

# An Overview of the Application of Property Market Modelling in Malaysia

Norhaya Kamarudin<sup>a,\*</sup>, Suriatini Ismail<sup>b</sup> Hishamuddin Mohd Ali<sup>a</sup>, Ibrahim Sipan<sup>a</sup>, Fauziah Raji<sup>a</sup>

<sup>a</sup>Department of Real Estate, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

<sup>b</sup>Faculty of Technology Creative & Heritage, Universiti Malaysia Kelantan, Bachok Campus, 16300 Bachok, Kelantan

\*Corresponding author: norhaya@utm.my

## Article history

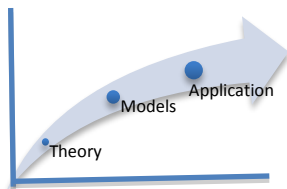
Received : 6 February 2014

Received in revised form :

24 July 2014

Accepted : 9 October 2014

## Graphical abstract



## Abstract

This paper examines the application of property market models in Malaysia. The aim is to determine the relevance, success and trend of models in explaining problems of the property market. The theoretical underpinning of the property market form the foundation of the property market model where models represent the real property market situation. Through the analysis on research applying property market models, this research evaluates the application of property market modelling in Malaysia. The SWOT analysis enables the identification of the problems and the advantages of applying models for understanding property market behaviour. Analysis of the strength, weakness, and issues suggests that the main strength lies on the ability of the models to provide an objective explanation to property market problems and its ability to link to other technological innovations, which are useful for resolving real estate problems. The Malaysian experience in this field is relatively new but nevertheless it has significant contribution towards the application of models in real estate research

*Keywords:* Property market; models; strength; weakness; issues; trend

## Abstrak

Kajian ini meneliti penggunaan model dalam menerangkan masalah dalam pasaran harta tanah. Teori disebalik pasaran harta tanah membentuk asas kepada pembentukan model pasaran harta tanah. Melalui analisis terhadap kajian lepas yang menggunakan model bagi penyelesaian permasalahan dalam harta tanah, kajian ini menilai keupayaan model tersebut dalam menerangkan permasalahan yang wujud dalam harta tanah di Malaysia. Analisis SWOT, dapat mengenalpasti masalah serta kelebihan dalam penggunaan model bagi menerangkan gelagat dalam pasaran harta tanah. Analisis keatas kekuatan, kelemahan dan isu yang timbul menunjukkan bahawa kekuatan utama model adalah keupayaannya dalam menerangkan permasalahan yang terjadi dipasaran harta tanah serta keupayaannya untuk dikaitkan kepada inovasi teknologi yang penting dalam penyelesaian masalah harta tanah. Pengalaman Malaysia dalam bidang ini agak baru namun ia memberi sumbangan yang besar dalam penggunaan model dalam kajian harta tanah.

*Kata kunci:* pasaran harta tanah; model; kekuatan; kelemahan; isu; tren

© 2013 Penerbit UTM Press. All rights reserved.

## 1.0 INTRODUCTION

The approach of modelling the property market has been extensively explored in property research. Models are designed to explain property market behaviour (43, 41, 22). Understanding the property market behaviour is very important since it forms the basis of important decision-making. Models form the micro foundation of the property market behaviour (5), with first conceptualising the reality of the property market in terms of its functions, theories and assumptions. The need to examine the use of models lies in its ability to demonstrate the causal factors of the property market behaviour illustrated through the values in

numerical form. In developing property market models, arguments on the inefficient property market are characteristics (30,31), such as high capital cost, fixed location and, the affect of legislation and policy are assumed to be perfect.

This paper evaluates the application of property market models in Malaysia to determine the effectiveness in property market research. The aim is addressed in the following structure. The next section presents the review of models in property market. This provides the basis for evaluating the application of models in the wider context. Section three reviews the property market modelling by analysing on the trends and pattern of property market models in Malaysia. Section four evaluates the

application of models of the property market in terms of the strength, weakness and issues that arises from models. Finally section five concludes the review on the application of property market models in Malaysia.

## ■ 2.0 LITERATURE REVIEW

The property market that is heavy on capital is noted with inefficient characteristics such as inefficiency in information, high transaction cost, lumpiness, non-centralised and indivisibility. In order to model the property market, these inefficient characteristics are assumed to be perfect. The property market is important for all having interest in the market such as the users, investors, financiers and, developers to make sound decisions and these have drive researchers in the real estate field to understand the changes on the property market. The theoretical concepts of the property market act as the basis for developing property market models. The function of the property market changes through changes in demand and supply (22). The prices from the interaction of demand and supply represent the attributes of the property that buyers and sellers evaluate before transaction. Modelling of the property market is usually associated with hedonic modelling where the market is composed of different attributes where each attributes are given different weightings (32, 28) suggests that the method of hedonic equations is one way where expenditures on housing can be decomposed into measurable prices and quantities so as to enable comparisons and predictions of properties between identical and different dwellings in different areas. The property market acts as indicators, which sends signals to buyers and sellers through price changes. At equilibrium level price, demand would be equal to supply. As market is always changing, the increase in price would suggest increase in demand and market will be at disequilibrium. Increase in supply through construction activities will pull price down in the course of bringing market back to equilibrium. As construction takes considerable time, there will be a lag in supply. Hence, the market is constantly changing and the process of adjustment is a continuous process of readjusting demand and supply.

The property market model is portrayed as an interlinked market of four main activities. These are the development, investment, use and the land markets (6). They illustrated the market equilibrium and the adjustment process through the shocks in demand and development carried out to increase supply in response to demand. The dynamic behaviour of the property market could be analysed by developing models illustrating the changes that takes place in each sector (41, 6). The user market is measured by rents paid by occupiers for business or dwellings. As markets move away from equilibrium it will cause rents to rise or fall. There are a number of reasons that could cause a shift in the market equilibrium such as population increase, economic growth or economic recession. These changes in markets may trigger response in property stocks. They are determined by different attributes of determined by consumers. These attributes were characterised into structural, physical, neighbourhood and environmental, in which they constructed a model using transaction-based data to evaluate residential property values in Hong Kong (36)

As an investment asset, performances of properties are distinguished through the analysis of yields or returns on property. The capitalisation rates are analysed through prices and rental movements. The two main ways in which capitalisation factors are determined are through the valuation rules and economic evaluation (Ball et al., 1998). The valuation

rules rely on the professional valuation to determine the property market. In the economic evaluation, the annual rental flow is capitalised into net present value taking into account depreciation and rental growth. In the investment market investors', particularly institutional investors rely on property market analysis to guide them in asset selection. As capital and property markets are different form of investment, investors are keen to know the performance of these markets and how they relate to each other. Keogh (1994) monitored and suggests that investors may switch investment these two mediums although it is difficult to track the switching of funds from property to capital market when property investments do not perform.

Estimating the time for properties to be in the market is important. Equilibrium Time On the Market (ETOM) was to determine the right time to be in the market (9). The concept focuses on the speed or time the market takes to correct for information differences between open market valuations and traded prices. The time taken for discrepancy between expected sellers price and open market valuations to converge is the ETOM. Equally important in the property investment sector is the information on market changes. The construction of the price index is important to help investors to be informed of the property market condition. The price index informs investors on the changes in the property market and this improves investment decision-making. In this context, models have been developed to construct property index. The construction of property indices can be, appraised based, transaction based, survey or sentiment based. This suggests that although property market models are useful in many areas, its application is not without problems.

The property development activities are driven by changes of capital values in the property markets. Thus, the modelling of the property markets is designed to illustrate how development responds to the dynamic market changes. Theoretically it is assumed that the market will move from equilibrium level when the market is triggered with an increase in demand from price and rent increases. Development will take place when demand exceeds supply in the existing stock and this continues until excess demand is satisfied. In identifying the development level, no development occurs where it becomes unprofitable for new buildings to be built (6). At this point, property values are equal to its replacement cost. In their analysis of the land market, (6) presented the different situation of property values, replacement cost and its effect on new office development. In a model of the urban housing market, Wheaton and DiPasquale (41) defined the structural attributes and density of cities.

The development and redevelopment of properties can be made possible where land is available. The land market analyses the competition between different land uses. Land will be made available through the process of land conversion if there is demand for it. Such demand is normally shown by rent or price increases. The pricing mechanism of the land market determines the allocation of land for development. In the analysis of land supply, restriction to it that may affect development is an important factor to consider. Restriction may be in the form of the planning regime. Theoretically planning restraints that restrict the supply of land for new development is likely to reduce supply elasticity, increase land and house prices and increase housing densities (8). Studies have shown that there are various measures adopted to assess planning restrictions (7, 27). In order to assess the impact of the planning system on the property market, the model are shaped accordingly to explore the effect of the land-use planning system on house prices in Hong Kong. The model first establishes the demand and supply

equations to set forth the market at equilibrium level. In their study, they analysed planning system variables such as usable floor area (UFA), land supply (LS), residential gross floor area under planning applications (GA), residential zones (RZ) and green belt/ open space (GB) and approval rate of planning applications (AR) relationship to house prices (HP).

The operation of the property market explained in the four inter related markets are also examined over time. The economy, population change and other market constraints, which are exogenous and have affected the dynamics of the property market as a whole, are also examined through property market models. Property market cycles are examined through models both in specific countries and across various markets. For example Edelstein and Tsang (16) modelled the dynamic changes that take place in four different cities in the USA. The aim is to develop and test a theoretical model of residential housing market cyclical dynamics. They contended that commercial real estate cycles are different from residential cycles. As for the market forces, they suggest that local fundamentals are important impact in explaining cycles. Other market cycles that were examined are the explanation to the British property cycles (26). The cross border analyses of the housing market dynamics of twelve European countries suggest that it is possible to some degree to consider the European housing market as one market (42). Using the stock-flow and error correction model, they illustrate that housing stock and macroeconomic determinants are robust across countries. Price and cost elasticity of housing supply are low while shocks on demand and supply have small effects on housing stocks.

The above illustrates some of the ways in which models are being applied to the property market. In the Malaysian context, similar approaches are being applied to the property market as will be discussed in section 3.0. The following section identifies some of the issues relating to the adoption of models in property market.

### 2.1 Issues with property market models

Although the theoretical underpinning to property market models is in place, application of it is not without problems. The housing market models are complex as reflected in the different approaches to the housing market models (19). Basically two main approaches were considered namely the mono-centric spatial model and the filtering process, which focus on the process and the dynamics of the housing market. Both models demonstrate some strength and weakness and as such extension of models and redefining markets remains a continuous process. Criticism of models centres on getting the best realism from models. Problems of the property market may arise from a number of situations such as the imperfect property market characteristics, existence of sub markets, location differences and other heterogeneous characteristics. Having acknowledged these difficulties, recent trends in property market models have moved towards addressing these issues.

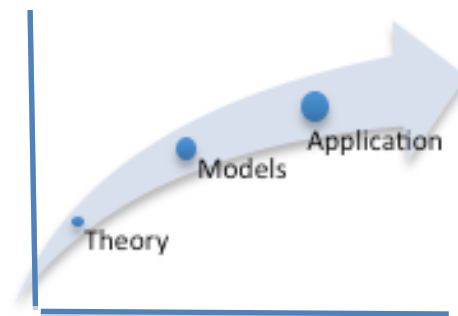
The property market complexities are further examined in the existence of sub market (18, 40). They used aggregate and disaggregate models to compare differences between actual and predicted house prices. The disaggregate models of the sub markets showed statistical significance though with small improvements. The regression models would be subjected to bias if they fail to accommodate the existence of the housing markets (18). Comparison on the empirical performance of a standard hedonic house price regression model with a segmented model which acknowledged the underlying market structure

reflecting the existence of sub markets for different dwelling types showed that the standard error for the segmented model is significantly lower than that of the market wide model. Hence, to reflect the behavioural realities of the property market, a two-stage approach was suggested to the application of the MRA techniques to residential valuation. First is to follow the traditional institutional analysis to subdivide market structurally into different market segments. The second part is to separate the house price equations into each segment. Although market segments are an attempt to create the realistic feature of the property market, the concept of market segment could not be clearly defined, as each segment would be associated to the local characteristics.

Similar to the problem of market segments is the problem of location characteristics of the property market since the property market can also be segmented according to their locations. The property market is modelled at the micro level to extract location attributes that are most important for market value (27). Using empirical evidence of developed property markets, the meta-analysis is applied to extract location attributes and weigh their importance. Results suggest that it is possible to substantiate location attributes, which influence market value for different real estate types. In the question of the location effect, influences on neighbourhood and access appear to be dominating location. The neighbourhood and access attributes are integrated to sort out cross influences between both series so as to achieve an optimal model design with minimal information loss (33) in order to explain property prices on the basis of physical and neighbourhood related characteristics. Using hedonic model on global data bank, property information are located using geodetic co-ordinates, which are integrated into MapInfo GIS. Multi sources data such as schools, universities, colleges, shopping centres, remote sensing images, street grids, road and highway networks, power lines etc. are located using appropriate reference systems. Results show that the model had greatly improved with location and access factor being explained in property values. It suggests that the factor analysis used is highly efficient at sorting access and neighbourhood attributes. The method provides useful insights into the housing market dynamics of the region with findings in line with theoretical expectation.

### 3.0 MALAYSIAN PROPERTY MARKET MODELS

The process of evaluating of property market model can be illustrated in Figure 1.



The formation of theory of property market enables models to be constructed. There are various models that are

constructed from the theories on the property markets. These are discussed below. Each model has their strength and weakness. The strength are further developed to enable applications of the property markets

### 3.1 The MRA property market model

The MRA property market model was the first attempt to model the property market. It was to illustrate property valuation through a statistical analysis. The attributes of property values are determined and they are then tested through models (17, 2, 3). The variety of floor finishes in Malaysian houses suggest that floor finishes has an influence on values as this has been practiced by many valuers when undertaking property valuation exercises (2). The need to give objective adjustments on differences of floor finishes and to improve on subjective valuation practice is the reason for deriving this index. Using data from a sample of 322 double storey houses, randomly selected from twelve housing schemes in Johor Bahru, a model was created to assess value of residential units with different floor types. A linear regression, which assumes that a floor index,  $Y$  is a linear function of the flooring materials  $X$ , located at the respective position of those materials in a particular house or  $Y=f(x_1, x_2, x_3...x_n)$ . Regressing subjectively the assigned floor ratings against the floor finishes, a consistent floor type index was derived. The advantage of making objective valuation through regression models was later captivated in mass valuation for rating purposes.

### 3.2 The Mass Appraisal Model

The Mass Appraisal Model (MAM) was an attempt to incorporate MRA to property valuation. Early experiment using data on a local market showed that it has potential for further development (13). Later a system for local authority property tax system was developed (14). The Computer Assisted Mass Appraisal (CAMA) system has benefited some local authorities in terms of expediting the single valuation that was then practiced. This has not only expedited mass appraisal exercise but is also capable of reducing the cost of revaluation exercise. The CAMA system was later incorporated with GIS to help local authorities to position the individual properties.

### 3.3 Macro Market Model

In search for the explanation on the dynamics of the property market, models were also utilised to explain the nature and the forces that drive the market. The main macro economic factors affecting real estate market operations suggest that indicators such as the economy measured by growth domestic product (GDP), labour force, income level; and population exhibits direct relationship with the construction of the office development (12). In another area (1) investigated the dynamics of the Malaysian real estate cycle to examine the closeness of the property cycles with the macro economy. Adopting linear relationship analysis, the macro economy seems to influence property market cycle movements. In the housing market sector, models are used to explain the dynamics of the Malaysian house prices (39). Using the correlation analysis and MRA, they analyse the relationship between house price and other variables that are related to house production such as building material index, consumer price index, GDP, housing stock, composite index, population level and base lending rate.

Although there is no straightforward relationship, the importance of the variables is significant.

### 3.4 GIS based market model

In line with technological innovation and the problems related to hedonic models, many researchers have moved towards integrating hedonic models with spatial elements. In order to improve the ability of the data base system, a land value map is suggested as it is able to illustrate the distribution of land values which can be utilised in many ways such as the growth pattern, market preferences and potential areas (4). The construction of land value map incorporates GIS with MRA, may have the ability to show property value distribution even if the property is not transacted. In addition, it is also able to portray past, present and future land value distribution. In another study (15) assessed the location influence on the rental value of shop houses by adopting the Geographical Weighted Regression (GWR) that enabled exploration of spatial variation of the relationship between variables under investigation. The GWR reviews data coordinates into the ordinary least squares, which will allow some form of spatial measurement to be made. The GWR with the aid of GIS software highlights the sub-areas within the localities where rental values are higher or lower than in other sub-areas.

### 3.5 The Malaysian House Price Index model

The MHPI was first initiated in 1993 and finally came into force in 1997(38). The aim of creating the house price index was to establish a national price index to monitor the movement of house price in Malaysia. The index should represent the overall housing markets and should be disaggregated by region and house type with individual indices for key markets and house type. The index may be used to formulate national economic policy with respect to housing and property development. The hedonic approach to price measurement was used and utilised a total of 170,000 property sales data. The dependent variable, price was regressed against independent variables both quantitative as well as qualitative to account for variations. Sampling procedure of average volume of residential transactions for 1990-1992 were then categorised under district, types of houses, location and condition. The MHPI was officially accepted and used as a measure of house price change although certain limitations to it were acknowledged.

### 3.6 Micro market models

In line with the awareness of understanding the real estate markets, (10) critically analysed the literature on hedonic house price model and applied it on the Penang condominium market in order to understand the property market structure. Based on previous research, the main attributes affecting prices are categorised under location (L), structural (S) and neighbourhood (N). The model identified that condominium units in Penang were very homogenous and that represents a desirable characteristics for the application of the hedonic pricing model. The coefficient of the included attributes was significant. Later (11) assessed the effect of the Asian financial crises (AFC) in 1997 on the real estate market. A regression analysis was carried out where price acts as dependent variable and location (L), structural (S) and neighbourhood (N) act as independent variables. The regression for price variation for condominium market was selected and findings indicated that the market for



1998 reflected some disturbance caused by the financial crises. In another study, (22) examined the characteristics of inflation hedging properties according to its neighbourhood and type. Evidence showed that inflation-hedging characteristics of residential properties are different across geographic areas and property types. It disclosed that the inflationary characteristics of property could work differently at the local level.

Throughout the construction of property market models, the hedonic pricing was the main approach in deriving the property market models. However hedonic models are subject to a number of problems arising from the involvement of many variables representing relevant characteristics. One of the main problems that can distort models was the effect of spatial correlation. In a review of the literature on spatial autocorrelation, (35) acknowledged that the use of GIS in dealing with the problem. Though there are a few ways of dealing with spatial autocorrelation, the spatial weight matrix is more suitable for property analysis as it constitutes a number of factors underlying the economic behaviour of property. GIS has indeed broadened the way in which property markets are analysed. It has facilitated the property sector in terms of public sector information management in support for property valuation (29).

#### **4.0 EVALUATION OF THE MALAYSIAN PROPERTY MARKET MODELS**

The review on property market models suggests that there is growing interest in developing models on the property market. The relevance of the property market models in Malaysia are examined in terms of strength and weaknesses of models to address the problems and specific issues that arise from an individual model.

The application of property market models illustrated above suggests that modelling of the property market is designed accordingly so that they can help us to explain the changes that occur in the property market. Hence they act as a tool to explain the property market. However, there are specific strengths and weaknesses associated with the application of property market modelling as prescribed below.

##### **4.1 Strength of property market models**

The strength of models in Malaysia appears to be similar with the global context. Although the Malaysian property market model constitutes only a small sector of the broad area, it has given the picture that there is practically no limit as to the use of models in property market analysis. Models are early attempts to explain markets in scientific form.

Experience in property market modelling in the Malaysian context may be relatively new but it has captured some strength. An important contribution of models in the property market was the MHPI (38), which acted as a benchmark on the performance of the Malaysian housing market. The effort to collect and assemble data and analysed to explain changes in house prices across regions have eased monitoring house price performance. Although faced with weaknesses it is the official source of reference to assess the performance of the housing market.

Another important contribution derived from research on property market models was the development of CAMA (13). The system was tested in a few local authorities and it has proven to expedite mass property valuation. The benefits of automated valuation has increased efficiency and reduced cost involved in rating valuation exercises. The integration of GIS

into CAMA has further enhanced the model where location variables are being included in the model.

The GIS incorporated model is to include spatial data to show locations, which are vital in property values. One important characteristics of the property market is the existence of various sub market. The need to address the importance of sub markets was also examined (21) through the price segmentation of residential properties. Using the GIS and hedonic modelling, the GIS base price contour technique creates spatial dummy variables to segment residential property by determining neighbourhood characteristics. Results suggest the importance of neighbourhood in affecting residential property value with the central business district as a regional residential centre. The model explains 80 to 82 per cent variation in property prices with the consideration of sub markets. The overall picture on the above review suggests that there is diversity in the use of models in real estate research although the number of research in a particular area is still small. There are indeed large opportunities for research in this area.

##### **4.2 Weakness of property market models.**

The weakness of property market models is mainly attributed to the theoretical concepts, which affect the approaches (19) and other methodological issues (34). This leads to problems on the reliability of models to explain the property market. The most important aspect that models fail to address is the theory in which property market operates. As argued in the earlier section, property market is imperfect with high transaction costs. Modelling of the property market should consider these aspects. It is indeed difficult to put a value on these variables and hence this affects the reliability of how the market functions.

Other areas that require attention, which may affect both socially and the economy is the research involving policy assessment. Policy is another aspect that is important as it may have significant effect on the property market and it acts as a means to intervene into the market. It may have a short or long term effect either on one sector or the overall property market. As market sentiments can be affected by policy, it is important for models to be created to assess how it has influenced the property market. However this has not been examined in great detail.

Other areas that models are still lacking in Malaysia are in the investment sector of the property market. As international property investment has caught the attention of many investors, there is a need to create flexibility for property investment in Malaysia. The property markets need to be analysed critically and models can perform this function. Models are also developed to analyse the benefits of diversifying residential property investment with other forms of property investment. With the housing index in place, it is time for the rise of the commercial property market index. Hence the availability of information through index will give light into investment decision-making.

##### **4.3 Issues on specific property market models**

Throughout this review, it was noted that there were certain specific and common issues underlying the Malaysian property market models. The first issue was surrounding valuation accuracy and inconsistencies of manual valuation. The MRA models were developed to address inconsistency in manual valuations faced in the early 90's (17). Then the MRA was incorporated in the mass appraisal model to expedite local

authority valuations (13). The micro level model had succeeded in facilitating local government mass valuation task. However, as the market is in microform, adjustment is required when it is applied at other markets.

The second issue underlying the property market models is on the function of models to determine market changes with the macro economy. As the market moved from recession to its peak period, there issues on how this has affected the property market. Since the functions are to establish relationship between market changes and the economy (12), the finding reflected a direct relationship. However some components of the economy were not much affected by changes in the property market. This suggests that macro factors are important in determining the direction of the property market.

The third issue on the property market models is on property information. As the market moves from undeveloped to a developing market, there is a need to improve on the property information system. The MHPI was developed based on sale transactions to show house price changes over the years. Although the MHPI cannot show accurate figures across regions, it has succeeded to be the only source of information to house owners to monitor their property prices.

Similar to the global situation, the Malaysian property market models are subject to many issues. Apart from the technical issues, models are also subject to theoretical issues. The problem of getting accurate and reliable model is always hindered by a number of problems in terms of data as well as getting the right analytical tools. It is thus difficult to explain property market behaviour, which are subjected to a number of interrelated subjective factors through mathematical models where the power of explanation is limited. Hence theorising the property markets with closed mathematical models may not provide the best solutions to some problems. In property market modelling the availability of abundant data will facilitate the accuracy of results. Data such as property stock, absorption rate, and land supply, planning details, income level and, demography are essential to be fitted into models. The problem with the local market is the availability of these data and in many cases it is difficult to get access to such data. Other technical problems that are common in property market modelling are problems of dealing with inaccurate models caused by multicollinearity, heteroskedasticity and spatial autocorrelations.

In Malaysia, the use of property market models has gained popularity although there are problems attached. Researchers are aware of the limitation of these models but for the purpose of property market measurement, models can provide objective answers as to property market performance. In dealing with routine and mass valuations, models provide fast and economic solutions.

## 5.0 CONCLUSION

This paper has reviewed selected literature on property market modelling and evaluated the application of property market modelling in Malaysia. Property market models are designed to explain the nature and behaviour of the property markets given the inherent characteristics of the property market. The evaluation indicates that models are relevant since it has contributed much to the property market particularly where it has guided users of the market on market direction albeit with some caution. Although there are weakness of the property market models, as contributed by its' inherent characteristics, modelling of the property market still remains as one of the area that has received attention from researches in the property

sector. Models are important for researchers to explain various situations that arise from the market. As property market varies, so is the nature of models. Hence one model may work in one situation but not in another situation. The work of creating models in property research is a continuous effort and it may take in many different forms.

## References

- [1] Aminah, M. Y. 2002. An analysis of property investment cycles in Malaysia. *International Real Estate Research Symposium, Kuala Lumpur*, National Institute of Valuation, Valuation and Property Service Department.
- [2] Azhari, H. 1987. "Multiple Regression analysis: A review." *The Malaysian Surveyor. The professional Journal of the Institution of Surveyors, Malaysia*. 22(2).
- [3] Azhari, H. 1991. "The derivation of an index as a measure of different types of flooring " *The Malaysian Surveyor. The professional Journal of the Institution of Surveyors, Malaysia*. 22(3).
- [4] Azhari, H. and H. M. Ghazali. 1994. "The construction of land value maps using GIS and MRA: a case study of residential properties in Johor Bahru". *Universiti Teknologi Malaysia. Research Report*
- [5] Ball, M. 1998. "Institutions in British Property Research: A review". *Urban Studies*. 35(9) : 1501–1517.
- [6] M. Ball., B. D. Macgregor. and Lizeri, C. 1998. *The Economics of the Commercial Property Market*. London. E & F Spon.
- [7] Bramley, G. 1998. "Measuring planning: indicators of planning restraint and its impact on the housing market." *Environment and Planning B: Planning @ Design*. 25 : 31–57.
- [8] Bramley, G. 2003. "Planning regulation and housing supply in a market system". Oxford, Blackwell Publishing Brown, G. R. and F. S. Tien (2004). "Equilibrium time on the market (ETOM) for commercial real estate in the UK." *Journal of Property Investment and Finance*. 22(2) : 458–487.
- [9] Brown, G. and S.F. Tien. 2004. Equilibrium time on the market (ETOM) for commercial real estate in the UK. *Journal of Property Investment & Finance*. 22(6) : 458–471.
- [10] Chau, K. W. and T. L. Chin. 2002. "A critical review of the literature on the hedonic pricing model and its application to the housing market in Penang." *The seventh Asian Real Estate Society Conference, Seoul, Korea*. 36.
- [11] Chau, K. W., T. L. Chin, and Ng, F.F. 2004. "The impact of the Asian Financial Crisis on the pricing of condominium in Malaysia " *Journal of Real Estate Literature*, 12(1) : 33–49.
- [12] Copper, J. M., K. Norhaya, Dzurlkarnain, D. and Tee, M.H. 1995. "The impact of the national economy and its relation to the property market: a study focussed on office property in JB." *The Malaysian Surveyor. The professional Journal of the Institution of Surveyors, Malaysia*. 30(2) : 6–14.
- [13] Dzurlkarnain, D., A. Thiruselvam and Ibrahim, S. 1996. "Development of mass appraisal valuation model using multiple regression technique in rating valuation. *Johor Bahru*". Research Report.
- [14] Dzurlkarnain, D., A.R. Rosdi, A. Buang, D. Ghazali and A. Abdul Wahab. 2000. "CAMA system development", RM7. IRPA Research Report.
- [15] Eboy, O. V., S. Ibrahim and Buang, A. 2006. "Determining location influence for shop house rental value using Geographical Weighted Regression(GWR) " *Malaysian Journal of Real Estate*. 1(2) : 1–6.
- [16] Edelstein, R. H. and D. Tsang. 2007. "Dynamic residential housing cycles analysis." *Journal of Real Estate and Economics*. 35(3) : 295–314.
- [17] Fadilah, M. T. and H. M. Fauzi. 1991. "Multiple Regression Analysis: A practical study." *The Malaysian Surveyor. The professional Journal of the Institution of Surveyors, Malaysia*. 26(3).
- [18] Fletcher, M., P. Gallimore, and Mangan, J. 2000. "The modelling of housing submarkets." *Journal of Property Investment and Finance*. 18(4) : 473–487.
- [19] Gibb, K. 2003. "Urban housing models. *Housing Economics Public Policy*", O'Sullivan, T. and K.Gibb. Oxford, Blackwell Publication.
- [20] Hamid, A. M. 2006a. Combining Geographic Information System and regression model in generating locational value residual surface to predict residential property price. *International Real Estate Research Symposium, Kuala Lumpur*.
- [21] Hamid, A. M. 2006b. "Price contour based spatial dummy variables for segmenting market in the Geographic Information System assisted

- hedonic modelling of residential property prices 39-57." *Malaysian Journal of Real Estate*. 1(1).
- [22] Hamid, A. M. and A. Z. Hasmah. 2002. "Inflation hedging characteristics of residential properties according to neighbourhood and property types-A case of Johor Bahru, Malaysia". *International Real Estate Symposium Kuala Lumpur, National Institute of Valuation*.
- [23] Harvey, J. 1996. "Land Economics: The Economics of Real Property". Hound mills, Basingstoke, Hampshire and London, McMillan Publications.
- [24] Hui, E. C. and V. S. Ho. 2003. "Does the planning system affect housing prices? Theory and with evidence from Hong Kong." *Habitat International*. 27(3) : 339–359
- [25] Keogh, G. 1994. "Use And Investment Markets In British Real Estate." *Journal Of Property Valuation And Investment*. 12 : 58–72.
- [26] Key, T., B. D. McGregor and Nanthakumaran, N. 1994. "Understanding the Property Market Cycles". London, Royal Institution of Chartered Surveyor.
- [27] Kryvobokov, M. 2007. "What location attributes are the most important for market value." *Property Management*. 25(3).
- [28] Malpezzi, S. 1998. "Welfare analysis of rent control with side payment: A natural experiment in Cairo, Egypt." *Regional Science and Urban Economics*. 28(6) : 773–796.
- [29] Nasir, M. D. 1999. "Public sector Information Management and Analysis Using GIS in Support of Property Valuations in Malaysia". Department of Geomatics, Newcastle Upon Tyne, University of Newcastle, unpublished PhD thesis.
- [30] Norhaya, K. 2004. *Institutions and the operation of the industrial property market*. Department of Property Management, Johor Bahru, Universiti Teknologi Malaysia. Unpublished PhD thesis.
- [31] Norhaya, K. 2006. "Institutions and the provisions of the Malaysian Industrial property market." *Malaysian Journal of Real Estate*. 1(1): 76–87.
- [32] Norhaya K., I. Suriatini, Hishamuddin M.A., Sipan, I, and Rosadah M. 2008. "Modelling Of The Property Market: The Malaysian Experience,". *International Real Estate Symposium*, Kuala Lumpur
- [33] Rosen, S. 1974. "Hedonic prices and implicit markets: product differentiation in pure competition." *Journal of Political Economy*. 82(1) : 34–55.
- [34] Rosiers, F. D., M. Theriault, et al. 2000. "Sorting out access and neighbourhood factors in hedonic price modelling." *Journal of Property investment and Finance*. 18(3) : 219–315.
- [35] Sau, K. L. 2004. "Property Price Indices in the Commonwealth, construct ion methodologies and problems." *Journal of Property Investment and Finance*. 22(1) : 25–54.
- [36] Suriatini, I. 2006. "Spatial autocorrelation and real estate studies." *Malaysian Journal of Real Estate*. 1(1): 1–13.
- [37] Ting, K. W. 2002. "Performance of the Malaysian residential property sectors: A risk-return analysis". *International Real Estate Research Symposium*, Kuala Lumpur.
- [38] Tse., T. C. and P. D. Love. 2000. "Measuring residential property values in Hong Kong." *Property Management*. 18(5) : 366–374.
- [39] VPSD (1997). 'Malaysia House Price Index' Kuala Lumpur. Valuation and property Services Department.
- [40] Wan Zahari, W. Y. and Nasir, M. D. 2002. "House price dynamics: evidence from a Malaysia case study" *International Real Estate Research Symposium* Kuala Lumpur. 297–310.
- [41] Watkins, C. 1999. "Property valuations and the structure of urban housing markets." *Journal of Property investment and Finance*. 17(3) : 157–175.
- [42] Wheaton, W. and D. DiPasquale. 1996. *Urban Economics and Real Estate Markets*. New Jersey, Englewoods Cliffs, NJ: Prentice Hall.
- [43] Wigren, R. and M. Wilhelmsson. 2007. "Housing stock and price adjustments in 12 Western European countries between 1976 and 1999." *Housing Theory and Society*. 24(2) : 133–154.
- [44] Zhou, S.Z and Bao, H.X. 2009. "Modelling Price Dynamics in the Hong Kong Property Market. Theoretical and empirical". *Researches in Urban Management*. Special Issue/April : 8–26.