AN HEDONIC MODEL FOR HOUSE PRICES IN MALAYSIA

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ABSTRACT

This study attempts to examine the factors correlated with house price, and then estimate the future house price by applying the pricing model which incorporated those factors. If information on the prices of houses that correspond to the multi-dimensional attributes of the house can be obtained, it should be possible to derive the implicit market price. An hedonic house price model derived from multiple regression analysis is developed for the purpose. Correlation analysis has been carried out to study the lead and lag, as well as the co-movement of the House Price Index and the independent variables. The findings are consistent with the hypothesis that house prices are determined by the economic and financial factors identified as relevant for the demand and supply of housing units in this country. The coefficient of determination (R^2) indicates that about 98.7% of the House Price Index variation is explained by this multiple regression model.

1.0   INTRODUCTION

Shelter is one of the human basic physiological need (Maslow's Hierarchy of Needs). In this modern era, shelter comes in a form of house and it is the most important component of the socio-economy sector. This has laid to the formation of many policies and programs aimed at ensuring that all Malaysians, particularly the low-income group, have access to adequate shelter and related facilities.

1.1   General Attributes of House

A house can be seen as a bundle of multi-dimensional attributes that combine together to give a certain price. It is usually impossible to break up the house into its components and market them individually. If information on the prices of houses that correspond to the attributes of the house can be obtained, it should be possible to derive

the implicit market price. House price thus reflects the purchaser's valuation of the particular set of attributes of each house unit.

No two houses are alike, due to their heterogeneity; house prices differ according to a wide variety of attributes, such as locational and physical attributes. Econometric methodologies could be employed to construct a model that the relative significance of various characteristics are defined and their influence on price levels from one time to another, or between one region and another, are allowed for simultaneously. This is the concept used in the hedonic pricing model.

Once the exact mathematical relationship between the house price and the house attributes is determined, it should be possible to derive the market price of a house. The hedonic approach has gained wide acceptance in dealing with changes in the qualitative characteristics of houses under comparison.

1.2 House Price Index (HPI)

Indices are often used to compare changes in living costs for one year to another by comparing the average prices of a "basket of goods" between the two periods. In Malaysia, indices for other investment sectors have been long established. However, property sector is rather slow to come out with a reliable index. This may due to the difficulty of grouping the similar properties in a basket, since no two properties are homogenous.

Prior to 1997, there was no government-published house price index for residential properties and therefore no reliable way of monitoring the movement of house price in the country. To fill this gap, the Valuation and Property Services Department has established the Malaysian House Price Index, which represents the overall housing market in Malaysia, including the 13 states and 2 federal territories. The main objective of a house price index is to indicate how much the house price changes over time, as a result of inflation, holding other attributes constant.

1.3   Objectives

The aim of this paper is to model the Malaysian residential house price, therefore business-related factors, such as the number of business establishment (which are often used in models to explain commercial-industrial property prices) are avoided. Economic factors such as per capita income, unemployment rate, Consumer Price Index for durable goods, and financial factors, loans and advances to housing, average commercial bank lending rate and Composite Index are used to model the house price.

To indicate the price variations in the individual attributes from one house to another, the price measure must be segregated. The hedonic function can be derived using Multiple Regression Analysis (MRA), which enables the estimation of changes in average price from one time period to another on a standardised basis. It isolates the variations in price that are caused by changes in the attributes of houses from those which reflect other market forces, such as purely inflationary factors. The results of the regression provide information on how much a change in a property attribute would affect the price of a property.

To overcome the heterogeneity of houses, the hedonic approach to the Malaysian House Price Index enables a full appraisal of the effects of the housing attributes on house prices.   The technique of Ordinary Least Squares allows the estimation of the relative contribution of each of the variables, on average, to the measurement of house prices. This relative contribution is the coefficient of the variables in the regression equation is to indicate the relative importance of the variables in explaining the variation of house prices.

This is a modest attempt to examine the factors correlated with housing prices, and then estimate the future house price by applying the pricing model which incorporated those factors. Put simply, this study aims at developing a hedonistic model, and applying it to a market.

2.0   METHODOLOGY

Housing is thought to be an integral part of national output. It is possible that expansion of housing activity is preceded by an increase in economic output, with the initial effect felt largely within the housing sector and only subsequently on the aggregate economy. If markets are interdependent, disturbance in one market will be transmitted to other markets.   Therefore any changes in the economic indicators or other market indicators, especially financial indicators, the demand or pricing of the houses will be affected too. However, there have been few empirical studies of relationships between the housing sector and the aggregate economy in Malaysia.

In order to capture price variations in the individual attributes, a hedonic function derived from Multiple Regression Analysis will be used to enable the estimation of changes in average price from one time period to another. The output of the regression will provide information on how much a change in a property attribute would affect the price of a property and, estimate the predictive capability of pricing model incorporating these factors.

Therefore, in order to capture the effect of house price movement, economic indicators such as per capita income, unemployment rate, and durable goods inflation rate will be used.   Per capita income represents the average household income while unemployment rate indicates the ability to generate income, and Consumer Price Index for durable goods provides a general inflation rate of other durable goods. Financial indicators such as total loans to housing, and average lending rate that indicate availability and cost of housing mortgage loan respectively; while KLSE Composite Index is used to show the substitution effect of different investment options. The period of the following analysis will limit to 10 years, which is from 1988 to 1997 due to the constraint of the dependent variable, House Price Index.

Only six predictors are selected because an important criterion of building a multiple regression model is parsimony.   Parsimonious model includes the least number of explanatory variables which permits a good representation of the dependent variable, HPI,

and is less likely to be affected by the problem of multicollinearity.

2.1 Extrapolation of Annually Data

The data available for House Price Index, per capita income and unemployment rate is in annual series. Per capita income was recorded in nominal value, therefore the data needs to be converted into real value. Furthermore, the constraint of study period is lied on HPI that is only available from 1988 to 1997. Therefore with only 10 sets of observation, it is inadequate for the purpose of this study. The annually data is extrapolated into quarterly figures to match other quarterly independent variables.

2.2 Correlation Analysis

From the findings of other property-related studies, we know that many of the economic as well as financial indicators have the leading and lagging effect on the property market. To better recognise the direction and the bond of the co-movements of the dependent and independent variables, correlation analysis will be carried out. We need to beware that the correlation between the two variables may not be a causal relationship. The result of correlation analysis, r-value, just shows us the direction and strength of co-movement of the two variables.

Examine the correlation coefficient of independent variables (the highest for each variable) on a quarterly basis, and shifting the time reference of the independent indicators forward (lead) or backward (lag) against the dependent variable will indicate which variable is a leading or lagging indicator and the lead or lag period.

2.3   Multiple Regression Analysis

Multiple linear regression analysis (MRA) is an extension of the methodology of linear regression to more than one independent variable. By using more than one independent variable, we could better explain the variation in *dependent variable* and hence provide more accurate predictions.

A common application of multiple regression analysis is residential property value assessment. In this study, the objective is to estimate (or predict) the value of all Malaysian residential house price, y, based on certain descriptive information. The author begins by recording the average household income, x_1, as measured by the per capita income. However, income alone is not a precise determinant of house price.   Therefore unemployment rate (x_2); CPI-DG (x_3); total loans to housing (x_4); average lending rate (x_5) and KLSE CI (x_6) will be incorporated into the analysis. These predictors are important determinants of house price and, when considered collectively with income in a multiple regression model, will almost certainly improve our ability to estimate market value accurately in comparison with a model that only uses income.

The multiple regression analysis will incorporate the results from the correlation analysis and the effect of lead and lag will be built into the model.   The mathematical expression of the relationship between the dependent variable and the independent variables is as follow:

$$y \; = \; f(x_1, x_2, x_3, x_4, x_5, x_6)$$

2.4   House Price Index Estimate

One objective of this study is to estimate the House Price Index for the following 3 years, which are 1998, 1999 and 2000.   The best fit multiple regression model developed using the above methodology will be used to do the prediction.   Scenario analysis is employed in the estimation.   The prediction indicators will be based on the

following scenarios, which are optimistic, most likely and pessimistic scenario. The figures are based on the author's personal viewpoint to the current crisis and the estimated recovery pace.

3.0 FINDINGS

Correlation analysis has been carried out to study the lead and lag, as well as the co-movement of the HPI and independent variables. The findings are as follow. The *r*-value of real per capita income is 0.988 with 4 quarters lead, which indicates house price index and real per capita income have very high co-movement (almost perfect). Unemployment rate has a negative coefficient correlation of 0.886 at 4-quarter lead. Consumer Price Index for durable goods has moderate negative *r*-value (-0.426) with 7 quarters lag. Total loans and advances by commercial bank and finance company for housing has very strong positive correlation (*r* = 0.980, 1 quarter lag) with the HPI. The coefficient correlation of average commercial bank lending rate is 0.500 with 1 quarter lag, the figure shows moderate positive co-movement between the HPI and average lending rate. The correlation coefficient of KLSE Composite Index is leading 2 quarters at a high positive relation (0.873) with HPI.

An improved hedonic model has been developed by carrying out stepwise regression to mitigate the effect of multicollinearity. Multicollinearity exists in virtually all multiple regression models. In fact, finding two completely uncorrelated variables is rare. An alternative to minimise the effect of multicollinearity is to use a stepwise regression package. Backward stepwise regression starts with all the independent variables included in the equation and removes variables if they are not strongly related to the dependent variable. Because the stepwise technique excludes redundant variables, it minimises multicollinearity.

The summary equation is as below:

HPI = - 8.423 + 0.0127 Real PCI (4Q lead) + 3.579 Unemployment rate (4Q lead)

+ 0.00088 Total loans (1Q lag) + 0.00372 KLSE CI (2Q lead)

All the F value, significant F or ρ, t-state, and P-value are shown significance results. The coefficient of determination (R^2) indicates that about 98.7% of the HPI variation is explained by this multiple regression model.

Real PCI, Total Loans and KLSE CI have positive coefficients mean that increase in any of these predictors will increase the HPI. This is in line with the findings in the correlation analysis. However, the positive coefficient of Unemployment Rate is contradicting to the finding in correlation analysis. Unemployment Rate supposed to move opposite to the HPI. This anomaly may be attributed to the 'too low' unemployment rate in the later period of study. The observations were from the recovery and high growth stage of the economic cycle. Therefore slightly increase in unemployment rate would stabilise the economy growth and the HPI as well. The unemployment rate rises during cyclical downturns and falls during periods of rapid economic growth. The unemployment rate is considered a lagging indicator of economic activity.

The improved multiple regression model will be used to provide a reasonable estimates of the HPI for the next three years.

3.1 Summary Output of Scenario Analysis and Forecast Results

Below are the estimated HPI for year 1998 to 2000. Scenario analysis considers an overall view of macroeconomic impacts as well as uncertainty about assumptions for the model itself. Scenario Analysis entails taking an overall view of potential outcomes of the currency crisis and will be based upon informed subjectivity. The main weakness of the process of scenario analysis was in the subjective determination of value ascribed to the variables in future.

A couple of warnings must attend to any conclusions drawn from the tests. First, if one or more of the required conditions of multiple regression analysis is violated, the

results may be invalid. Second, because all the independent variables were observed over a relatively narrow range, it is dangerous to extrapolate far outside this range. Remember that we can draw valid conclusions about the model only for values within the range of the observed values of the independent variables.

Table 1

Summary output of Scenario Analysis using the improved multiple regression model.

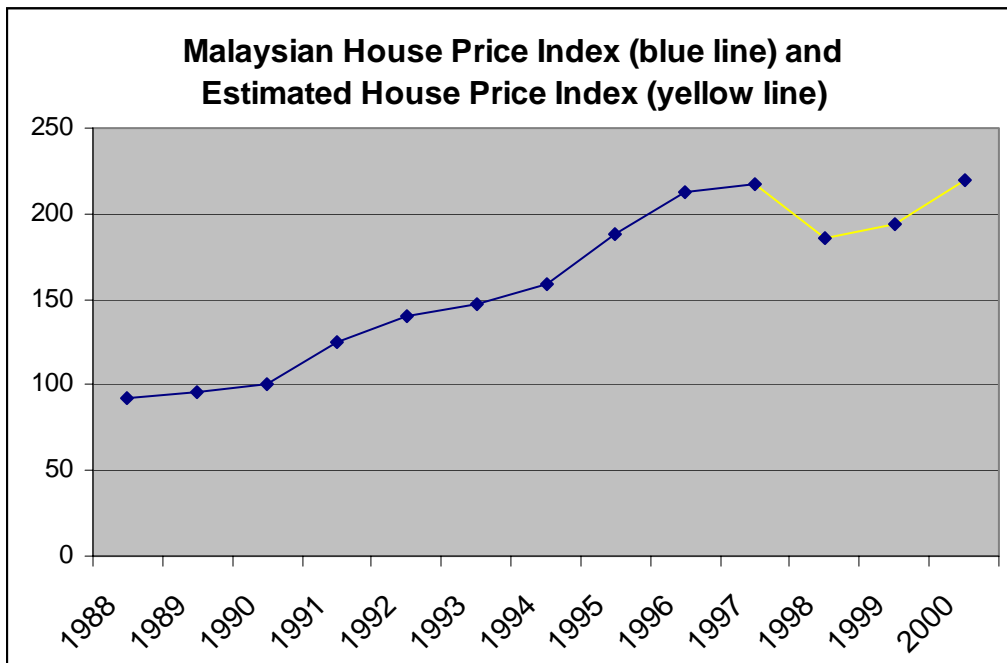| Year	Scenarios	HPI
1998	Optimistic	202
	Most Likely	186
	Pessimistic	171
1999	Optimistic	225
	Most Likely	195
	Pessimistic	185
2000	Optimistic	244
	Most Likely	220
	Pessimistic	205

Figure 1

Figure 1 shows the trend of actual HPI from 1988 to 1997, and projected HPI (base on most probable outcome) from 1998 to 2000 (indicated by yellow line). We can notice the sharp downturn from 1997 to 1998 and this trend is consistent to the current economic turmoil in Malaysia. From 1998 to 1999, the HPI will recover but at a very slow pace. The recovery pace will pick up after 1999.

4.0 CONCLUSIONS

The hypothesis of this study is that Malaysian residential housing price was determined by the identified economic and financial factors. Now, we have sufficient evidence to conclude that, even not all predictors are significantly related to house price, but 4 out of 6 predictors are significant determinants of HPI. The four significance determinants of HPI are real per capita income and unemployment rate, both with 4 quarters lag, and total loans to housing (1 quarter lead) while KLSE CI with 2 quarters lag.

The objective of producing a hedonistic house price model that can explain the variation in HPI using multiple regression analysis has been achieved. The hedonistic model, which account for 98.7% variation in the house price, is applied to future residential market and estimates of the economic scenarios were produced. The model is as follow:

$$\text{HPI} = -8.423 + 0.0127 \text{ RPCI (4Q lag)} + 3.579 \text{ UR (4Q lag)}$$
$$+ 0.00088 \text{ TL (1Q lead)} + 0.00372 \text{ CI (2Q lag)}$$
$$R^2 = 0.9869$$

Where

HPI	=	House Price Index
RPCI	=	Per Capita Income
UR	=	Unemployment Rate
TL	=	Total Loans to housing
CI	=	KLSE Composite Index

-8.423 = coefficient of intercept

4.1   The Effect of Market Expectations to the House Price

Market psychology can depend on any number of factors that cause participants to have a negative or positive view of the market. When market psychology is negative, as in present economy situation, house buyers are bearish, feeling that prices will decline further because of unstable income and interest rate pressure. Consequently, they will view strong economic indicators with a negative tinge. Negative market psychology causes house buyers to look for strong economic data, such as low interest rate and recovering GDP growth to support house price. When market psychology is positive, as in the study period, house buyers are bullish and expect the house price to rise.

Negative market psychology looks for and reacts for adverse numbers (undue pessimism), whereas positive market psychology looks for and reacts to positive numbers (undue optimism). Market psychology can shift rapidly. A change in market psychology is difficult to predict.

4.2   Implications of the Study

The findings of this study have a number of implications. Economic indicators such as per capita income and unemployment rate, except CPI for durable goods, have a lagged effect to the Malaysian house price. However, financial indicators such as total loans to housing and lending rate lead the HPI.

All the financial indicators used have positive correlation with the HPI. Economic indicator, per capita income has positive co-movement with HPI while other indicators, unemployment rate and CPI for durable goods exhibit opposite movements.

The refined multiple regression model indicates HPI is significantly related to changes in real per capita income, unemployment rate, total loans to housing and KLSE

Composite Index. All of these predictors have a positive relation to the HPI i.e. increase in any predictors' value will increase HPI, or vice versa.

In other words, per capita income, unemployment rate, total loans to housing and KLSE CI have a significance relationship to the movement of Malaysian house price. Therefore close monitoring of these indicators may give hints to when the residential housing market will bottom up and recover.

Lending rate, being an important element in the investment decision was found not significantly related to HPI. This indicates Malaysian house buyers are not sensitive to the lending rate, and/or the fluctuation of the lending rate is too narrow to induce attention. However, eyeing current hike in lending rate, this indicator is expected to carry much more weight in house mortgage loan decisions.

Applying scenario analysis methodology together with the improved multiple regression model, estimates of HPI for the coming three years was produced. The findings reflect the impact of the recent economic crisis to HPI. HPI is expected to drop 7% to 21% this year. HPI is also expected to recover slowly by 1999 with average 5% growth and gain momentum again in year 2000 with double-digit growth rate.

4.3   Possible Limitations

The main limitation of this study is small sample size of HPI. This has limit the validity of this study and the extend of study period. The available HPI started from 1988 to 1997 which covered only the recovery and boom stage of the residential property market cycle. Therefore the findings are skewed towards positive expectation of the industry.

Use of extrapolation method to expend the data set has smoothed the variation in the data set and hence produces an extremely high coefficient of determination in the multiple regression analysis.

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