

On the Price Formation of Single-Family House Properties – An Analysis of Comparable Sales Prices for Single-Family Houses in Some Regional Areas in Finland

Ari HILTUNEN, Finland

Key words: non-built housing property, price formation, price factors, regression analysis.

SUMMARY

The thesis deals with the comparable sales prices of non-built housing sites in the Helsinki, Jyväskylä, Kajaani, Lahti, Oulu and Turku regions in 1985 to 1998. There are 14 732 transactions in total in the town plan and building plan areas. The research methods are the regression analysis and the covariance analysis.

The study indicates that the most important price factors are the efficiency of the site, the zip code, the distance from the main centre of the region, the socio-economic status of the inhabitants, and time. The passing of the years changes the amount and direction of the price factors in all research areas. The price formation of non-built housing sites differs by the number and intensity of the price factors in different price formation areas. The price data for the regional level is sufficient when analysing the amount and the intensity of general price factors for single-family house properties. The hedonic price theory can be used for analysing the price formation of single-family house properties when the demand and supply factors are in the same model. The price formation of single-family house properties can be described with the model, in which all continuous variables are transformed by taking the natural logarithm.

TIIVISTELMÄ

Tutkimuksessa analysoidaan rakentamattomien asuinpientalokiinteistöjen kauppahintoja Helsingin, Jyväskylän, Kajaanin, Lahden, Oulun ja Turun seutukuntien alueilla vuosina 1985-1998. Kauppahintahavaintoja on 14 732 kappaletta ja niiden alueella on vuosina 1985-1998 voimassa joko asema- tai rakennuskaava. Tutkimusmenetelminä käytetään regressio- ja kovarianssianalyysiä.

Tutkimuksen mukaan rakentamattomien asuinpientalokiinteistöjen hintaa selittäviä tärkeimpiä tekijöitä ovat tontille kaavassa sallittu rakennusoikeuden määrä, tontin postinumerokohtainen sijainti, tontin etäisyys seutukunnan pääkeskuksesta, asukkaiden sosioekonominen asema ja ajan kuluminen. Ajan kuluminen muuttaa hintatekijöiden suuruutta ja suuntaa kaikilla tutkimusalueilla. Asuinpientalokiinteistöjen hinnanmuodostus eroaa toisistaan poikkeavilla hinnanmuodostusalueilla hintatekijöiden lukumäärän ja voimakkuuden suhteen.

On the Price Formation of Single-Family House Properties, an Analysis of Comparable Sales Prices for Single-Family Houses in some Regional Areas in Finland

Ari HILTUNEN, Finland

1. INTRODUCTION

The research subject is the price formation of single-family properties. In Finland the volume of non-built housing site transactions is approximately 7000 numbers per year and 168 million euro per year. So the research subject is always important and topical issue in Finnish property market.

In the early 1980's the real property market in Finland was quite stable. It changed radically in the late 1980's and the early 1990's. A steep fall in yields and a rise in asset values caused a boom in the real property market. Property prices exploded, especially in the Helsinki Metropolitan area.

The boom ended during 1989-1990 and some reasons were the high price of money and collapse of Soviet trade. At that time the property market suffered a lot through bankruptcies, unusual high vacancies, dramatic decrease of rents, increasing financial costs etc. Since 1994 the economy, as well as the property market, has improved fast in Finland. When we think this background, it is obvious that price formation mechanism has gone through many changes in 1985-1998 in Finland.

2. OBJECTIVES OF THE RESEARCH

Land and property are factors of production. As with any other asset, the value of property flows from the use to which it is put, and that in turn is dependent on the demand (and supply) for the product, which is produced. If there is a high demand for the product (at a fixed level of supply), the price will increase and the economic trend for the land or property will increase accordingly. This is the underlying paradigm of Ricardian rent theory where the supply of land is fixed and a single good produced. In such a case the rent of land is wholly an economic rent.

The price for which the land rents depends on the land's characteristics. This relationship can be represented by a hedonic equation (Palmquist 1989 and Rosen 1974):

$$R = R(z_1, z_2, \dots, z_n)$$

where R is the rental price (sales or asset price) of the parcel and $z = (z_1, \dots, z_n)$ is a vector of the n characteristics of the land. This function need not be linear, since many of the characteristics cannot be sold independently. The interaction of all demanders and suppliers of land in a particular market determine equation.

The hedonic house price function relates the price of a house to the implicit prices of its housing attributes. Thus a hedonic equation can be described (Orford 2000):

$$P(Z) = f(S, L) + \varepsilon$$

where P is a vector of observed house prices (or housing site prices), S and L are vectors of structural attributes and location attributes respectively and ε is a vector of random error terms.

The aim of research is to analyse the prices of non-built housing sites and factors that determine the price in Finland (Helsinki, Turku, Lahti, Kajaani, Oulu and Jyväskylä region) during 1985-1998. Next issues will be researched:

- Which factors determine the price of housing sites and how the factors do it
- How the price formation of housing sites can be described by the hedonic methodology
- What is the best formula for mathematical model and how the transformations of variables will affect the results?
- How the price formation of housing sites changes with different areas
- What is the most suitable area for the formation of price
- How the passing of the years affect to the price factors

3. FACTORS AFFECTING TO THE PRICE OF UNBUILT HOUSING SITES

There are several factors affecting to the price of non-built housing sites. Price factors, according to the land price theories and earlier studies, can be described as shown in table 3/1.

Table 3/1. Factors affecting to the price of non-built housing sites according to the land price theories and earlier studies (*)

Price factor	Theories connected to land prices	Finnish research work	Research work outside Finland
Distance from the town centre	*	*	*
Efficiency of the site or the building right allotted to the site.		*	
Number of population in town centre or its growing	*	*	*
Income level	*	*	*
Location with relation to lake or river		*	
Plan symbol for the site		*	
Area (m ²)	*	*	*
Time of transaction	*	*	
Building costs			*
The situation of streets attached to the site			*
Distance from the train station			*
Commercial zone			*
Agricultural land rent	*		
Value of expected future land rent increases	*		
Cost of land conversion for a higher use	*		
Area of good repute			*

Quite essential price factors by table 3/1 are:

- distance from the town centre
- number of population in town centre or its growing
- income level
- area (m²)
- time of transaction

4. DATA OF THE EMPIRICAL STUDY

4.1 The Research Material

The research material was gathered from the Transaction Price Register maintained by the National Land Survey of Finland (NLS 1999, Real Estate Market Price Register). The original data consisted of 23 009 transactions (plan symbol for site was single family-house, terraced house or block of flats). Unrepresentative transactions and transactions marked plan symbol terraced house sites or block of flats house sites were taken away from original data. The data analysed in this research consisted of 14 732 transactions (plan symbol for site was single family-house and transactions were representative). The following boundary conditions were maintained, when the research material was gathered:

- search area was regional units (Helsinki, Turku, Lahti, Kajaani, Oulu and Jyväskylä)
- non-built sites (plan symbol for site was single family-house, terraced house or block of flats)
- a transaction was situated in detail plan area or building plan area
- time of transaction was 1.1.1985-31.12.1998

When these limitations were observed, the following information was obtained from the register:

- province and municipality where a transaction is located
- month of transaction, price (the Finn mark) and area (m²)
- the building right allotted to the site
- detail plan area or building plan area
- purpose of use by plan symbol (single family-house, terraced house or block of flats)
- coordinates for transaction (rectangular coordinate system)
- category of purchaser and category of seller
- information whether the site is adjacent to lake or sea

This research material was supplemented. More information was gathered from Statistics Finland (Statistics Finland 1999). The following information was obtained from Statistics Finland:

- number of population in municipalities

- number of net population in municipalities
- average income level in municipalities
- percentage value of academic degree over 15-year aged population in municipalities
- percentage value of upper clerical employee in municipalities
- zip code
- income level in zip code areas
- percentage value of academic degree over 15-year aged population in zip code areas
- percentage value of upper clerical employee in zip code areas
- price of gross national product (the Finn mark) per person in region areas
- amount of all cumulative housing loans (the Finn mark) given by financial institutions in Finland (quarterly)
- interest rate (monthly)
- building cost index (monthly)
- nominal price index of older flats (quarterly)

Two distance factors were calculated:

- distance from the centre of each municipality
- distance from the centre of regional area

4.2 Basic Statistics

Basic statistics of the key variables from data are included in table 4.2/1. There are each variables name, unit, mean value, minimum value, maximum value and standard deviation in table 4.2/1.

Table 4.2/1. Basic statistics of the key variables

Variable (unit)	Mean value	Minimum	Maximum	Standard deviation
price (the Finn mark)	163408,91	1664	6248492	278619,58
Price per the building right allotted to the site (the Finn mark/ floor square metre)	582,37	8	13696,37	632,91
area (square metre)	1320,68	400	20000	1125,25
Efficiency (floor square metre/ area)	0,23	0,02	3,15	0,07
the building right allotted to the site (floor square metre)	288,67	35	7350	262,44
number of population (persons)	86697	826	546317	111234
net migration to municipality (persons)	502	-1108	7520	1066
net migration to region area (persons)	1559	-558	10560	2810
income level in municipality (the Finn mark)	83446,24	38328,02	196554,35	19686,34
Income level in zip code area (the Finn mark)	85302,27	39730,65	279621,85	21848,74
price of gross national product per person (the Finn mark)	106046,03	70587	155726	25428,73
Amount of housing loans (million Finn mark)	148872,94	79067	204263	38544,90
interest rate (%)	9,16	3,07	16,41	3,96
Building cost index	182,29	140	209,6	21,29
price index of older flats	169,69	115,6	238,10	36,38
Percentage value of academic degree in municipality	7,86	1,21	36,64	4,61
Percentage value of academic degree in the zip code area	7,64	0,43	42,09	5,21
percentage value of upper clerical employee in municipality	17,90	4,59	45,34	6,75
percentage value of upper clerical employee in zip code area	17,75	3,53	54,2	7,80
distance from the centre of municipality (kilometre)	5,22	0,10	21,44	4,22
distance from the centre of regional area (kilometre)	18,06	0,63	59,35	13,85

4.3 The Volume of Transactions and the Price of Non-Built Housing Sites in some Regional Areas in Finland

Figure 4.3/1 shows the volume of transactions in 1985-1998. According to the picture the highest volume is in 1988 and in 1989. Figure 4.3/2 shows the volume of transactions in regional areas in Finland in 1985-1998. The volume of transactions is highest in Helsinki regional area (6928 transactions) and lowest in Kajaani regional area (256 transactions).

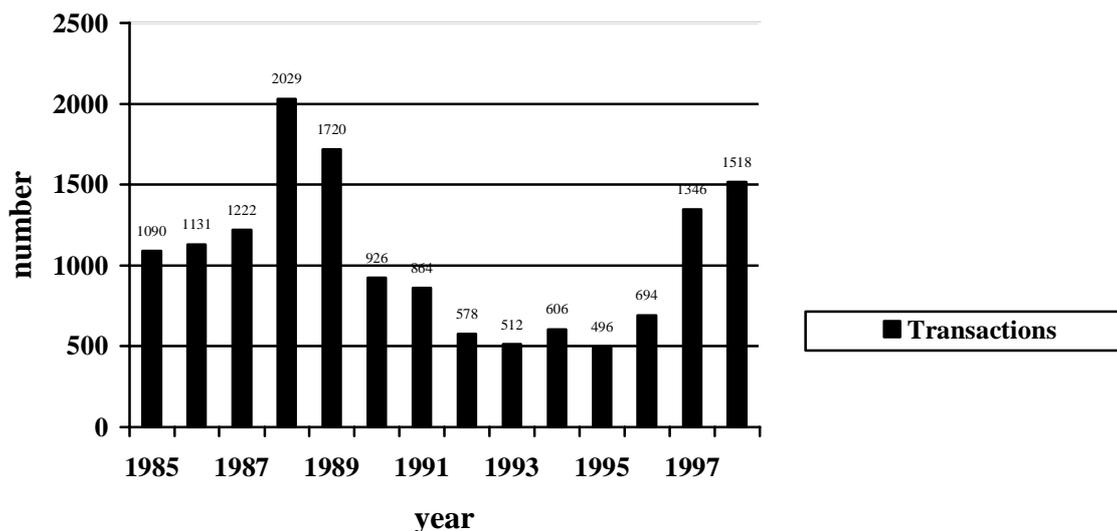


Figure 4.3/1. The volume of transactions (non-built housing sites) in all research regions in Finland in 1985-1998.

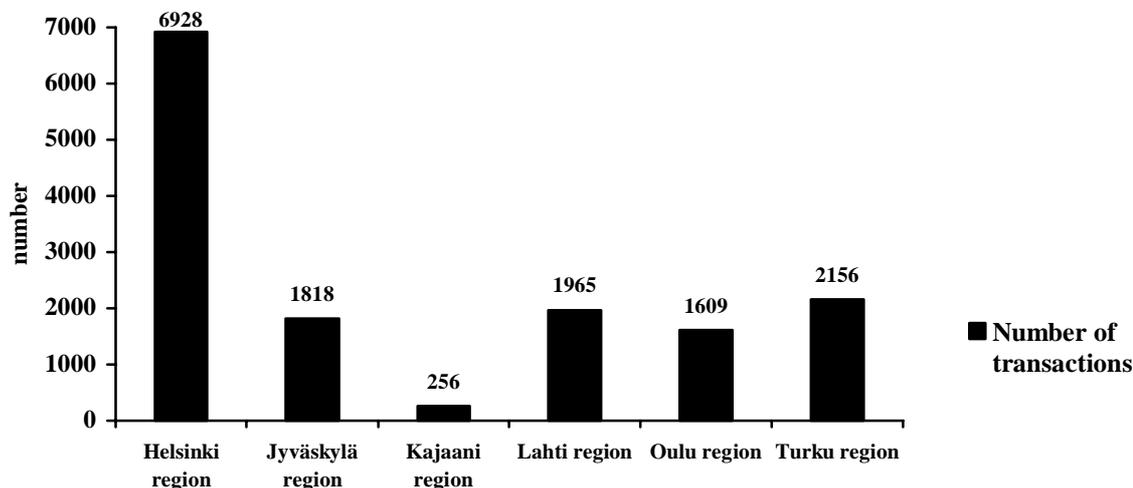


Figure 4.3/2. The volume of non-built housing site transactions in regional areas in Finland.

When we divide the volume of transactions by the number of population living in regional area, we will have a different kind of view to the volume of transactions in regional areas. Now according to the picture 4.3/3 the highest volume of transactions is in Jyväskylä regional area and lowest in Kajaani regional area as earlier.

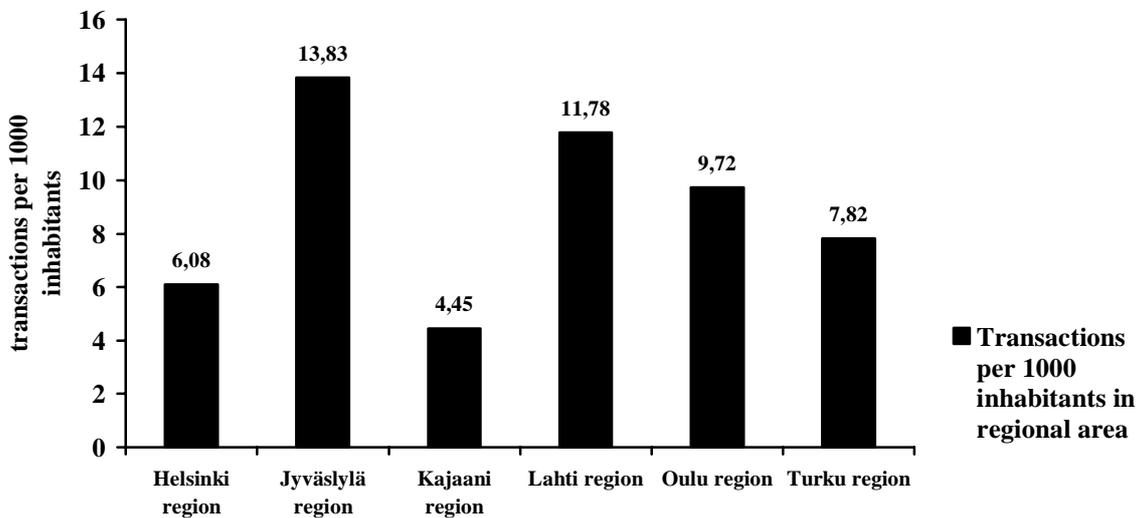


Figure 4.3/3. The volume of transactions per 1000 inhabitants in regional area.

4.4 Category of Seller and Buyer in the Research Material

Figure 4.4/1 shows the category of seller in the research material. The private sector has sold 43 % of non-built housing sites. Then there are municipalities (37 %) and private company (13 %).

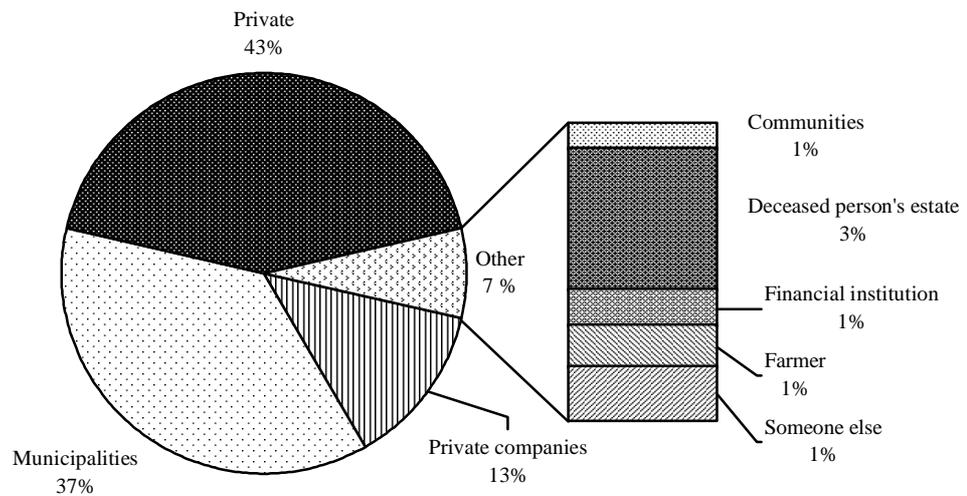


Figure 4.4/1. Category of seller in the research material.

Figure 4.4/2 shows the category of buyer in the research material. The private sector has bought major part (78 %) of non-built housing sites, private companies 13 %, others 5 % and communities have bought 3 % of non-built housing sites.

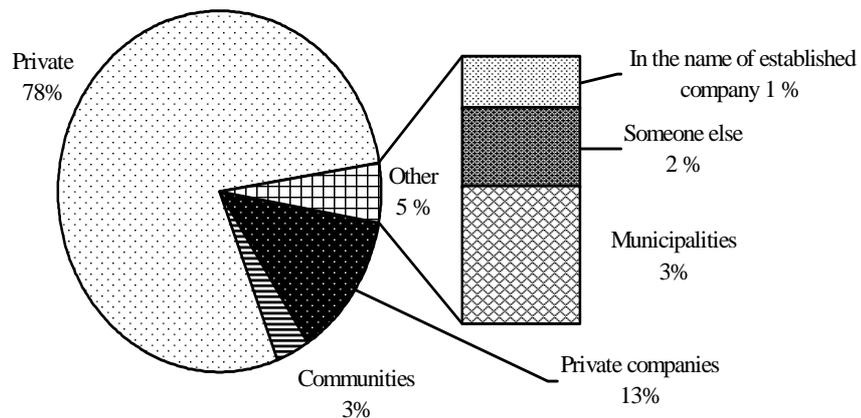


Figure 4.4/2. Category of buyer in the research material.

4.5 The Price of Non-Built Housing Sites in Helsinki Region Area

Figure 4.5/1 shows the mean total price of non-built housing sites and mean total price per building right allotted to the sites in Helsinki region area in 1985-1998. According to the figure 4.5/1 prices have changed radically in that time. The mean total price has decreased 38 % in 1990-1991. If we compare total price and total price per building right at the late 1990's,

we can see the different kind of developments. Figure shows that the direction of price movement is depending on how the price is defined.

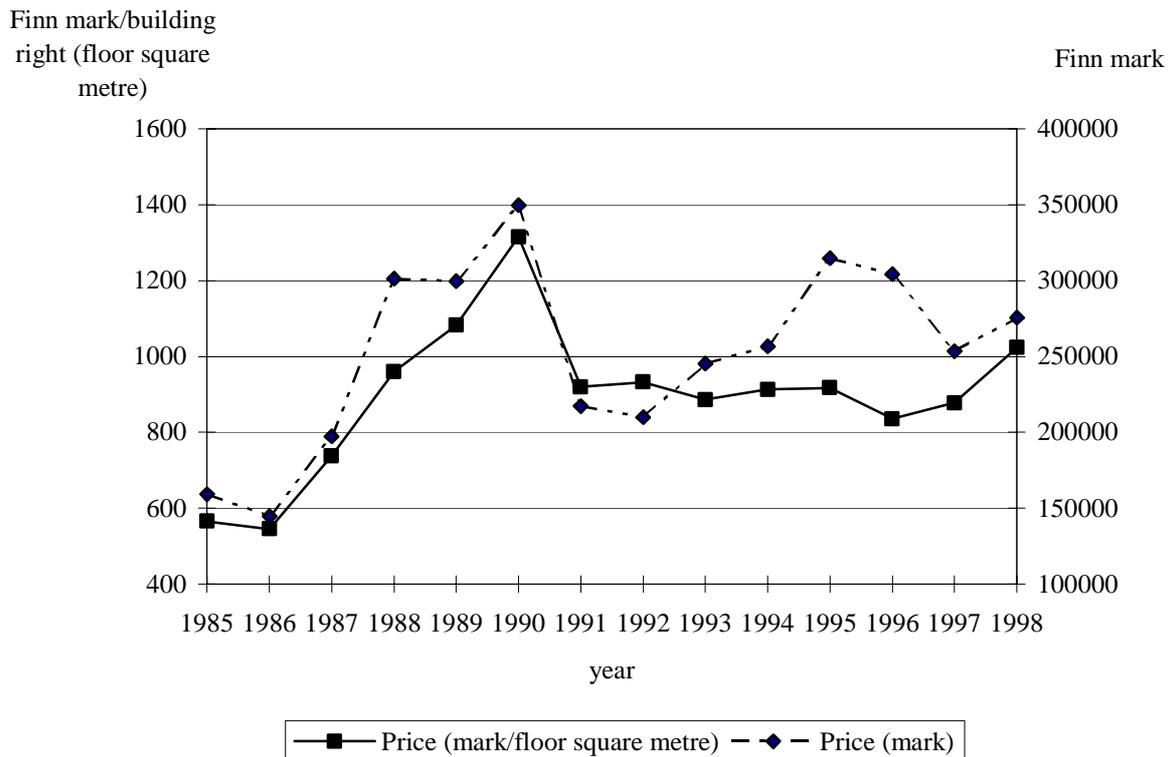


Figure 4.5/1. The mean total price (mark) of non-built housing sites and the mean total price per building right (mark/ floor square metre) allotted to site in Helsinki region area in 1985-1998.

5. THE RESEARCH METHODS

5.1 Econometrics

In this research econometrics is used to formulate hedonic price functions. Econometrics is the application of statistical and mathematical methods to the analysis of economic data, with a purpose of giving empirical content to economic theories and verifying them or refuting them (Maddala 1992 p. 1). The aims of econometrics are (Maddala 1992, p. 4):

- Formulation of econometric models, that is, formulation of economic models in an empirically testable form. Usually, there are several ways of formulating the econometric model from an economic model because we have to choose the functional form, the specification of the stochastic structure of the variables, and so on. This part constitutes the specification aspect of the econometric work.
- Estimation and testing these models with observed data. This part constitutes the inference aspect of the econometric work.
- Use of these models for prediction and policy purposes.

Revised schematic description of the steps involved in an econometric analysis of economic models is in Figure 5.1/1.

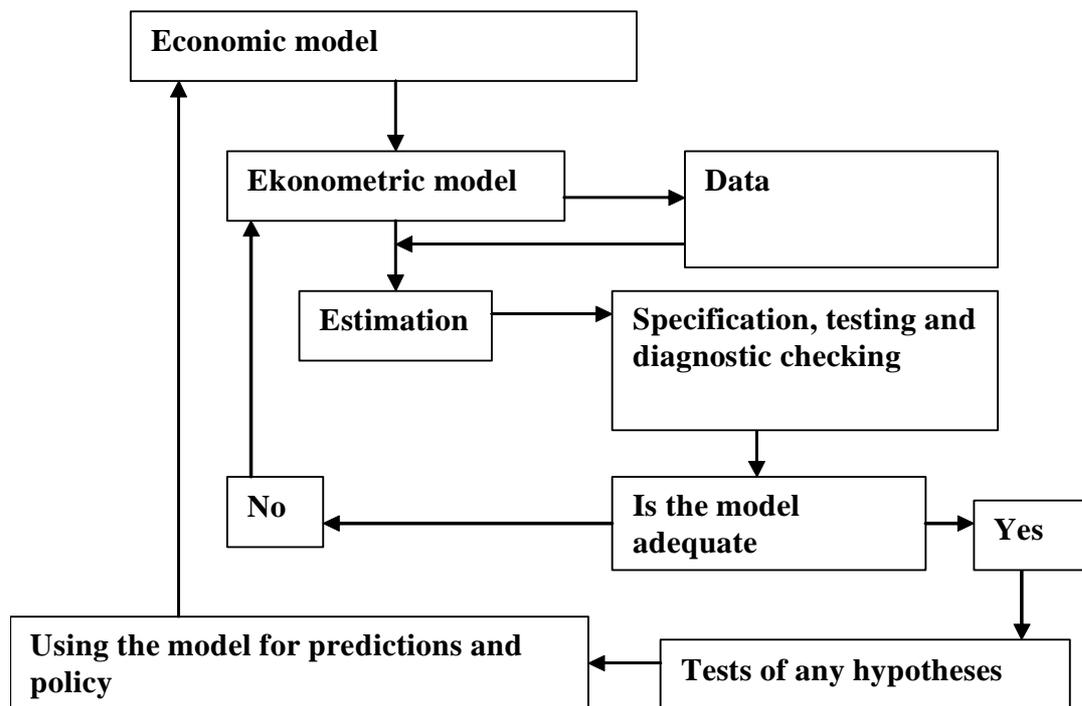


Figure 5.1/1. Steps involved in an econometric analysis of economic models (Maddala 1992, p. 7)

5.2 The Functional Form of Model

The theory of hedonic price does not give much guidance for choosing the functional form for an empirical hedonic price model. Regression analysis and covariance analysis was used to form hedonic price functions in this research. We can write regression model in matrix form as (Pindyck & Rubinfeld 1991, pp. 93-95) :

$$Y = X\beta + \varepsilon$$

, where Y, β and ε are vectors and X is matrix:

$$Y = \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ \vdots \\ \vdots \\ Y_n \end{bmatrix} \quad X = \begin{bmatrix} 1 & x_{11} & x_{21} & x_{31} & \cdot & \cdot & \cdot & x_{k1} \\ 1 & x_{12} & x_{22} & x_{32} & \cdot & \cdot & \cdot & x_{k2} \\ 1 & x_{13} & x_{23} & x_{33} & \cdot & \cdot & \cdot & x_{k3} \\ \cdot & \cdot \\ \cdot & \cdot \\ \cdot & \cdot \\ 1 & x_{1n} & x_{2n} & x_{3n} & \cdot & \cdot & \cdot & x_{kn} \end{bmatrix} \quad \beta = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \cdot \\ \cdot \\ \beta_n \end{bmatrix} \quad \varepsilon = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \cdot \\ \cdot \\ \varepsilon_n \end{bmatrix}$$

Covariance analysis model is a special case of regression analysis. It is a combination of regression analysis and variance analysis. The covariance analysis can handle continuous variables and class variables simultaneously.

Functional form of model is logarithmic linear model. We can write this model as:

$$\ln(P) = \alpha_0 + \sum_{i=1}^k \alpha_i \ln(z_i) + \sum_{j=1}^r \beta_j D_j + \varepsilon$$

where \ln = the logarithm to the base e ($e \approx 2,718$), P is either total transaction price (Finn mark) or total transaction price per building right allotted to the site (Finn mark / floor square metre), α_0 is constant, α_i are regression coefficients of continuous variables, z_i are continuous variables, β_j are regression coefficients of class variables (dummy –variables), D_j are class variables (dummy –variables) and ε residuals.

5.3 The Formation of Models

The formation process of models is described in Figure 5.3/1. At first models with different price factors were formulated both in regional areas and in three municipalities (Helsinki, Vantaa and Espoo). Then the most important price factors were chosen and began to formulate models with the same price factors. These models were analysed more accurate. After that the information from models was analysed in conclusion.

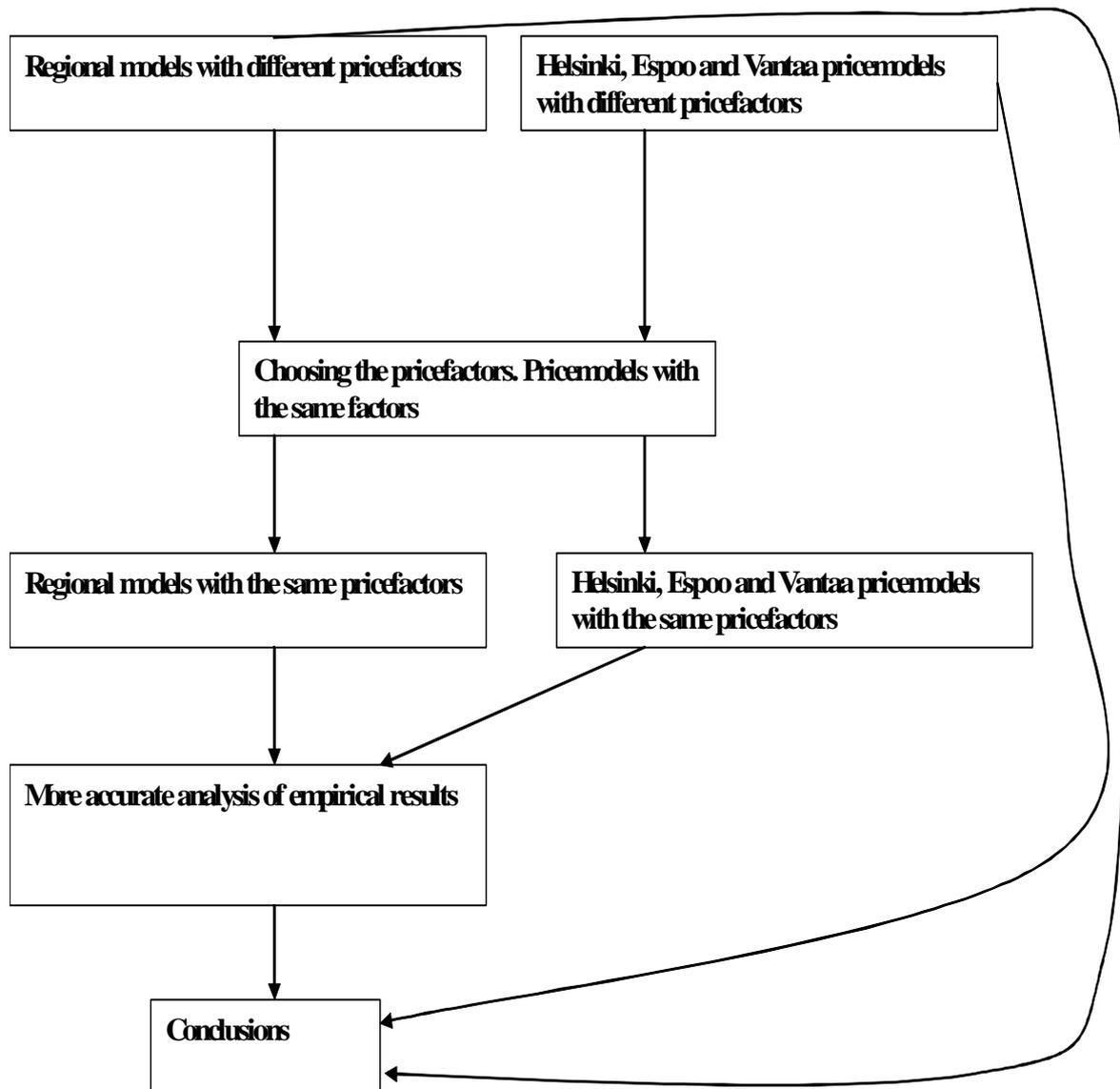


Figure 5.3/1. The formation process of models.

6. EMPIRICAL RESULTS

In this research 62 regression models and 31 covariance models were estimated. According to the models the most important factors affecting the price of non-built housing sites are: *building right allotted to site, zip code, distance from the main centre of region, price of flats (time factor) and percentage value of upper clerical employee in zip code area (socio-economic factor)*.

Table 6/1 gives an example of regression models estimated in Helsinki, Espoo and Vantaa municipalities in 1991-1998. Functional form of models is as described in chapter 5.2 (parties of purchase factors are dummy –variables). According to the table the models are quite powerful (coefficient of determination is over 75 %) to explain the price formation of non-built housing sites. Regression assumptions connected to the error terms are almost accepted in every model.

Table 6/1. Regression models explaining the total transaction price (Finn mark) in Helsinki, Espoo and Vantaa municipalities in 1991-1998.

	Ordinary number describes the explanatory power of price factor in each model. (1=explains most, 2= explains second most, etc), factors coefficient [] and its t-test P –value ().		
Municipality and time	Helsinki 1991-1998	Espoo 1991-1998	Vantaa1991-1998
Coefficient of determination %	78,2	79,2	75,4
Residual deviation (logarithmic)	0,25	0,34	0,28
Normality test (error terms)	almost accepted	almost accepted	almost accepted
Common variance test (error terms)	is accepted	almost accepted	almost accepted
Durbin-Watson test statistic	1,79	1,71	1,57
Number of transactions	368	794	616
Constant term in model, coefficient [] and its P-value ()	[4,54] (<0,0001)	[6,97] (<0,0001)	[8,13] (<0,0001)
Factors connected to the site			
Building right allotted to the site	1[0,89] (<0,0001)	1[0,88] (<0,0001)	1[0,77] (<0,0001)
Distance from the main centre of region	5[-0,14] (=0,04)	4[-0,51] (<0,0001)	2[-0,60] (<0,0001)
Distance from the municipality		7[-0,12] (=0,03)	11[-0,01] (=0,52)
Site is adjacent to sea		3[1,02](<0,0001)	
Site is adjacent to lake		11[-0,12] (=0,64)	
Site is situated in detail plan area		9[0,12] (=0,46)	4[0,27] (<0,0001)
Demographic factor			
Net migration to the municipality	4[-0,30] (<0,0001)	5[-0,31] (=0,0001)	5[-0,41] (<0,0001)
Socio-economic factor			
Percentage value of upper clerical employee in zip code area	3[0,33] (<0,0001)	6[0,17] (=0,01)	6[0,23] (=0,001)
Time factor			
The price of flats	2[1,07] (<0,0001)	2[0,82] (<0,0001)	3[0,74] (<0,0001)
Parties of purchase factors			
Seller is municipality	7[-0,05] (=0,42)	14[0,008] (=0,99)	10[-0,03] (=0,40)
Seller is individual person	6[0,04] (=0,26)	10[0,06] (=0,48)	9[0,04] (=0,23)
Seller is private company	8[0,03] (=0,49)	12[-0,01] (=0,77)	12[0,03](=0,54)
Buyer is individual person	10[0,002] (=0,97)	8[-0,04] (=0,32)	7[-0,12] (=0,006)
Buyer is private company	9[0,008] (=0,87)	13[-0,004] (=0,93)	8[0,14] (=0,006)

7. CONCLUSIONS

In this research next conclusions and results were found:

- The most important price factors are the building right allotted to the site, the zip code, the distance from the main centre of the region, the socio-economic status of the inhabitants and time.
- The passing of the years changes the amount and direction of the price factors in all research areas.
- The price formation of non-built housing sites differs by the number and intensity of the price factors in different price formation areas. The price data for the regional level is sufficient when analysing the amount and the intensity of general price factors for single-family house properties.
- The hedonic price theory can be used for analysing the price formation of single-family house properties when the demand and supply factors are in the same model.
- The price formation of single-family house properties can be described with the model, in which all continuous variables are transformed by taking the natural logarithm.

REFERENCES

- Hiltunen Ari. 2003. Rakentamattomien pientalokiinteistöjen hinnanmuodostuksesta; Analyysi asuinpientalojen kauppahinnoista eräillä Suomen seutukunta-alueilla. [On the price formation of single-family house properties; An analysis of comparable sales prices for single-family houses in some regional areas in Finland.] Helsinki University of Technology. Publications of Real Estate Studies and Economic Law. A33. Espoo 2003. 168 p. ISBN 951-22-6812-4. Dissertation. (written in Finnish)
- Maddala G. S. 1992. Introduction to econometrics. Prentice-Hall Inc. Second edition. United States of America 1992. ISBN 0-02-374545-2.
- NLS. 1999. National Land Survey of Finland. Real Estate Market Price Register
- Palmquist Raymond B. 1989. Land as a Differentiated Factor of Production: A Hedonic model and its implications for Welfare Measurement. Land Economics. Vol. 65, No. 1, pp. 23-28.
- Pindyck Robert S. & Rubinfeld Daniel L. 1991. Econometric models & economic forecasts. Third Edition. McGraw-Hill, Inc. Singapore 1991. 596 s. ISBN 0-07-050098-3.
- Rosen Shervin. 1974. Hedonic prices and Implicit Markets: Product Differentiation in Pure Competition. The Journal of Political Economy, Vol 82, Issue 1, pp. 34-55.
- Statistics Finland. 1999. Information service contract 30.11.1999.
- Orford Scott. 2000. Modelling Spatial Structures in Local Housing Market Dynamics: A Multilevel Perspective. Urban Studies, Vol. 37, No. 9, pp. 1643-1671.

CONTACTS

Ari Hiltunen, Dr. Sc.
Helsinki University of Technology
Department of Surveying
Institute of Real Estate Studies
P.O.Box 1200
FIN-02015 HUT
FINLAND
Tel + 358 9 451 3874
Fax + 358 9 465 077
e-mail: ari.hiltunen@hut.fi
Web site: http://www.hut.fi/Yksikot/Kiinteisto/henkilokunta/ari_hiltunen.htm