

# Hedonic pricing model and how housing prices are derived



The topic I have decided to research in my dissertation is the effect that determinants have on house prices. I will research a set number of houses in the Bradford area by researching the relationship between the determinants and the house prices. The aim of my dissertation is to research the hedonic price model and how factors are used to set house prices. I will try to explain how this determinant affects consumer's choice because spending on a commodity of this scale is a big decision for a consumer and is an important factor of consumption. Consumers also have a choice of preference and this can influence what is bought and other little factors will affect the prices of houses such as noise pollution or smell pollution and location and so on. This will be researched to see how house prices vary with changes in determinants such as the size of the house, house type, number of bedrooms, number of bathrooms, age of the house, number of garages, the location and the environmental advantage and the facilities available around the house. (Witte et al., 1979) The main question I will focus on is the effects determinants have on house prices.

My motives to base my dissertation on the hedonic pricing system is because I would like to know how determinants such as location and number of rooms and so on have an affects the price of houses. In this dissertation I will research micro side of housing prices and how different determinants affect house prices.

## **Theory**

In this paper I will research the possible use of the hedonic price model to value the implicit prices of housing characteristics in Bradford, UK. The housing market of a country is seen to be strongly connected with the wealth

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of nation. If the demand for housing is high this would trigger economic growth in many sectors of society, investment into a property is a very big decision that a consumer has to make as it is an investment and a consumption decision.

The word hedonic is used to define the construction of all the different parts of utility gained from different attributes of the commodity. Different consumers have different bid prices which they propose to the seller, the bid price is set out by the consumer as to what they believe is the amount of money they are wanting to pay for the good by holding on to a certain level of utility. By this we understand that the value of a house reflects the buyer's estimate of the utility he would gain from a set of attributes the house offers. (Rosen, 1974)

According to Triplett hedonic pricing method where created long before the framework was understood. The word hedonic was produced by Haas in a study 15 years prior to the study by Court made in 1941. The word "hedonics" is extracted from the Greek word that is "hedonikos" and means pleasure, interpreted in an economic context this will refer to utility gained from goods and their services. (Triplett, 1986)

The mechanism that is obviously used in the housing market is supply and demand. Every house has a different price summed up by different combinations for attributes and supply and demand in the local market. Each attribute is assumed to have its own market under hedonic analysis and has its own supply and demand. So each characteristic has its own price in the market. (Triplett, 1986)

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Buyer and the seller's interaction in the market results in offers and counter offers being exchanged. Demand of the product relies on the cost of the product and the customer's disposable income and his personal preferences. The supply of the product will depend on substitutes available i. e. houses in a different area or a smaller house and the amount of houses available. The market's function is to balance supply and demand through the price mechanism. If more of a product is demanded and there is less of its supply, buyers will bid higher and if there is more supply of the product buyers will bid lower. The demand conditions of housing effects the willingness of people to pay for the house. (Anselin, 1988)

The housing hedonic measurement system is used to estimate a price for non-noticeable characteristics such as local attractions, noise or air pollution or both and environmental facilities. In the past few decades the hedonic pricing model has been implemented expansively into the housing market and has been used to explore the link between the price of houses and the housing characteristics. The reason why this was heavily implemented was to examine housing demand for attributes and to set a guide of house pricing. (Casetti, 1972)

The 2 main approaches that have contributed to the work of hedonic prices are the work that was done by Lancaster in 1966 and his consumer theory and the second is the model suggested by Sherwin Rosen in 1974. These 2 approaches main aim was to put a price on attributes, the price was created on the relationship of the product and the attributes associated with it. (Lancaster, 1966: Rosen, 1974)

The Lancaster model assumes that products are part of a group and subject to the consumers budget constraint the goods in the group can be consumed in mixtures. Sherwin Rosen's model assumes there is a variety of goods and a consumer does not gain preferred characteristics by acquiring a group of goods, but a product is chosen from a variety and is consumed individually. (Lancaster, 1966; Rosen, 1974) The hedonic pricing model does not need the combined consumption of goods. (Lancaster, 1966)

Rosen assumed that if consumers could not separate and repackage arbitrage attributes, then it would be likely that they would be a non-linear relationship between the cost of a product and the inherent characteristics. A non-linear functions means the implicit price will not be constant. (Rosen, 1974)

In Sherwin Rosen's theoretical model on hedonic pricing, the equilibrium price function model method relies on the fundamental distribution of technology and preference. When under precise parametric assumptions of the latent distribution, like the Tinbergen linear-normal model in 1959, a convenient closed form can also be under taken by the equilibrium price function. Ekeland showed in 2004 that non-linearity is a basic property in the hedonic price function. A special case would be a linear function form because this can cause a vast amount of deviation from linear by there being marginal perturbations to the fundamental distribution of technology and preference. (Ekeland et al, 2002)

The link between the price of the house and the attributes associated with it are used in the hedonic pricing theory. The general form of the hedonic price function is shown below:

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$P$  = is the value of the house or its rental value

$\hat{\alpha}$  = under decided coefficients

$Z_i$  = vector of housing attributes variables

$\hat{\mu}$  = Random errors

Sherwin Rosen's model has two diverse phases. Estimation of the marginal price of a product is predicted with the group of attributes associated with it. The first phase of Rosen's model develops the price but it doesn't show the inverse demand function. The second phase is to locate the marginal willingness to pay function from the first phase. (Triplett, 1986)

In this model focusing on noise which is denoted as  $L$ , marginal willing to pay is estimated as:

$$MWTP = \hat{\alpha}, P(L, A)$$

$$\hat{\alpha}, L$$

The price a consumer is willing to pay for the good will be its market price.

As the consumer is optimising the price of the property by replacing utility

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bearings offered by the property with the price willing to be paid for the property this is a consumer's marginal willingness to pay. (Can, 1992)

## **General Attributes of House**

The classic hedonic pricing model creates a link between the qualities of a house and housing prices. The housing qualities can be split up in to 3 sections

S= Structural

N = Neighbourhood

L= Locational

The equation can be redrafted as:

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## **Locational**

The location of the house is very important as a house is immobile and the position is vital to determine its value. The location attributes may give more utility to the residents, the length of distance between the house and the resident's place of work as well as local entertainment facilities and other facilities such as the local gym, shopping centres, hospitals, distance from schools, distance from public transport facilities or restaurants can be examples of location attributes. (Dubin, 1992) In valuing a house these attributes add or reduce the amount of utility a resident can take from the housing services and this will have an impact on the price a person is willing

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to pay for the house after considering what utility he will gain from occupying it. (Witte et al., 1979)

The decision to buy a house can also depend on the decision to get your child into a particular school. This will depend on how close you live to from a school and if you live within the catchment area.

## **Structural**

A house provides many services it has to give resident utility, the services could be inform of the land, the amount of space available inside the house, the age of the house and amount of bathrooms and bedrooms and also other attributes such as a driveway or a garage etc. (Case and Quigley, 1991)

## **Neighbourhood**

Neighbourhood qualities can be identified as the services a community provides such as methods of waste disposal or local security services. A person can also create a constant quality cost of living link between different time and location, for example it can be tough to differentiate between the real difference in price between houses in Bradford and Leeds even though the supply and demand for house in both areas are different but also the attributes linked to them would also be different. A house in Leeds might have more land available than a house in Bradford, this is where hedonic price function allows us to differentiate between the different attributes available in each area. Other environmental attributes such as air pollution or noise pollution can have a negative impact on the price of the house i. e. a close by airport or air pollution i. e. a local poultry factory and also the postal effect in terms as how crime affects insurance. The neighbourhood could also



affect the price of insurance within an area, high crimes within an area would mean high insurance rates.

The value of houses is set to give a considered calculation of the assets, benefits and amenities that amass from owning the house. The valuations required are undertaken by many different people in the market such as mortgage lenders, property developers, real estate agents, analysts, market researchers and assessors and some more specialists. The market value put on the house can be valued using estimate procedures that look at the state of the house and surroundings and under what circumstances the property would trade in as open market. (Witte et al., 1979)

## **Empirical / Contextual literature review**

There are a variety of different hedonic regression models that have been suggested other to the model created for the spatial nature of variables. All the models use spatial characteristics of variables within the models to try to further develop the model. Even though most models are experimental models the results are critically analysed to see if the model is accurate and if the variables used in the model are believable and by this making a decision on what will be the best model to use for a group of data. (Dubin, 1992)

Court and Tinbergen where the first to implement any formal contribution to the hedonic price theory, Tinbergen showed that the hedonic wage function depended on the allocation of workers and a company's attributes and the amount of utility gained. He also showed that by predicting hedonic parameters you can recover utility and production function parameters.

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(Ekeland et al, 2002) Sherwin Rosen developed his own theoretical method in 1974, his method estimated demand and supply parameters if there is no obvious method available. (Rosen, 1974)

Mick silver used hedonic regression to estimate the quality adjusted price changes for TV's in the UK and it comprises many major empirical developments to deal with difficulties. The study provided results in price changes for TV's in the UK by exploiting EPOS scanners to their advantage unlike previous studies. The hedonic regression model includes omitted variables to tackle and reduce bias that rises from old and new models, weight is included even though the sale of the commodity can be significantly different, make-effects is consider to lessen the omitted variable bias as well as price-cost mark up. The hedonic approach used by Silver uses the estimation of implicit of the quality attributes of a product. Products are sold by many manufacturers and manufacturers normally supply more than a single model with different attributes associated with them. Silver's model being successful on the use on UK TV's shows how variables associated with the age of the model can be collinear with variables associated with price cost margin. Feenstra's method of hedonics by a linear design by implicitly contains bias from price cost margin is tested against a model which explicitly embraces the variables and the results were in favour of explicitly embraced variables. Parameters were found to be unstable over time because of the omission of price cost margin variables and the source of the bias being omitted variables. (Silver and Heravi, 2007)

A hedonic pricing model had been employed previously in the UK to gather standardised indices for the Halifax building society (Fleming, and Nellis, <https://assignbuster.com/hedonic-pricing-model-and-how-housing-prices-are-derived/>)

1991). A weighted index was used in 1982 to measure major housing patterns in UK, the model focused on the locational attribute as its only physical attribute. Thus, this piece of work allow for more refined research to take place and cover the range of physical attributes of a house (Fleming, and Nellis, 1991).

## **A Simple Linear Regression Model**

Below is the simplest form equation for the hedonic regression model:

$y$  = Unit price

$x_k$  = ...  $k = 1, 2 \dots$  Independent variables.

$a_0$  and  $a_k$  = Parameters to be established

$\hat{\mu}$  = Error term

A way to improve this model, is study locational data with spatial characters of a dataset, as it does not fully consider the effect of spatial location on unit price. Techniques to capture the spatial dependency and spatial heterogeneity have been discussed by numerous literatures. Spatial dependency has been discussed by Can and Dubin, while modelling techniques where developed to capture spatial heterogeneity. In addition some models created to identify both of them. ( Can, 1992)

## **Spatial Dependency Model**

A model suggested by Switzer(Switzer et al, 1982) is applied to study the effect of spatial dependency. The model was used to evaluate data for a

location that had been gathered from satellite classification maps.  $x_k'$  is added to the simple linear model:

One might claim that Correlations between  $x_k$  and  $x'$  can lead to unstable estimate and whether spatial dependency is present. If there was no spatial dependency then the model let alone the estimates would be improper.

## **A Geographically Weighted Regression (GWR) Model**

A Geographically Weighted Regression model was suggested by Fotheringham (Fotheringham and Brunson, 1999) to identify spatial variations in relationships. This model allows factors to be studied locally. The traditional regression model is rewritten as:

An observation is made in accordance to its proximity to point  $i$ .

## **A Spatial Dependency +GWR Model**

Below is the equation to investigate if both spatial dependency and spatial heterogeneity are present:

Like the spatial dependency model,  $x_{ki}'$  represents the corresponding values of the nearest sample to  $i$ . With the GWR technique regressions are localised at each point and the regression estimates the constraints at each sample points.

Models propose that the equilibrium price function is non-linear and linearity in most studies is treated as a constant assumption. The study by Cropper, Deck and McConnell on Monte Carlo in 1988 is often used as justification of this practice. The Monte Carlo analysis of how to predict the marginal

willingness to pay changes through competing functional form assumption, the distinctive feature of CDM's study was that it was theoretically consistent. CDM use the study of Wheaton's linear programming algorithm created in 1974 to answer the equilibrium vectors of the price of a house given specific assumptions of the utility gained, the availability or supply of housing and the allocation of preferences. By this it allowed CDM to match the true marginal willingness to pay for every individual characteristic such as number of bedrooms, number of bathroom, size of land etc

and predictions made by the 6 functional forms: semi log, linear, quadratic, double-log, quadratic box-cox and linear box-cox. (Cropper et al., 1998)

All the housing characteristics that enter in the utility function are encompassed in the hedonic regression model as an explanatory variable. The lower mean percentage error of predicting the marginal willingness to pay is produced by linear box-cox and quadratic box-cox. If a characteristic is replaced by a proxy or is unobserved this will change the results. (Cropper et al., 1998)

## **Empirical Model Specification**

3 empirical models were suggested by researchers to allow more flexibility in the hedonic pricing model as the hedonic pricing model was frequently criticised for not having suitable function form specification:

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## **The Hedonic Method**

The economic measurement which is the relationship between different prices of different goods and the attributes they are associated with. The function can be given as:

$$P = h(c)$$

P = price

(c) = is a  $k \times n$  matrix of characteristics.

This theory provides an economic perception of price measurement of different goods by deriving consumer utility attributes rather than a single factor of consumption (Lancaster, 1966 and Rosen, 1974).

We now look at the application of a hedonic approach to develop house price indices for the UK by Fleming and Nellis. The function used is:

$P_{it}$  – house price

t – represents the time period in which each house i is sold

$X_j$  – Various characteristics

$\epsilon_{it}$  – unmeasured Factors specific to each house

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Prices may be different due to supply and demand conditions of the housing characteristics. They can be due to qualitative or quantitative characteristics such as type of property and location etc. for qualitative characteristics and age of property, size, bedrooms etc. for quantitative characteristics.

(Fleming, and Nellis, 1991)

Given the data employed, qualitative characteristics will be represented by dummy variables which will either be 1 or 0, this will depend if the attribute is present or not.

Price can be created by characteristics and the characteristics can't be sold in the market. A property is thought to be a bundle of characteristics and each characteristic can increase the value of the property. A hedonic approach statistically builds up the price of a property adding features that sums up the value of the features. To obtain the price the property characteristics, environmental and neighbourhood properties will be included in an equation in the form of:

Property price = f (attributes)

## **Method**

The research I will carry out will be quantitative which will be obtained from housing estate website of my local area and a thorough research will be done to get the relevant information required. The data will be used to carry out an ordinary least square regression model (OLS) by using this format on SPSS. This will allow me to show how different determinants affect house prices and will be used to answer my dissertation question. The OLS

regression model is built on standard variables. The houses prices will be the <https://assignbuster.com/hedonic-pricing-model-and-how-housing-prices-are-derived/>

dependant variable and the determinants will be the independent variables. Each independent variables will be allocated a dummy variable and each variable will either be multiplied by 0 or 1, this will be done to see if a variable will be part of the regression or not. The OLS regression method will allow me to estimate the amount of impact each variable has on the price of a house.