενοίκιο. Εικονικές τιμές των δομικών καθώς και χωρικών χαρακτηριστικών των οικιών έχουν υπολογιστεί και τα δεδομένα συλλέχτηκαν με τη μέθοδο των ερωτηματολογίων. Οι εξαρτημένες μεταβλητές παρήγαγαν αναμενόμενα πρόσημα. Η εγγύτητα σε σημεία ενδιαφέροντος όπως η θάλασσα είτε το κέντρο της πόλης επηρεάζουν θετικά το μηναία διαμορφωμένο ενοίκιο. Επίσης υπάρχει μία σαφής τάση των φοιτητών να επιλέγουν διαμερίσματα παρά μονοκατοικίες ή ανεξάρτητες οικίες και παρά το γεγονός ότι η θέση του ακινήτου παίζει σημαντικό ρόλο στο ενοίκιο, παροχές στην οικία όπως η ύπαρξη τζακιού είτε κλιματιστικού επηρεάζει περισσότερο από κάθε άλλο παράγοντα την τιμή του ενοικίου που οι φοιτητές είναι διατεθειμένοι να πληρώσουν.

Λέξεις κλειδιά: Φοιτητική κατοικία, ηδονικά μοντέλα τιμών, Βόλος.

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Chapter 1: Introduction

1.1 General framework

This dissertation intends to explore the factors that determine the choice of student residence in the city of Volos. The intent is to estimate the economic determinants that lead University of Thessaly students into making housing decisions in the city of Volos. We will focus on factors such as: size and characteristics of the student houses, their distance from the university, amenities offered in the house, income level in neighbourhood etc. Through the use of a hedonic price model (HPM), the implicit prices of these will be assessed, which can help us to determine the price of the units thought the change of these characteristics. In other words we will try to answer the question if any of the factors change how the choice of the students will be affected and furthermore the value of rent paid monthly will be changed.

Rosen (1974) was one of the first scholars who developed the theory of HPM, arguing that a price of a good is the sum of prices its characteristics. In other words, the transaction, which we observe, is in fact a bunch of several smaller hidden transactions (Bazyl, 2009). Hedonic models are in fact regression analysis, in which the property value is viewed as a dependent variable and the property attributes or characteristics are the independent variables.

Before Rosen, Lancaster (1966) provided the microeconomic foundations for analyzing utility-bearing characteristics to topics such as housing market, financial assets, labour-leisure trade off etc. Lancaster focuses on the demand side of the market while on the other hand Rosen's model analyses both the supply and the demand side and specifically on buyers and seller's choices on market equilibrium and empirically implicates the HPM.

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1.2 Research objectives – purpose of the study

Today the population of students in Volos are nearly 7000 people, creating demand and making student housing one of the apartment industry's most enticing niche opportunity. The lack of off-campus student housing research in general and especially for the city of Volos will lead this dissertation to find in what way factor determine the choice of student's apartments. Furthermore the way these factors affect the monthly paid rent will be explored. Through this study we will try to answer to the following questions.

1) Which are the factors that most affect the choice of housing for the students in the city of Volos?
2) Which is more important for the students, proximity to points of interest or amenities that every apartment offers?
3) How the monthly paid rent changes as several characteristics of the house unit changes?

This study will try to determine an auxiliary regression specific to the city of Volos which will be a useful tool for landlords and researchers on the niche market of student housing and its characteristics.

1.3 Utility of the research

When most people think of student housing, they are inclined to think of on-campus dormitories or residence halls. However in the city of Volos due to absence of university campus, about 7000 students live in rented apartments, and serving this population has created a niche market. Additionally, the resilience of the student housing market during the recent recession, coupled with increased consolidation and sophistication of the often regional and fractured business, has many investment players interested in this real estate niche. From a physical standpoint, student housing shares many of the characteristics with residential housing options, as both are heterogeneous and typically offer the same things such as bedrooms, bathrooms, physical and relative location etc. However there are differences such as physical features, management process or the way the characteristics are perceived.

Many studies have been conducted to analyze how individual characteristics contribute to pricing for single-family houses, but little has been studied about apartment communities

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and even less has specifically addressed student housing and especially for the city of Volos which is our objective.

The purpose of this study is to explore through questionnaires answered by students of University of Thessaly from the departments of Early Childhood Education, Architecture Engineering, Economics, Primary Education and Civil Engineering all of them studying on their first and last year of studies, and the use of hedonic price model the student housing market in the city of Volos and try to develop a regression that will represent its function.

1.4 Structure of the dissertation

The intent of this quantitative study is to evaluate the marginal contribution of the individual characteristics that comprise student housing properties with the use of a hedonic regression model to single out marginal contributions.

This dissertation will progress as follows:

-Chapter 2 (The Hedonic Price Model) will discuss an overview of the HPM through the work of Lancaster and Rosen. From the general forms of HPM and their implications on implicit markets their use in students housing is next presented.

-Chapter 3 (Review of the Literature). In this chapter previous studies and findings regarding hedonic valuation of physical and locational characteristics for residential and transient housing, as well as a review on student housing will be presented.

- Chapter 4 (Method-Results). The method used for the analysis as well as the findings of the research will be presented in this chapter.

- Chapter 5 (Conclusions) in that final chapter conclusions, limitations of the study and recommendations for future research will be briefly discussed.

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Chapter 2 : Hedonic Price Models

2.1 Introduction

The hedonic model is based on the hedonic hypothesis that goods are valued for their utility (Rosen, 1974). Utility is either perceived or actual, and is objectively measured by its attributes. The hedonic model can be used to "clarify the meaning and interpretation of estimated implicit prices" and "identify the underlying structural parameters of interest" (Rosen, 1974).

Hedonic price models date back to Waugh (1928) and after him Court (1939) and Stone (1954). Waugh with his study "Quality Factors Influencing Vegetable Prices" in 1928 is considered the first researcher to introduce hedonic models on implicit prices. His study focuses on the measurement of the physical qualities of food that influence consumer choices. After him Court by his "Hedonic Price Indexes with Automotive Examples" in 1939 tried to estimate the implicit price coefficients for the characteristics of cars such as horsepower and breaking distance etc. He combined all the car characteristics to produce a complex index for the satisfaction which consumers gain from differences in quality and price of the car they bough. However the basis of the use of Hedonic Price Models in real estate was laid down by Rosen (1974), and a little bit earlier by Lancaster (1966). Lancaster's consumer theory through a range of topics such as housing market, financial assets, the labour-leisure trade off, and the demand for money establishes microeconomic foundations for the analysis of utility-bearing characteristics. He uses the term "household production function" to identify the relationship between quantities of goods and quantities of characteristics. With his model he focuses on the demand side of the market and the utility households derive from the set of characteristics of the goods they can afford with their budget. Rosen (1974) on the other hand speaks of maximization of the consumer's utility and maximization of producer's utility and he demonstrates that in equilibrium the hedonic price function represents the "gold union" of this functions. Rosen used a vector of objectively measured characteristics to represent differentiated products and then by the observation of the product prices and the amount of the characteristics each good have, he estimates a set of implicit or hedonic prices.

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2.2 Overview in the theory of Hedonic Price Model (HPM)

The main assumption of Hedonic Price model theory is based on the fact that for some goods the price *p* is related to a fixed number of characteristics (say *k*) which is measured by quantities z_k. By the hedonic price model the transaction price is decomposed into various components or characteristics (Oduwole and Eze, 2013). The most common form of HPM is as following

$$p = f(z_1, z_2, \ldots z_k, \xi_k) \quad (1)$$

where $\xi\kappa$ is the random error term, generally known as white noise. In literature mainly three types of models are used and these are linear, semi-log and double log model which are expressed as below:

Linear model: $p = f(z_1, z_2, \ldots z_k, \xi_k)$ (2)

Semi-log model: $Log\ p = \beta_o + \sum_{\kappa=1}^{N} \beta_k z_k + \xi_k$ (3)

Double-log model: $Log\ p = \beta_o + \sum_{\kappa}^{N} \beta k Log zk + \xi_k$ (4)

Where β_o and β_κ are the intercept term and the characteristics parameters to be estimated, *p* is the dependent variable and z_k are the independent variables (explanatory variables).

A thing that every researcher should account is the correct functional form used, as otherwise the HPM model become inefficient. By definition HPMs don't have a specified form; it is up to the researcher to choose the correct form fitting to its assumptions arbitrarily. In literature there is a tendency to consider HPMs nonlinear models, although there are many examples of linear hedonic models (Ekeland, 2002; Kauko, 2003). In practice, the linear regression of HPF is not always reasonable under the hedonic price theory since is assumed that inherent prices of characteristics/attributes is constant. Hence the linear form should be excluded from the hedonic price function, since the characteristics parameters are allow to change over time when demand and supply conditions changes. It can be assumed that the only allowance for the linear from should be that price is constant for a very short time and for reasons best implied by the researcher. Rosen in his model adopted the "goodness-of –fit" criterion, examining several forms for the relationship between attributes and commodities. Following his example many researchers use the Box-Cox form or the Box-Cox transformation in order the statistical validity of alternative hypothesis about the functional form to be tested. On the other hand Cassel and

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Mendelsohn (1985) contended that the many parameters estimated in the Box-Cox transformation reduce the accuracy of any single coefficient.

Another issue researcher should give attention to on the application of Hedonic Price Models is when an irrelevant independent variable is included (over-specification) or when a relevant independent variable is omitted (under-specification). Under-specification leads to biased estimates and an estimated covariance matrix that may be severely misleading, while over-specification leads to inefficiency. As the hedonic price model deals with the implicit prices of quantities of attributes of a product, the problem of misspecification of variables is inevitable. On this matter a solution to the problem of missing variables is to use data sets that are homogeneous so the hedonic price approach is justified.

2.3 Lancaster's consumer theory

In 1966 Kelvin Lancaster introduced a new approach to consumer theory and basically he analyzed fundamental characteristics of a product and argued that the demand for a product is not only based on the product itself, but on its characteristics also. His approach is built upon activity analysis to model the combinations of characteristics in the household production process that can be achieved given assumptions on

(i) whether combinations of goods are possible or not in a market,

(ii) whether combinations can be made in a linear way or not,

(iii) whether the number of characteristics is larger or smaller than the number of goods containing then, etc.

Goods with heterogeneity (such as housing) have a series of integrated characteristics, and the good's price depends on this characteristics. Households buy these goods and use them as "investment" by turning them into utilities. Utility on its turn depends on the quantity of the different characteristics, making the analysis of such goods market, with the traditional economic models, difficult because they cannot be considered by a single total price.

Lancaster's model may be defined more precisely as follows: A consumer maximizes an ordinal preference function for characteristics, U(z), where z is a vector of characteristics 1, . . . , r, subject to the usual budget constraint $px \leq X$, where p is a vector of prices for each of these goods and K is income. Goods, x, are transformed into characteristics, z, through the relation $z = Bx$, where B is an R x N matrix which

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transforms the N goods into R characteristics. The model may therefore be written succinctly as:

Maximize U (z)

Subject to $px \leq K$

With $z = Bx$.

His model postulates that goods are employed either singly or in combination to produce the characteristics which are the source of the consumer's utility. Lancaster adopted then the idea of hedonic prices of a product which content implied prices of each characteristic and a price structure is formed by all hedonic prices. In his model a linear relationship between the price of the goods and the characteristics is assumed and the implicit prices are constant over ranges of characteristic amounts. Implicit prices can only change when the combination of goods consumed changes. Lancaster’s model explains the role of price in determining the demand for differentiated products. At the same time provides a framework for estimating the sensitivity of demand to changes in the relative price of brand. As shown in Lancaster’s work it is possible to estimate the price elasticity of demand given the knowledge of the distribution of consumer preferences either by assuming that all consumers have linear indifference curves or in more complex analysis where curves are non-linear or when there are more than two relevant characteristics.

In conclusion there is no doubt that Lancaster’s model provide valuable economic insights and a useful framework for empirical demand analysis from survey data. His work definitely adds some subtle refinements to the current application of conjoint measurement and scaling models.

2.4 Rosen’s theory

Rosen in 1974 by his article “Hedonic Prices and Implicit Markets: Product Differentiation in pure Competition” presents a model based on the hedonic hypothesis that goods are valued for their utility-bearing attributes or characteristics. He defines the hedonic prices as the implicit prices of attributes, which are revealed by the differentiation that products have and the observed prices related to the specific characteristics.

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Assuming one intrinsic group of goods yielding characteristics $Z_1, Z_2, \ldots, Z_n$ and defining y as all other goods consumed, Rosen's model may be stated as

Maximize $U(Z_1, Z_2, \ldots Z_n, y)$

Subject to $P(Z_i, Z_2, \ldots Z_n) + y\ K,$

Where the price of y is set equal to one dollar, K is income, and $P(Z_i, Z_2, \ldots Z_n)$ represents the price of the one good yielding characteristics $Z_1, Z_2, \ldots, Z_n$, which is actually purchased. Despite its similarity to traditional economic model of utility maximization, in Rosen's model maximization of utility subject to the budget constraint which would show marginal utilities of characteristics, $\partial U/\partial Z_1$, proportional to their marginal prices, $\partial P/\partial Z_1$

His model amounts to a description of competitive equilibrium in a plane of several dimensions on which both buyers and sellers locate. The hedonic price model posits that goods are typically sold as a package of inherent attributes (Rosen, 1974). Rosen's theoretical foundation leads to a two step approach as follows: on the first stage a measure for the price is developed which will reveal the inverse demand function and on the second stage the inverse demand curve is estimated through the implicit price function estimated in the first stage. In contrast to Lancaster's model, Rosen's theory incorporates income directly in the budget constraint of the consumer. Every change in the income effects on the marginal willingness to pay for a certain implicit attribute. A major assumption on his model is that the buyer's willingness to pay for an attribute is a function of the utility level, the buyer's income and variables that influence tastes and preferences.

Rosen's model depends on the assumptions made about the supply side of the implicit market and therefore the identification of the inverse demand function poses some problems when the supply of a commodity is perfectly elastic or the supply of an attribute is fixed then the marginal price becomes exogenous in the estimation of the inverse demand function. On this direction Bartik (1987) argued that the hedonic estimation problem does not represent the interaction between demand and supply because suppliers cannot be affected by individual consumers and set endogeneity of both prices and quantities of attributes in the context of a non-linear budget constraint as the cause of the hedonic estimation problem.

Lancaster's and Rosen's models mainly differ in the following two ways: they use different functional form of hedonic regression and they address differently the issue

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whether the consumer buys a bundle of goods or separate goods. Lancaster on the one hand adopts the idea that consumers buy goods within groups based on the number of characteristics they possess per dollar. Therefore consumer's utility originates from the different characteristics (and not just the quantities of the different goods) that are provided by the goods themselves. Accordingly Lancaster's model is more appropriate for consumer goods while Rosen's model on the other hand, is more appropriate to estimate demand for durable goods. By assuming that through a range of goods consumers choose each good from a spectrum of brands and consume it discretely Rosen's model corresponds better to estimating demand for durable goods. Furthermore Lancaster in his theory assumes a linear relationship between the price of goods and its characteristics while Rosen argued that there is a non-linear relationship between the price of goods and their characteristics. A nonlinear price function implies that the implicit price is not a constant, but a function of the quantity of the attribute being bought, and on the quantities of other attributes associated with the good as well.

2.4 Hedonic Price model in housing market

Housing is a heterogeneous good, composed of a bundle of characteristics – both structural and locational (Sirmans et al., 2005). As locational characteristics the relationship between the housing unit and its surrounding environment as well as proximity to commercial amenities or points of interest, the quality of the neighbourhood, employment opportunities, or the school district and quality of schooling options are involved. Structural characteristics on the other hand refer to features like construction quality, the number of bedrooms, total square footage, interior finishes, age, etc. The hedonic model is used so the effect of the individual characteristics on the price of housing can be determined under several key assumptions. Some of these assumptions are homogeneity of house product, perfect competition of the market and finally that there is a market equilibrium and no interrelations between implicit prices of attributes. Several researchers argued that these assumptions are arguable as housing can be rather heterogeneous as differ in terms of locational, structural, or neighbourhood attributes, buyers and developers are free to enter and exit the market and individuals buyers or suppliers can not affect the price of

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the property. Finally market equilibrium in the real world property market is almost impossible as price vector does not adjust instantaneously to changes in either demand or supply at any point in time.

Despite these disputable assumptions, which involve substantial simplification and abstraction from a complex reality, the hedonic price model has been deployed extensively in housing market research (Ball, 1973; Chau et al., 2001; Freeman, 1979; Leggett & Bockstael, 2000). As astutely observed by Freeman, the data may be inadequate; variables are measured with error; and the definitions of empirical variables are seldom precise, but these do not render the technique invalid for empirical purposes. Ridker and Henning (1967) by investigating the relationship between air quality and property values, first applied the hedonic price approach in residence and after them Freeman (1979) used the hedonic price equation to measure the marginal implicit prices and the willingness to pay for housing attributes, such as environmental quality and gave the first theoretical justification of the application of HPM to housing. After them many researchers used HPMs in order to define the possible influence of the many attributes on the house price with a focus on locational, structural and neighbourhood attributes. While there is an extend literature on housing and HPMs, there is no direct research on the issue of student housing as a niche market of housing, especially in Greece.

2.5 Conclusions

Since Waugh (1928), Court (1939) and Stone (1954) the development of Hedonic Price method was slow but stable with a focus on goods such as food and car market. Only after Lancaster (1966) and Rosen (1974) the use of hedonic price models was laid in real estate and each one from a different point of view defined a relationship between the price of a good and a fixed number of characteristics. Several key assumptions are made in order the housing price to be connected to the individual characteristics of the house, assumptions not always uncontested. However until today HPM has been deployed extensively in housing market research and despite inadequate data, errors in the measurement of variables and inconsistence in the definition of empirical variables, the technique for empirical purposes is most subservient and acceptable. There are two stages to the hedonic price method, first hedonic housing price function is estimated and marginal implicit prices for the attributes of the house is calculated. Then secondly

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demand function for the attribute under investigation with the observed quantity demanded as a function of the marginal implicit prices is estimated.

Most hedonic studies only estimate the first stage, which is insufficient in large geographic area and large number of homeowners, where the second stage is required in order the marginal willingness to pay for attributes to be measured.

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Chapter 3 :Literature review

3.1 Introduction

Many researchers studying the relationship between market price and the value of the characteristics of a good are using hedonic price method (HPM), which applies on many sectors. HPMs are used in consumer and market research (e.g. Hirschman and Holbrook, 1982), calculation of consumer price indices (e.g. Moulton, 1996), tax assessment (e.g. Berry and Bednarz, 1975), valuation of cars (e.g. Cowling and Cubbin, 1972), computers (e.g. White et al, 2004), and finally to real estate economics. The fundamental idea of HPM is that the value of a commodity can be calculated by summing up the estimated values of its separate properties, and that is the reason HPM are used extensively in real estate and housing market research.

3.2 Historical review of HPM

In literature the first who introduced the method of hedonic regression seems to be Court (1939) who first used the term “hedonic” in order to explain the measurement of car’s characteristics such as horsepower, window area, seat width etc.
Robert and Shapiro (2003), commenting on Court’s methodology, contend that “…implicit price components for each of a bundle of product characteristics are determined by a regression procedure that expresses the price of a product as a function of the coefficients associated with each characteristic. The price of a new product (or different product) can then be compared with that of the previously existing product when one utilizes these coefficients…”.
There is another group of researchers pioneered by Colwell and Dilmore (1999) argue that Haas (1922) by analyzing the prices per acre in relation to the year of sale, road type and city size from farm sales in Minnesota, actually a hedonic method but without the use of the term “Hedonic” in his study. Thirty years after Haas’s study another scholar Houthakker (1952) by assuming that consumers purchase only negligible fraction of all goods available to them without having to deal with a myriad of corner solutions required by conventional theory, laid the foundations for Becker (1965), Muth (1966) and Lancaster (1966) to develop their theories on the utility bearing characteristics of a good from the point of consumers behaviour. Despite the fact that emphasis is given on consumer behaviour, properties of market equilibrium have not

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been worked out and goods do not posses final consumption attributes but rather are purchased as inputs into self-production functions for ultimate characteristics. A few years later Griliches (1958) popularised HPM at the early stage by studying firstly the demand for fertilizer in relation to the price of fertilizer with different components and secondly automobile price indices using automobile models as unit of analysis. Although his work was published in an inaccessible publication he embedded technological change and innovation into hedonic prices through the quality of goods and attracted considerable attention.

After all these researchers it is widely recognised that the most important theoretical foundations of the HPM are Lancaster's consumer theory and Rosen's model. With his model Lancaster (1966) focuses on the demand side of the market and uses a fixed relationship between quantities of goods and quantities of characteristics called "household production function". Rosen (1974) on the other hand inspired by the work of Houthakker (1952), Becker (1965), Muth (1966), and Lancaster (1966), under the condition of equilibrium put forward a meticulous explanation of the implicit market and hedonic prices in the context of differentiated products. By his work Rosen analyses buyer and seller choices, market equilibrium and the empirical implications of the HPM.

3.2 Empirical issues on HPM

Despite the long history of hedonic price models there is very little guidance on the choice of the proper functional form and that is a great issue for a researcher because an incorrect form may result in inconsistent estimates. In Rosen's model there is not a specific functional relationship between the attributes and the commodities but the likelihood ratio test was used to compare the more restricted forms with the more complex forms derived from the Box-Cox transformation (Box & Cox, 1964). Box and Cox developed a model determining the functional specification which provides the best fit in terms of log likelihood. They argue that some transformations of the dependent variable are normally distributed and linearly related to some set of transformations of the independent variables. In their model if a transformation factor equals 1 the associated functional form of the variable is linear.

Lineman (1980) indicates a limitation on the Box-Cox transformation which is that the transformation cannot be applied to binary or dummy variables because they are not strictly positive (So, et al. 1996). In order to avoid functional misspecification, several

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attempts have been made to estimate the hedonic price models using semi- or nonparametric models, by the development of a flexible modeling of the influence of continuous covariates on the dependent variable.

Another issue associated with the hedonic price model is the misspecification of variables, where an irrelevant independent variable is included or where a relevant independent variable is omitted. Because of the fact that hedonic price model deals with the implicit prices of quantities of attributes of a product is unavoidable the problem of misspecification of variables, and to that direction Butler (1982) suggested that only those attributes that are costly to produce and yield utility be considered in the regression equation.

3.3 HPM on housing

As argued in the literature for housing a given housing unit is characterized as a bundle of attributes describing the structure itself, the land or the relevant locational characteristics. There is a differentiation in rents paid by students and to that fact contributes the heterogeneity of house market (apartments, houses or other types of units) as well as proximity to university, town center of amenities of the house itself. At any given time, there exists a given distribution over space of the supplies of these attributes, since the housing stock alters only slowly over time and the attributes are perfectly inelastic in supply (Brown and Pollokowski, 1977). By the use of hedonic analysis the effect of location and amenities on housing prices is depicted and the implicit prices of attributes are estimated through hedonic prices.

Sirmans and Macpherson‟s (2003) research, titled "The Value of Housing Characteristics," is one of many studies that has looked at the implicit value of single-family housing characteristics. Among their conclusions amenities in the house such as an extra bathroom or fireplace adds on price f the house. Research pertaining to rental units also indicates implicit values with positive and significant coefficients for bedrooms, fireplaces, and bathrooms.

In rental housing is used a model which hypothesizes that renters maximize their net utility by trading changes in price for changes in varied house attributes. Regarding to the effect of physical characteristics to the apartment on rents, there is a group of scholars including Des Rosiers and Theriault (1994), Sirmans, al (1990), Guntermann and Norrbin (1987), Jud and Winkler (1991), Ozanne and Malpezzi (1985), Sirmans et al. (1989), Sirmans, Sirmans and Benjamin (1990), and Smith and Belloit (1987) that

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include in the group of characteristics determining the level of rent, factors such as the number of bedrooms, number of bathrooms or other amenities offered. On the other hand Allen, Springer and Waller (1995) argue that factors like the above reduce the effectiveness of hedonic analysis as they work like submarkets.

One of the first hedonic price models used to research rental rates was the study of Marks (1984) which used data from the city of Vancouver to research "the extent, at the margin, to which controlled rent falls below the level it would reach if the particular unit were not controlled." Similar to Marks (1984) is the study of Sirman, Sirman and Benjamin (1989) which investigates the effects of various amenities on the rental rates for housing, and found out that several amenities such as parking or new kitchen have a great impact on rental rates.

3.4 HPM on students housing

Universities around world maintain residential campuses for their students or alternatively students live in off-campus housing. On the issue of location and the demand for student housing there is no direct research while there is a wealth of literature in the area of rent level and location. Many researchers used neighbourhood characteristics as proxies for location, between them are Benjamin, Sirmans, and Zietz, (1997) that include criminality, Smith and Kroll (1988) that include accessibility and Hoch and Waddell, (1993) that include distance from city center, employment center and university campus. Using the theory that "…land values should decline as distance increases from central points," Jaffe and Bussa (1977) conducted a study of students attending the University of Illinois with the central focal point being the center of campus. By their simple model adjusted rent per square foot and distance from campus were compared, and found out that there was a downward sloping relationship which confirmed that a university campus can be an effective focal point.

On student housing market there is also a report of Des Rosiers, Theriault (1996) which use hedonic models to accurately describe cause and effect relationship using for the analysis five markets. They found out that there were three main factors which contribute to the student rental prices, the first was amenities, services and physical characteristics, the second was location-based characteristics and the final factor was vacancies. In their research found that the strongest variable in the determination of rent was the distance and this led them to the result that a house in a central location near the university may drive landlords to increase rents throughout the academic year so they compensate for higher

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vacancies in the summer time. On the other side Guntermann and Norrbin (1987) by conducting a study of apartment rents in Phoenix, Arizona concluded that despite the strong location preference students may have, they are sensitive to the condition of apartment units with better quality units having significantly higher rents.

Location has always been an important determinant of a property's value and as for student housing is considered a niche market such that the supply of which has been adapted to meet the specific needs of the student population. In that niche market landlords have a tendency to increase the rents of small surface area accommodation accordingly, safe in the knowledge that they can recoup the rents of the students' apartments, which are paid for them by their families. Hoesli, M., Thion, B. and Watkins, C. (1997) in a research for Bordeaux city they argue that landlords overcharge considerably for renting small apartments to students. Furthermore in 2009, a student off-campus housing survey was administered at the University of Wisconsin-Whitewater (Kashian, 2009). Among their findings are the facts that 85% of the srespondents lived near campus, 65% lived in an apartment and 86.9% indicated that they have a private bedroom.

As we can notice from literature there are numerous studies on student housing for the United States, but there are fewer for Europe and even less concerning Greece. As the limited information suggests, off-campus student housing presents consumers and consumer mindsets that are likely to value housing differently than what has been studied so far. There are much more possibilities on the exploration of student housing. Especially in Greece very few studies have been conducted on that issue offering a unique research opportunity for academic researchers.

3.5 Conclusions

Since the application of Hedonic Models on housing many studies have been conducted, but to the direction of student housing there is little literature. However most of the existing literature attempts to model student rental prices using as variables distance to campus, number of bedrooms/bathrooms, utilities included, as well as a basic list of amenities (dishwasher, washer/dryer, parking, balcony or outdoor space, common space, exercise room, security etc.) as the most significant factors affecting rent per square foot in the student market. Even though the set of price-influencing characteristics are different across different markets in general we can notice than the factors mentioned above are the most commonly used by researchers.

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Chapter 4 : Method- Results

4.1 Introduction

There are several forms of housing such as detached houses, apartments, townhomes flats etc. From the above list students living in Volos have to choose their residence having in mind the characteristics and perceived benefits of these options. For example, the number of rooms in a house, the age of an apartment, or how close is to the sea or city center impacts the perceived utility, and therefore the monetary value of the property.
What if one wanted to know the worth of each characteristic? What is the marginal contribution of an additional room? How much does one year of age increase or decrease the monthly paid rent? Questions like these and more like them we will try to answer in this study. This study will use the hedonic pricing model to analyze student housing in the city of Volos and estimate the marginal contribution of the characteristics offered on monthly paid rent. Two different models will be developed in order the impact of structural, neighbourhood and locational characteristics on rent apartment price will be estimated.

4.2 Research method

4.2.1 The study area

The study area is the city of Volos, which is a coastal port city in Thessaly situated midway on the Greek mainland, about 326 kilometers north of Athens and 215 kilometers south of Thessaloniki. Volos is the capital of Magnesia regional unit with a population of 145.000 (2011) citizens and its economy is based on manufacturing, trade, services and tourism. Home to the University of Thessaly, the city offers facilities for conferences, exhibitions and major sporting, cultural and scientific events. In the city of Volos there almost 7000 students living in small or big apartments as the University of Thessaly offers only 40 rooms in its Student Residence Hall. The rest of the students finds shared or by themselves accommodation in the city. This study focuses on the factors that determine the choice of student’s residence and the monthly paid rent through the use of Hedonic Price Models. Data were kindly provided by personal research of Prof. P. Arvanitidis and were comprised of questionnaires. The questionnaires were given in students of University of Thessaly from the departments of Early Childhood Education, Architecture Engineering, Economics, Primary Education and Civil Engineering all of them studying on their first and last year of studies. Constitution of the respondents educational departments are as shown below on Table 1

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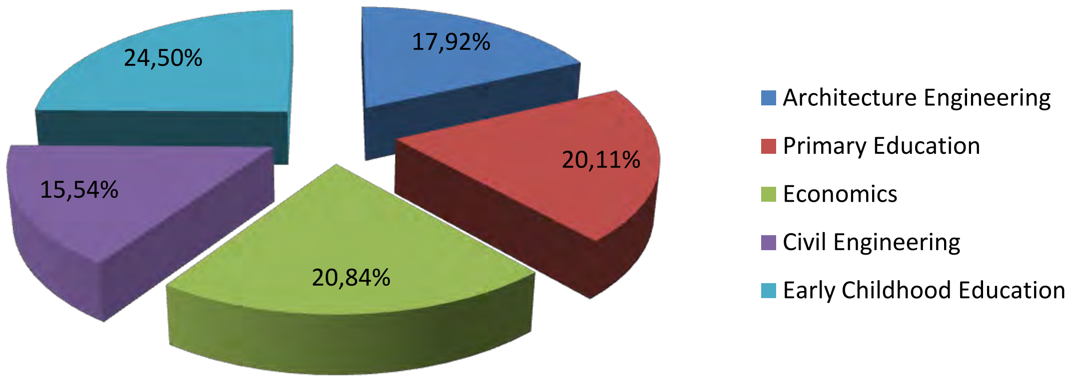
Table 1: Samples Structure



4.2.2 Questionnaire-inquires definition

This empirical study used questionnaires as research tool which was developed mainly in three sections as following:

A. **structural characteristics**, in this section several features of the unit are included as independent variables like construction quality, the number of bedrooms, total square footage, age, etc

The first question respondents were called to answer was about the type of house unit whether there is an apartment, a duplex apartment or a detached house. This variable was considered dummy in our model and almost 91% of the students answered that they live in an apartment. After that the floors in which the apartments is was explored. This variable was also considered dummy and almost 39% prefer to live above the third floor. Another dummy variable in our questionnaire was the existence of elevator in the building and only 16% of the buildings have no elevator. Another important question was the size of apartment measured in square meters and as we can observe from the data an allotment of 29.69% prefers apartments of between 51-70 m2. Next questions were about the number of rooms and bathrooms existing in the apartment as well as the existence of kitchen in a separate room. On average most of the apartments have two rooms and one bathroom and on half of the apartments kitchen is a separate room. Age of the building and renovations were the next questions and on the whole most of the apartments are built before 2004 although there are some that they were build in

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1950 but with almost half of them been renovated in the kitchen or bathroom. Next group of questions also concerning structural characteristics of the houses was the existence of furniture, air-condition, fireplace, the kind of heating source used, solar system for water heating, safety door, alarm, decks, view, garden, parking space, storehouse and the quality of indoor and outdoor of the apartment. All the above variables were used as dummy variables in the model in order the structure of the unit to be more specific.

B. **locational characteristics**, in this group of questions, characteristics of the location of the unit are included which define its position near a supermarket, the city centre, a bus station, a park, the sea, a church or proximity to university. The general expectancy is that the further the unit from points of interest the lower the monthly paid rent.

C. **Neighbourhood characteristics,** next in this part of the questionnaire, features of the neighbourhood and surrounding environment are presented. Questions developed in this section were about buildings and environment quality such as noise level, security, public spaces, parking spaces or the existence of friends, relatives or colleagues in the neighbourhood.

D. **Cost characteristics,** in this final group of questions economic characteristics of the apartment are included. The provision of receipt for the paid rent, the amount of deposit requested for the agreement, the existence of common shares on rent and finally the capacity of landlord paying the electricity and water bill are the questions of this section.

4.2.3 Methodology

The following procedure was applied to all variables and was carried out for statistical computing the hedonic price model that respond to our data.

1. First the variables were selected using stepwise LS regressions
2. Test for heteroskedasticity and change of variables which provoke problems
3. Outlier exclusion using studentised residuals
4. LS coefficient estimation and final variable selection
5. Final regression and model specification

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After estimating stepwise LS regression, through the use of statistical program SPSS, we selected 9 variables which consist model A and 10 variables which were used developing model B. We also tested both models for collinearity with the Variance Inflation Factor (VIF). The VIF provides an index that measures how much the variance of an estimated regression coefficient is increased because of collinearity. All VIF values in our models are far below 10, which indicate no collinearity problem. Besides the model coefficients, standard errors (SE), coefficients for standardized variables and t statistics (T stat.) are computed. The SE represents the average difference between the estimated coefficient and the true coefficient. Scaled coefficients are computed because they can be directly compared with each other. The higher the absolute value the stronger the impact of a variable. The t-test is used to examine the hypothesis that a regression coefficient is actually equal to zero. Higher t-values indicate a higher precision of the estimated parameter. To appreciate goodness of model in general, the Akaike's information criterion (AIC) is used. This index basically takes into account both the statistical goodness of fit and the number of parameters that have to be estimated to achieve this particular degree of fit, lower AIC values indicates better model specification.

4.2.4 Variable definition and descriptive statistics

In our study two different models are compared in order to include locational and neighbourhood characteristics as well. In model A only statistically significant variables are included while in model B variable related to distance to the city center was added.

4.2.4.1 Variable definition

Table 2 provides the variables included in models A and B. There are three mainly hedonic variable types; structural, locational and neighbourhood characteristics, some of which are dummy and some continuous. As dependent variable rent price per month is used, and all the other variables are independent or predictor variables.

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Table 2: overview of variables

s/n	Variable name	Variable type	Variable code	Description & variable measurement
1	Rent Price	Dependent	RENT	Rent price per month in Euros
2	Lot size	Continuous	SQMTR	The size of the whole residential apartment measured in m2
3	Building age	Continuous	BUILDINGAGE	The age of the building measured in years with base year 2014
4	Number of rooms	Continuous	ROOMS	Total number of rooms excluding bathrooms and kitchen
5	Detached house	Dummy	DETACHEDHOUSE	Whether the unit is a detached house (yes=1, 0=otherwise)
6	Fireplace	Dummy	FIREPLACE	Existence of fireplace in the apartment (available =1, 0=otherwise)
7	Air-conditioning	Dummy	Air-condition	Existence of air-conditioning in the apartment (available =1, 0=otherwise)
8	Distance from sea	Continuous	DISTSEA	The distance of the apartment from sea measured in minutes of walk
9	Receipt	Dummy	RECEIPT	Provision of receipt of the monthly paid rent
10	Income of the	Continuous	INCOMENEIGH	The income level of

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	neighbourhood			the neighbourhood measured in a scale of 0-10
11	Distance from city center	Continuous	DISTCITY	The distance of the apartment from city center measured in minutes of walk

Table 3 shows the descriptive statistics of the final variables included in Model A and B. Data set used in both models contains about 400 observations and it stands out that the building stock represented in this data set is quite old as on average buildings were build 20 years ago. Furthermore most apartments are with two rooms and around 55 m^2 and as we can see monthly paid rent is configured around 302.27€. On average apartments are located near points of interest such as sea or the city center with a mean of 10 minutes of walk for each destination.

Table 3: Descriptive statistics of variables

	RENT	SQMTR	BUILDINGAGE	ROOMS	DETACHEDHOUSE	FIREPLACE	AIRCONDITION	DISTSEA	RECEIPT	INCOMENEI	DISTCITY
Mean	302,2127	54,5482	20,9518	2,2030	0,0152	0,0635	0,3655	11,2064	0,8985	6,4319	10,1060
Maximum	800,0000	200,0000	64,0000	6,0000	1,0000	1,0000	1,0000	240,0000	1,0000	10,0000	100,0000
Minimum	60,0000	25,0000	4,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Std. Dev.	73,17007	21,4437	12,9817	1,0285	0,2262	0,4408	0,4822	14,0658	0,3024	1,4621	8,7005
Skewness	1,2333	1,62763	0,81797	0,94812	7,91721	3,58159	0,55867	11,26490	-2,63875	-0,58620	3,41592
Kurtosis	9,38888	9,2688	3,1251	3,4027	63,6821	13,8278	1,3121	179,4573	7,9630	4,9592	31,1983
Jarque-Bera	818,691	819,09900	44,19244	44,14501	64567.56	2767,04900	67,26587	519501.5	861,60070	84,49326	14030.29
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

4.3 Estimation results

4.3.1 Model A

Through the use of statistical program EVIEWS and by the method of Least Squares Model A is specified as linear model with the monthly paid rent as dependent variable. It concludes 416 observations and 9 explanatory variables.

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After running the first equation there were signs of heteroskedasticity, which exists as a problem for most cross-sectional data collections such as ours. It occurs when the disturbance term in each observation is not constant and results in coefficient estimates that are inefficient. Because we did not know what the form of our heteroskedasticity might look like, we used White's correction because it does not require a form to be specified. White's correction is an automated correction in statistical program Eviews that corrects the standards errors to normalize the output. Our model seems to have no collinearity problems as all VIF values are below 10 , our R^2 adjusted is 0.420 which indicates that our model explains 42% of our total variance. To compare goodness of models in general, the Akaike's information criterion (AIC) is used. This index takes into account both the statistical goodness of fit and the number of parameters that have to be estimated to achieve this particular degree of fit. Lower AIC values indicate a better model specification. In model A, AIC criterion is 10.80 which is low and indicates a good fitness of the model.

Table 4 shows the estimated LS coefficients and important model diagnostics. Number of rooms turned out to have important influence on rent as an increase of one unit on rooms cause an increase of 16.57€ on monthly paid rent; holding all other variables constant. Additionally total size in square meters have a positive influence on rent, and more specific an increase of one m^2 cause an increase of 1.19€ on monthly paid rent. Existing of amenities such as fireplace and air-conditioning in the apartment seem to influence positively the monthly pad rent as existence of fireplace adds 36.86 €on monthly paid rent and the existence of air-conditioning counts up 14.73€ on monthly paid rent. A noticeable observation from model A is that there seems to exist a trend on student's choice towards apartments as the existence of detached house has a strong negative influence on rent. As expected building age has a negative price impact on monthly paid rent with a year change on building age reflecting a decrease of rent by 1.82€. Distance from sea also pervades negatively monthly paid rent as an increase of one minute walk on distance from sea cause a decrease of 0.54€ on rent; holding all other variables constant. Finally a strong positive influence on monthly paid rent seems to have the provision of receipt as landlords seem to increase monthly rent by 12.1€ if tenant asks for receipt. As expected the income level of residents in the nearby area seems to influence positively monthly paid rent.

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Our final regression for Model A appears as following:

$$RENT_i = \beta_0 + \beta_1 SQMTR_i + \beta_2 BUILDINGAGE_i + \beta_3 ROOMS_i + \beta_4 DETACHEDHOUSE_i + \beta_5 FIREPLACE_i + \beta_6 AIRCONDITION_i + \beta_7 DISTSEA_i + \beta 8 RECEIPTi + \beta_9 INCOMENEIGHi$$

And more precisely, after using the results of our regression analysis, the following equation was produced:

$$RENT_i = 198.44 + 1.19\ SQMTR_i - 1.82\ BUILDINGAGE_i + 16.57\ ROOMS_i - 66.74\ DETACHEDHOUSE_i + 36.86\ FIREPLACE_i + 14.73 AIRCONDITION_i - 0.54\ DISTSEA_i + 12.19\ RECEIPTi + 3.98 INCOMENEIGHi$$

Table 4 : Estimated coefficients and diagnostics

	Model A			Model B		
VARIABLES	Coefficient	t-Statistic	Prob	Coefficient	t-Statistic	Prob
C	198,44890	10,72741	0.0000	196,96600	10,37685	0.0000
SQMTR	1,19842	3,74628	0.0002	1,16988	3,65311	0.0003
BUILDINGAGE	-1,82548	-9,20951	0.0000	-1,87861	-9,34333	0.0000
ROOMS	16,57121	2,62721	0.0090	17,37777	2,73444	0.0066
DETACHEDHOUSE	-66,74181	-1,92613	0.0549	-66,03266	-1,87728	0.0613
FIREPLACE	36,86585	1,60377	0.1096	37,06421	1,61303	0.1076
AIRCONDITION	14,73054	2,60507	0.0096	15,01145	2,60865	0.0095
DISTSEA	-0,54952	-3,11212	0.0020	-0,46908	-2,45765	0.0145
RECEIPT	12,19678	1,21173	0.2264	14,55064	1,44801	0.1485
INCOMENEIGH	3,98214	2,00401	0.0458	4,14472	2,08370	0.0379
DISTCITY				-0,20261	-0,58449	0.5593

	R-squared	0.434581	R-squared	0.438287
	Adjusted R-squared	0.420484	Adjusted R-squared	0.422597
	Akaike info criterion	10,80840	Akaike info criterion	10,81007
	Schwarz criterion	10,91396	Schwarz criterion	10,92665
	F-statistic	30,82935	F-statistic	27,93363
	Prob(F-statistic)	0.000000	Prob(F-statistic)	0.000000
	Number of observations	416	number of observations	416

4.3.2 Model B

As well as in Model A, Model B is specified as linear model with monthly paid rent as dependent variable. It includes 416 observations and 10 explanatory variables.
Model B was also corrected for heteroskedasticity by the automated correction of statistical program EVIEWS and our model seems to have no collinearity problems as all VIF values are below 10. As we can see from model summary Table 3 above Model B has similar to Model A R^2 adjusted with a value of 0.422. This fact indicates that

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Model B explains slightly better total variances of our models. Again in model B, AIC criterion is 10.81 which is low and indicates a good fitness of the model.
Table 6 shows the estimated LS coefficients and important model diagnostics. As already seen in Model A, number of rooms is a strong price determinant as an increase of one room increase the monthly paid rent by 17.37€. Total size of the apartment is also positively interrelated to the monthly paid rent with an increase of one m^2 reflecting an increase of 1.169€ on rent. Amenities such as fireplace and air-conditioning seems to play an important role with existence of fireplace adding 37.06€ on monthly paid rent and existence of air-condition increasing monthly paid rent by 15.01 €. As found in model A, in model B detached house has a strong negative effect on rent and reflects student's preference on apartments rather than detached houses. The new variable added in model B is distance from the city center in an attempt to include in the model more locational characteristics. Distance from city center, as well as distance from the sea, as expected has a negative effect on rent with a every minute further from city center decreasing monthly paid rent by 0.20€ and every minute of walk further from sea decreasing monthly paid rent by 0.46€.

Our final regression for Model B appears as following:

$$RENT_i = \beta_0 + \beta_1 SQMTR_i + \beta_2 BUILDINGAGE_i + \beta_3 ROOMS_i + \beta_4 DETACHEDHOUSE_i + \beta_5 FIREPLACE_i + \beta_6 AIRCONDITION_i + \beta_7 DISTSEA_i + \beta_8 RECEIPTi + \beta_9 INCOMENEIGHi - \beta_{10} DISTCITYi$$

And more precisely, after using the results of our regression analysis, the following equation was produced:

$$RENT_i = 196.96 + 1.16\, SQMTR_i - 1.87\, BUILDINGAGE_i + 17.37\, ROOMS_i - 66.03\, DETACHEDHOUSE_i + 37.06\, FIREPLACE_i + 15.01 AIRCONDITION_i - 0.46\, DISTSEA_i + 14.55\, RECEIPTi + 4.14 INCOMENEIGHi - 0.20 DISTCITYi$$

4.2.6 Analysis of the results

Hedonic models generally produced expected coefficient signs. There are some clear patterns that emerge when we analyze the demand for student housing in the city of Volos. In both the regression and the descriptive statistics apartments are paramount. In both models students chose apartments rather than detached houses. Furthermore amenities such as fireplace and air-condition unit effect positively the monthly paid rent. The most noticeable observation is that despite the fact that location of the

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apartment is an important issue for students existing of amenities have stronger impact on monthly paid rent. In both models fireplace adds more than 35.00 € on rent and the existence of air-conditioning adds more than 14.00€ on monthly paid rent. While students do not place much value on total size of the apartment in square meters they appreciate an additional room and landlords add on rent more than 15.00€ for every extra room of the apartment. Location seems to be an important issue for students as we can see from both models living closer to the sea or the city center increases the monthly paid rent. Finally age of the building as expected has a negative effect on rent as in both models a year older building decreases rent by more 1.15€.

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Chapter 5: Conclusions

Hedonic analysis of housing market is an important part of the toolbox of applied urban economics. This technique has been evolving over the last decade and has become very important in the past 25 years, despite the fact that the use of hedonic prices has difficulties many of which have been only poorly understood.

The intent of this study was to evaluate the marginal contribution of the individual characteristics that comprise student housing properties, through the use of a hedonic regression model after collecting data by questionnaires, and for this purpose two hedonic models were developed for students residence in the city of Volos. The obtained results are similar to the ones reported in the literature. As we can notice student housing submarket offers a unique environment for the valuation of housing characteristics and by the regression results of this study coefficients for certain variables on monthly paid rent was calculated. It became more apparent how proximity to points of interest, the additional number of rooms and the existence of amenities such as fireplace and air-conditioning can impact students on choosing their house. A noticeable observation derived from this study is that students do not place as much value on being close to points of interest, they do place a great deal of value on the existence of amenities. Furthermore the level income of the neighbourhood seems to be an important factor on the choice of student residence. Neighborhoods with wealthier inhabitant tend to increase monthly paid rents. One of the most interesting issues is the results for the provision of receipt upon rent. In both our models if tenants ask for a receipt for the money they pay as monthly rent landlords tend to increase rent price. Finally despite the fact that houses are not that old and some of them have been renewed age of the building influences negatively rent.

On student housing market, pricing and valuation is a complex procedure because of the infinite number of possible options, features and amenities available.

This study attempted to add a small body of academic literature regarding student housing. As student housing market continues to grow and mature more and more research will be greatly appreciated. This study consist a preliminary study on student housing in the city of Volos. Further research may help to better understand the relationship between rent and student housing.

In closing, a study such as this has limitations related to the hedonic property method's assumptions about information availability and mobility or the limitation

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is that this is a case study based on relative factors and therefore the results may not be generally applied to other populations. An interesting extension would be to perform the same analysis for other cities in Greece.

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02/06/2024 04:29:49 EEST - 18.227.21.169

Bibliography

Allen, M. T., et al. (1995). Implicit pricing across residential rental submarkets. The Journal of Real Estate Finance and Economics. 11. Pp. 137-151.

Ball, M. (1973). Recent empirical work of the determinants of relative house prices, Urban Studies, vol. 10, pp. 213-233.

Bartik, T. J. (1987). The estimation of demand parameters in hedonic price models, Journal of Political Economy, vol. 95, no. 11, pp. 81-88.

Benjamin, J. D., et al. (1997). Security Measures and the Apartment Market, Journal of Real Estate Research. 14. pp. 347–58.

Box, G. E. P. & Cox, D. R. (1964). An analysis of transformation, *Journal of the Royal Statistical Society Series B*, vol. 26, pp. 211-252.

Brown, G. M., Jr. and H. O. Pollokowski. (1977). Economic Value of Shoreline. Review of Economics and Statistics, 59. Pp. 272–78.

Berry, B. J. L. and R. S. Bednarz, (1975), 'A hedonic model of prices and assessments for single-family homes: does the assessor follow the market or the market follow the assessor?', Land Economics, Vol. 51, No. 1, pp. 21-40.

Becker, G. S. (1965), ‘A theory of the allocation of time', The Economic Journal, Vol. 75, No. 299, pp. 493- 517.

Butler, R. V. (1982). The specification of hedonic indexes for urban housing, *Land Economics*, vol. 58, pp. 94-108.

Cassel, E. & Mendelsohn R. (1985). The choice of functional forms for hedonic price equations: Comment, Journal of Urban Economics, vol. 18, no. 2, pp. 135-142.

Chau, K. W., Ma, V. S. M. & Ho, D. C. W. (2001). “The pricing of “luckiness” in the apartment market”, Journal of Real Estate Literature, vol. 9, no. 1, pp. 31-40.

Colwell, P. F. and G. Dilmore, (1999), ‘Who was first? An examination of an early hedonic study’, Land Economics, Vol. 75, No. 4, pp. 620-626.

Court, Andrew (1939), “Hedonic Price Indexes with Automotive Examples,” In The Dynamics of Automobile Demand, New York, NY: General Motors Corporation, pp. 99–117.
Cowling, K. and J. Cubbin, (1972), “Hedonic Price Indexes for United Kingdom Cars”, The Economic Journal, Vol. 82, No. 327, pp. 963-978.

Des Rosiers, F , Theriault, M. “Rental Amenities and the Stability of Hedonic Prices: A Comparative Analysis Of five Market Segments.” The Journal of Real Estate Research: Volume 12, issue 1. (1996)

Des Rosiers, F and M Thériault. (1994). Implicit Prices of Rental Services: Modeling the Quebec Market, Assessment Journal, 1. pp 47–60.

Institutional Repository - Library & Information Centre - University of Thessaly
02/06/2024 04:29:49 EEST - 18.227.21.169

Ekeland I.. Heckman J. J.. Nesheim L.. Identifying Hedonic Models. American Economic Review. Vol. 92 No 2. May 2002. 304 – 309

Freeman, A. M. (1979). Hedonic prices, property values and measuring environmental benefits: A survey of the issues, Scandinavian Journal of Economics, vol. 81, pp. 154-171.

Guntermann, K., Norrbin, S. "Explaining the Variability of Apartment Rents." Real Estate Economics: Volume 15, issue 4. (1987)

Houthakker, H. S. (1952), 'Compensated changes in quantities and qualities consumed', The Review of Economic Studies, Vol. 19, No. 3, pp. 155-164.

Hirschman, E. C. and M. B. Holbrook, (1982), 'Hedonic consumption: emerging concepts, methods and propositions', The Journal of Marketing, Vol. 46, No. 3, pp. 92-101.

Haas, G. C. (1922a), 'A statistical analysis of farm sales in blue earth county, Minnesota, as a basis for farm land appraisal', Masters thesis, The University of Minnesota.

Jaffe, A. J & Bussa, R. G. (1977). Using a simple model to estimate market rents: A case study. *The Appraisal Journal,* 7-13.

Jud, G. D. and D. T. Winkler. (1991). Location and Amenities in Determining Apartment Rents: An Integer Programming Approach. Appraisal Journal, 59. pp. 266–75.

Kashian, R. D. (2009). University of Wisconsin-Whitewater student off-campus housing survey. Research conduct by the Fiscal and Economic Research Center for the University of Wisconsin-Whitewater.

Kauko T.. Residential property value and locational externalities: On the complementarity and substitutability of approaches. Journal of Property Investment & Finance; 2003; 21 .3. pg 250

Lancaster, K. J. (1966), 'A new approach to consumer theory', The Journal of Political Economy, Vol. 74, No. 2, pp. 132- 157.

Leggett, C. G. & Bockstael, N. E. (2000). Evidence of the effects of water quality on residential land prices, Journal of Economics and Management, vol. 39, pp.121-144.

Marks, Denton. The Effect of Rent Control on the Price of Rental Housing: An Hedonic Approach. Thesis. The Board of Regents at the University of Wisconsin, 1984. Madison: University of Wisconsin, 1984

Muth, R. F. (1966), 'Household production and consumer demand functions', Econometrica, Vol. 34, No. 3, pp. 699- 708.

Martin Hoesli , Bernard Thion & Craig Watkins (1997) A hedonic

Institutional Repository - Library & Information Centre - University of Thessaly
02/06/2024 04:29:49 EEST - 18.227.21.169

investigation of the rental value of apartments in central Bordeaux, Journal of Property Research, 14:1, 15-26

Moulton, B. R. (1996), 'Bias in the consumer price index: what is the evidence?', The Journal of Economic Perspectives, Vol. 10, No. 4, pp. 159-177.

Oduwole, H. K and Eze, H.T , “A Hedonic Pricing Model on Factors that Influence Residential Apartment Rent in Abuja Satellite Towns” (Mathematical Theory and Modeling Vol.3, No.12, 2013)

Ozanne, L. and S. Malpezzi, (1985). The Efficacy of Hedonic Estimation with the Annual Housing Survey: Evidence from the Demand Experiment. Journal of Economic and Social Measurement. 13. pp. 153–72.

Ridker, R. G. & Henning, J. A. (1967). The determinants of residential property values with special reference to air pollution, The Review of Economics and Statistics, vol. 49, pp. 246-257.

Robert C. F. and M. D. Shapiro, (2003), ‘Scanner data and price indexes’, University of Chicago Press, pp. 25, 341.

Sirmans, G. Stacy, C.F. Sirmans, and John D. Benjamin. "Determining Apartment Rent: The Value of Amenities, Services and External Forces." The Journal of Real Estate Research 4.2 (1989): 33-43.

Smith, C. A. and M. Kroll. (1988). Improving Estimates of Potential Gross Income in Multifamily Properties through Market Research. Appraisal Journal. 1. Pp. 118–25.

Sirmans, G.S., et al (1990). Rental Concessions and Property Values. Journal of Real Estate Research, 5. pp. 141-151.

Smith, H.C. and J.D. Belloit. (1987). Real Estate Appraisal, 2nd Edition. Century VII Publishing. New York.

Sirmans, G. S. & Macpherson, D. A. (2003). The value of housing characteristics. Research paper completed for the National Association of Realtors.

Sirmans G. S., Macperson D. A., & Zietz, E. N. (2005). The composition of hedonic pricing models. Journal of Real Estate Literature, 13(1), 3-43.

So, H. M., Tse, R. Y. C. & Ganesan, S. (1996). Estimating the influence of transport on house prices: Evidence from Hong Kong, *Journal of Property Valuation & Investment*, vol. 15, no. 1, pp. 40-47.

Stone, R., 1954, The measurement of consumers’ expenditure and behaviour in the United Kingdom, 1920-1938 (Cambridge University Press, Cambridge).

Waddell, P., et al. (1993). Residential Property Values in a Multinodal Urban Area: New Evidence on the Implict Price of Location. Journal of Real Estate Finance and Economics. 7.. pp. 177-141.

Institutional Repository - Library & Information Centre - University of Thessaly
02/06/2024 04:29:49 EEST - 18.227.21.169

Waugh F. V. (1928), Quality Factors Influencing Vegetable Prices," Journal of Farm Economics 10, April, 185-196.

White, A. G., Abel, J. R., Berndt, E. R. and C. W. Monroe, (2004), 'Hedonic price indexes for personal computer operating systems and productivity suites', NBER Working Paper Series, Working Paper 10427.

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APPENDIX

EVIEWS REGRESSION RESULTS

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Table 5: Model A Regression Results

Dependent Variable: RENT
Method: Least Squares
Sample: 1 416
Included observations: 371
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	198.4489	18.49923	10.72741	0.0000
SQMTR	1.198420	0.319896	3.746277	0.0002
BUILDINGAGE	-1.825483	0.198217	-9.209512	0.0000
ROOMS	16.57121	6.307538	2.627207	0.0090
DETACHEDHOUSE	-66.74181	34.65075	-1.926129	0.0549
FIREPLACE	36.86585	22.98696	1.603772	0.1096
AIRCONDITION	14.73054	5.654557	2.605074	0.0096
DISTSEA	-0.549521	0.176574	-3.112122	0.0020
RECEIPT	12.19678	10.06558	1.211731	0.2264
INCOMENEIGH	3.982144	1.987092	2.004005	0.0458

R-squared	0.434581	Mean dependent var	298.4515
Adjusted R-squared	0.420484	S.D. dependent var	69.73838
S.E. of regression	53.08899	Akaike info criterion	10.80840
Sum squared resid	1017457.	Schwarz criterion	10.91396
Log likelihood	-1994.958	F-statistic	30.82935
Durbin-Watson stat	1.903750	Prob(F-statistic)	0.000000

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Table 6: Model B Regression Results

Dependent Variable: RENT
Method: Least Squares
Sample: 1 416
Included observations: 369
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	196.9660	18.98128	10.37685	0.0000
SQMTR	1.169876	0.320241	3.653113	0.0003
BUILDINGAGE	-1.878614	0.201065	-9.343329	0.0000
ROOMS	17.37777	6.355140	2.734443	0.0066
DETACHEDHOUSE	-66.03266	35.17459	-1.877283	0.0613
FIREPLACE	37.06421	22.97806	1.613026	0.1076
AIRCONDITION	15.01145	5.754496	2.608647	0.0095
DISTSEA	-0.469082	0.190866	-2.457648	0.0145
RECEIPT	14.55064	10.04872	1.448009	0.1485
INCOMENEIGH	4.144720	1.989119	2.083696	0.0379
DISTCITY	-0.202610	0.346645	-0.584487	0.5593

R-squared	0.438287	Mean dependent var	298.5786
Adjusted R-squared	0.422597	S.D. dependent var	69.82738
S.E. of regression	53.05977	Akaike info criterion	10.81007
Sum squared resid	1007891.	Schwarz criterion	10.92665
Log likelihood	-1983.458	F-statistic	27.93363
Durbin-Watson stat	1.869305	Prob(F-statistic)	0.000000

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