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AN ENHANCED HOUSE PRICE INDEX MODEL IN MALAYSIA: A LASPEYRES APPROACH

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ABSTRACT

The purpose of this study is to develop an enhanced house price index model in Malaysia. At the same time, it attempts to examine the determinants of the existing house price index in Malaysia. Review of the current Malaysian House Price Index (MHPI) model shows that this index is constructed based on demand driven variables. Past studies explained that both macroeconomic factors (income levels, interest rates, labor market) and supply factors are included in constructing the house price index. Therefore, this study aims at providing evidence on the determinants of the House Price Index (HPI). This study employs the Autoregressive Distributed Lag Model (ARDL) to discover the short and long-run dynamics between the variables. The study considers the quarterly data from first quarter 2008 to fourth quarter 2015. The analysis shows that supply and institutional factors are significant in determining the HPI. Hence, we propose a new enhanced house price index incorporating new demand and supply variables. By using Laspeyres Approach, the new enhanced HPI has been calculated. The findings revealed that MHPI was found to have a long run significant relationship with employment, Overnight Policy Rate (OPR), Consumer Price Index (CPI), land supply and housing loan while construction cost is not significant in determining the MHPI.

JEL Classification: C32, L11, O25

Keywords: House price index, Malaysia, Laspeyres approach

1. INTRODUCTION

House is shelter to support a household living and a basic need for all. Owning a house is somehow a privilege to some people. From a customer perspective, besides location, accessibility and facilities, price is usually the most important factor in buying a house. Hence, the house price index is used by the customers in deciding to buy a house. On the other hand, the developer will consider the house price index before building houses. Policy makers use the house price index to monitor price changes, while investors use it to assess when to buy a house as part of their investment planning.

In Malaysia, the house price index has been introduced in 1997 by the National Property Information Centre (NAPIC) which is known as Malaysia House Price Index (MHPI) (Kamarudin et al., 2008). It has been used as a benchmark for all parties including investors, financial institution, researchers and developers (Rosmera, Mohd Diah and Omar, 2012). Nevertheless, it was found that the construction of House Price Index (HPI) in Malaysia is based only on the demand side variables. A number of studies have pointed out that the supply factors are also important in determining the house price index. (e.g. Osmadi et al., 2015; Liew and Haron, 2013; Dröes and Minne, 2015).

The interaction between these demand and supply factors will determine the equilibrium house price index. This will be more representative of the housing market in the country. Therefore, the objective of this paper is to determine the significant determinants of HPI in Malaysia and calculate the enhanced HPI. It is assumed that other supply factors will also significantly influence the HPI in Malaysia.

The next section of this paper gives an overview of the MHPI followed by literature review in Section 3. Section 4 presents the research methodology employed in this study. Section 5 discusses the results and findings and lastly, Section 6 provides some conclusions and recommendations.

2. OVERVIEW OF MALAYSIAN HOUSE PRICE INDEX

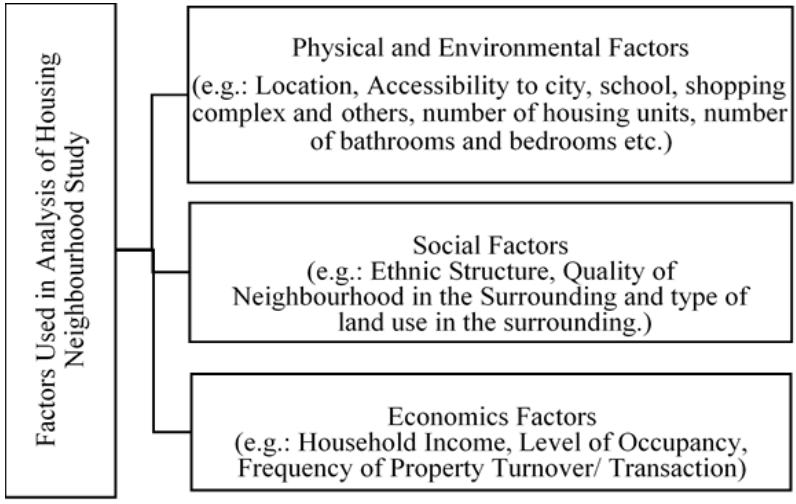
In 1997, the first MHPI was introduced by NAPIC. The role of this HPI is to monitor the performance of the Malaysian housing market. It provides both annual and quarterly data for 46 districts and 14 states in Malaysia. In 2003, the MHPI has been revised and the base year

was updated to 2000. After that, in early 2017, the base year has been amended again from 2000 to 2010 (NAPIC, 2018).

The hedonic method is adopted by NAPIC to construct the MHPI. This technique has been extensively utilized in the construction house price indices. As early as 1982, the United States (US) already used the hedonic method in constructing the HPI while the Halifax and Nationwide in the United Kingdom (UK) also used the same technique since 1983. By adopting this technique, the house price will be appraised depending on its attributes such as the number of rooms, size, age, land area and other factors (Rosmera et al., 2012).

Determinants used for computing the MHPI include the land area, floor area, age of building, distance to amenities, floor level (only for high rise unit), housing types, building quality, type of tenure and neighbourhood classification (NAPIC, 2018). Figure 1 defines the determinants which are included in principal component analysis of neighbourhood study. These determinants are divided into three categories which are physical and environmental, social and economic factors.

FIGURE 1
Factors Used in Analysis of Housing Neighbourhood Study

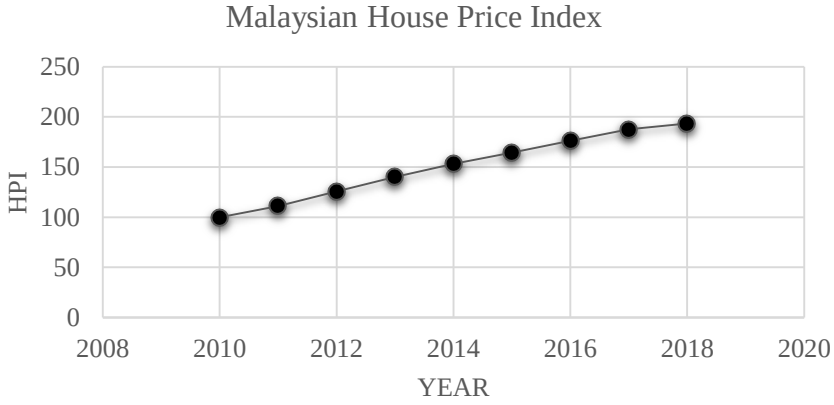


Source: National Property Information Centre (2018).

A quick glance at all the factors stated in the figure shows that most of the factors incorporated in calculating the HPI in Malaysia are

solely based on the demand side. These determinants are classified into three groups which are physical and environmental factors (age of scheme, location, distance, quantity of rooms and restrooms), social factors (ethnic structure, surrounding neighbourhood quality and type of land use in the surrounding) and economic factors (income, level of occupancy and frequency of property turnover). Meanwhile, figure 2 displays the growth of the MHPI from 2010 to 2018 based on the existing computation of HPI.

FIGURE 2
Malaysian House Price Index, 2010 -2018



Source: National Property Information Centre (2018).

Figure 2 displays the progress of MHPI since 2010 until 2018. The HPI shows an increasing trend in the Malaysian residential property market where the value was 100 in 2010 due to the base year that has been updated from 2000 to 2010 and went up to 110.9 in 2011. Then, the trend of house prices continuously increased from 2012 to 2018 at 193.3 (NAPIC, 2018). The interaction between demand and supply factors will derive the actual HPI. However, the computation of the current Malaysian HPI does not incorporate the supply factors.

Past research indicates that the house prices can also be affected by supply factors (Osmadi et al., 2015; Xu and Tang, 2014). In the long run, the house prices have a tendency to react to the new construction cost which encompasses the cost of land, the cost of materials and labor and the associated financing and consenting costs. Furthermore, a rise in land supply tends to reduce the house prices. Past literature also revealed that house price has a significant impact

on the land supply both in the long run and short run. Normally, house prices are more volatile in the housing market but in the business environment, house prices tend to be more flexible (Glindro et al., 2011; Yan, Feng and Bao, 2010; Craig and Hua, 2011).

Besides that, another variable that can be used to measure the growth in housing financing systems is the institutional factor. According to Égert and Mihaljek (2007) the countries that implement the better and faster developments in these institutions tend to experience rapid development of house prices. The development of housing markets and housing finance appear to have a strong impact on real house price dynamics in Central and Eastern Europe.

Next, this paper reviews the previous literature on the determinants of house prices. The review will then be followed by a discussion on the variables that may contribute to the overall HPI.

3. LITERATURE REVIEW

A credible house price index (HPI) is important in order to find the determinants that contribute and are significant to the house price. Many studies related to the construction of the HPI have been done in order to improve the modelling of the HPI and enhance its accuracy (Hepşen and Vatansever, 2011; Bourassa, Hoesli and Sun, 2004; Mohd Diah, Rosmera and Omar, 2013; Nagaraja, Browny and Wachter, 2010; Longford, 2009; Selim, 2008).

Based on Tsai (2012), the housing price index is influenced by both supply and demand, while also affecting supply and demand for housing. The house price can be determined based on the macroeconomic (market related) factors and microeconomic (house specific) factors. The demand side of the housing market is affected by factors such as economic growth, general price level, the cost of borrowing, loan availability, income or wages and the population, demographic structure, bank credit or money supply, disposable income, interest rates, inflation, taxation and others (Gasparėnienė, Remeikienė and Skuka, 2017; Madsen, 2011; Stepanyan, Poghosyan and Bibolov, 2010; Sunde and Muzindutsi, 2016).

Meanwhile, previous studies also suggest that house prices are highly correlated with the other microeconomic house-specific demand factors such as physical, structural, location, environmental and neighborhood (Md Yusof, 2008; Stohldreier, 2012; Ong and Chan, 2013; Tan, 2011). Falzon and Lanzon (2013) explained that

physical, structural, location and neighborhood factors are very important in determining house prices. Furthermore, many studies have shown that the number of bedrooms, land area, location, quantity of rooms, size of house, building type, floor area and floor level are the most important factors contributing to property values (Osmadi et al., 2015; Ge and Du, 2007; Kim et al., 2015; Mohd Diah et al., 2014). Besides that, Tan (2010) highlights the importance of neighborhood factors such as gated-guarded and freehold in determining house prices. Other than that, the existence of parking garage also has a strong effect while the view of graveyard gives a negative effect on the property value.

Then, the supply factors comprise the cost of construction, land supply index and geographical limitation. The equilibrium of HPI occurs with the interaction between the demand and supply factors (Cheng and Fung, 2015; Glindro et al., 2011; Yan et al., 2010; Craig and Hua, 2011). Table 1 shows the determinants for HPI from selected countries.

Table 1 shows the determinants used by selected countries to calculate the HPI. A study conducted by Chen et al. (2013) revealed that the Beijing HPI is significantly influenced by the economic fundamental variables such as inflation, income, interest rate, and construction cost from 2004 to 2007. Similar with Hou (2010) that exposed about 75 percent of the changes in Beijing house prices are explained by the economic variables used in the models. Besides that, the HPI in Korea is computed based on the total factor of construction cost including land and personal disposable income for single-family dwelling and apartments (KB Financial Group Inc., 2012). By looking into the determinants influencing the house prices index in Beijing and Korea, it is clearly shown that both demand and supply factors play a significant role in determining the HPI.

Furthermore, another study conducted by Eurostat (2013) described the important elements used to compute the Residential Property Prices Indices (RPPI) includes the area of structure, land area, location, property type and age, material used in house construction (wood, brick, concrete etc.) and other house price characteristics such as the number of bedrooms and bathrooms, distance to amenities and others. Other than that, Duebel (2012) explained the attributes used in constructing the HPI in Germany include physical, structural, neighborhood and social, location and construction cost factors. All the factors represent both the demand and supply side.

TABLE 1
Determinants for House Price Index from Selected Countries

	Malaysia	Korea	China	Germany	European Union
Physical and Environmental	✓	✓		✓	✓
Structural				✓	✓
Neighbourhood/Social	✓			✓	
Location	✓	✓		✓	✓
Income	✓	✓	✓		
Level occupancy	✓				
Frequency of property turnover	✓				
Building cost / Construction cost		✓	✓	✓	
Land Supply		✓			
Materials used in the construction (wood, brick etc.)					✓
Inflation			✓		
Interest rate			✓		
Housing loan				✓	

Source: Compilation from various sources

However, as for Malaysia, most of the determinants used to construct the HPI are only based on demand factors. It includes the physical, social, environmental, income, occupancy level and frequency of property turnover (NAPIC, 2018). Besides that, only a few studies have been carried out to construct an alternative HPI in Malaysia. These, however, only focused on microeconomic variables or hedonic characteristics to be included in the new HPI model. Rosmera et al. (2012) and Mohd Diah et al. (2013) proposed an alternative HPI to be used as one of the references in monitoring price changes. It is called a hypothetical price index. Determinants used in this study included physical and locational characteristics of property. The analysis shows that the hypothetical price index shows the same trend as the MHPI. Only at certain quarters, the index is different due to the different sample of data.

On the other hand, Tan (2011) adopted the hedonic model in order to analyze the variables that are significantly related with house

prices in Malaysia. The findings exposed that the selected variables such as income per capita, unemployment rate, total loans and Kuala Lumpur Stock Exchange Composite Index (KLSE CI) positively influenced the house prices in Malaysia. Meanwhile, Ong and Chang (2013) reviewed the determinants of house prices in Malaysia using the macroeconomic factors from year 2000 until mid-2012. The findings show that only real GDP rate is significant to the HPI compared to consumer price index and income increment rate. The strong economic growth (GDP) in recent years became a reason for the increase in housing price index in Malaysia. It is supported by Md Yusof (2008) that reveals over 80 percent of the HPI variations in every model of the movement of house price in Malaysia is explained by GDP.

Then, Apergis (2003) analyzed the effects of selected macroeconomic factors such as housing loan rates, inflation and employment rate toward the prices of new houses sold in Greece. The analysis indicated that all the three factors (employment rate, housing loan rate and inflation) have a significant effect on the real housing prices.

From the supply side, the variables that impact on house prices can be categorized into land supply, planning policy and construction cost. A number of studies on house prices have demonstrated that the majority of researchers incorporate the construction cost and land supply as vital parts of the supply side factors (e.g. Capozza et al., 2002; Glindro et al., 2011; Dröes and Minne, 2015; Mariadas, Selvanathan and Hong, 2016; Madsen, 2011; Yan et al., 2010; Craig and Hua, 2011). The growth in construction cost can have a significant impact on the increase of house prices. The construction and housing stocks will decrease if the financial cost of construction is increased while the lower level of housing space will produce higher rents and higher house prices (Osmadi et al., 2015; Liew and Haron, 2013; Watson, 2013; Xu and Tang, 2014).

Attempts have been made by Liew and Haron (2013) and Osmadi et al. (2015) to include the supply variables (construction cost) in the HPI model in Malaysia. Liew and Haron (2013) discovered that the increasing price of houses in the Klang Valley is due to rising cost of construction. This cost includes the price of land, high technology and heavy equipment, materials, period of the project, difficulty in building and labor. It is supported by Mariadas et al. (2016) who also found in their studies that the construction cost is one of the main

factors significantly related with house prices in the Klang Valley besides population and housing speculation.

Then, Osmadi et al. (2015) explained that the house price in Malaysia can be determined by supply factors which is cost of material and land. Moreover, house prices will decrease if there is an increase in land supply. Past studies indicate that land supply has a major effect on house prices both in the long run and the short run. House prices also tend to become more volatile in housing markets and more flexible business environment (Glindro et al., 2011; Yan et al., 2010; Craig and Hua, 2011).

On the other hand, not only demand and supply factors give an impact on house price movements; institutional factors play a role too. These factors demonstrate the differences in business environment and housing finance system arrangement (Égert and Mihaljek, 2007; Vizek, 2010). According to Glindro et al., (2007) housing regulatory framework, housing finance system, structure of economic and local conditions aspects is categorized under institutional factors. Then, the analysis on four institutional indices which are the business freedom index, financial freedom index, corruption index and property rights index towards the house prices in nine Asian economies have been tested. The results prove that all the selected institutional indices are significant in determining the house prices in the nine Asian economies (Glindro et al., 2011). Besides that, Égert and Mihaljek (2007) investigate the impact of institutional factors on house prices in Central and Eastern Europe (CEE) by employing the indicators of banking reform, interest rate liberalization, indicators of security markets and non-bank financial institutions' reform while Vizek (2010) applied housing loans as a proxy for the accessibility to housing financing.

As for Malaysia, other important variables might have been excluded in computing the HPI. To date, there is only one HPI available and it serves as a main reference by policy makers as well as the public in Malaysia (NAPIC, 2018). Due to this, there is no other HPI that could be used as a comparison to the existing Malaysian House Price Index (MHPI). Only a few studies have been conducted to produce an alternative HPI in Malaysia. However, they only focused on microeconomic variables or hedonic characteristics to be included in the new HPI model (Rosmera et al., 2012; Mohd Diah et al., 2013; Mohd Diah et al., 2014). According to Tsai (2012), both demand and supply factors should be incorporated into the computation of house price index because the HPI is affected by both

supply and demand factors. Besides that, a credible and accurate HPI is important in order to accurately measure the changes in house prices.

4. METHODOLOGY

The aim of this study is to develop an enhanced HPI model in Malaysia and at the same time to investigate the significant determinants of HPI in Malaysia. In this process, we employ secondary data covering the period of 2008:Q1 to 2015:Q4. Data were obtained from various sources including NAPIC, Bank Negara Malaysia (BNM), Department of Statistics Malaysia (DOSM) and Construction Industry Development Board (CIDB). The measurements of variables used in this study are summarized in Table 2.

TABLE 2
Measurement of Variables

Variables	Measurement	Sources
House Price Index (HPI)	Malaysian House Price Index	NAPIC
Employment (EMPT)	Employed Persons by Industry	BNM, DOSM
Construction Cost (CCI)	Building Cost Index	CIDB
Land Supply (LS)	Housing Permit Approvals	BNM
Housing Loan (HLN)	Housing Loan Approved	BNM
Consumer Price Index (CPI)	Consumer Price Index	BNM
Interest rate	OPR	BNM

Note: All variables are collected from 2008: Q1 to 2015: Q4.

Table 2 displays the proxies and sources of the variables used in this study. As CCI and LS are the supply factors that were broadly used in the literature, we incorporate the two variables in our analysis as the determinants of HPI. In addition, one institutional variable namely HLN is also included in the model.

4.1 EMPIRICAL MODEL

This study aims at constructing an enhanced HPI model. Hence, we first examine the determinants of the existing HPI in Malaysia by using Autoregressive Distributed Lag (ARDL). The coefficients computed in the ARDL model were later used to calculate the

enhanced HPI using a Laspeyres Approach. The detail of the methodology used in this study is explained below:

4.1.1 UNIT ROOT TEST

The stationary level for all selected variables in this study will be tested by using unit root test. The analysis shows whether the selected variables are stationary at level *I*(0) or at first difference *I*(1). The presence of a unit root shows that a particular variable is not stationary. This study applies the Augmented Dickey Fuller (ADF) test for the existence of a unit root in all variables. The regression of ADF serves to take care of the problem of serial correlation at the first differences.

4.1.2 AUTOREGRESSIVE DISTRIBUTED LAG (ARDL) MODEL

In this analysis, we adopt the bound testing and autoregressive distributed lag (ARDL) model which was developed by Pesaran, Shin, and Smith (1996). This technique is relatively simple and does not require all variables to be *I* (1) like Johansen. Furthermore, it is also more reliable for a small sample such as in our study where we only have 32 observations. In addition, Narayan (2005) confirms that the ARDL model approach is efficient and unbiased. At the same time, the short run and long run components of the model can be captured simultaneously by using the ARDL cointegration model.

Normally, ARDL requires a standard procedure which encompasses stationary test and cointegration test. Stationary test can be done through unit root test while cointegration test can adopt the ARDL bound testing approach. ARDL bound testing approach involves a number of steps. The first step is to identify if there is cointegration between the selected variables by using the Error Correction Model (ECM) procedure. Secondly, it involves the process of estimating the long run relationship between HPI and the selected variables. Lastly, the serial correlation, functional form, normality and heteroscedasticity need to be checked by using the residual diagnostic test. Besides that, we perform cumulative sum of recursive residual (CUSUM) and cumulative sum of square recursive residual (CUSUMSQ) in order to test the structural stability of our variables. The optimal lag length selected is based on the Akaike Information Criteria (AIC) which is considered to be equal to 2. The ARDL model used in this study can be articulated as follows:

$$HPI = \alpha_0 + \alpha_1 EMPT + \alpha_2 CPI + \alpha_3 OPR + \alpha_4 CCI + \alpha_5 LS + \alpha_6 HLN + e_t$$

where

HPI = House Price Index
$EMPT$ = Employment
CPI = Consumer Price Index
OPR = Overnight Policy Rate
CCI = Construction Cost
LS = Land Supply
HLN = Housing Loan
e_t = Error Term

The ARDL approach to cointegration involves estimating the conditional error correction (EC) (Pesaran, Shin, and Smith, 2001). The ARDL model for HPI and its determinants is given as:

$$\begin{aligned}\Delta\ HPI_t = a_0 &+ \sum_{j=1}^{k1} b_j\ \Delta\ HPI_{t-j} + \sum_{j=0}^{k2} c_j\ \Delta \ln EMPT_{t-j} + \sum_{j=0}^{k3} d_j\ \Delta \mathrm{OPR}_{t-j} \\ &+ \sum_{j=0}^{k4} e_j\ \Delta \mathrm{CPI}_{t-j} + \sum_{j=0}^{k5} f_j\ \Delta\ CCI_{t-j} + \sum_{j=0}^{k6} f_j\ \Delta \ln LS_{t-j} \\ &+ \sum_{j=0}^{k7} f_j\ \Delta \ln HLN_{t-j} + n_1\ HPI_{t-1} + n_2 \ln EMPT_{t-1} \\ &+ n_3\ \mathrm{OPR}_{t-1} + n_4\ CPI_{t-1} + n_5\ \mathrm{CCI}_{t-1} + n_6 \ln LS_{t-1} \\ &+ n_7 \ln HLN_{t-1} + \epsilon_t\end{aligned}$$

The error-correction dynamics is represented by the terms with the summation signs, while the long-run relationship is represented by the second part. ϵ_t refers to the random error term.

4.1.3 LASPEYRES APPROACH

This study will develop an enhanced HPI using the Laspeyres approach. This method is also used by NAPIC to compute price indices for Malaysia. For every quarter period, the regression coefficients are computed, and they are used to calculate the current period index number for each of the 86 indices from the fixed-weight

Laspeyres formula. The computation of price indices has been structured so that the index number equals 100.0 in the base year (2010) (NAPIC, 2018).

Laspeyres approach can be defined as an index formula used in price statistics for measuring the price development of the basket of goods and services consumed in the base period. This approach is a way of expressing how prices today compare with prices at some point in the past. The Laspeyres index has the following form:

$$I = \frac{\sum P_n W}{\sum P_o W}$$

where

$\sum P_n W$ = Sum of weighted Current Prices
$\sum P_o W$ = Sum of weighted base Prices

According to the Australian Bureau of Statistics (2009) the advantage of the Laspeyres approach is that the index can be extended to include another period's price observation when available, as the weights are held fixed at some earlier base period. Therefore, only prices have to be collected on a regular basis. It is much less costly and time consuming to calculate a time series Laspeyres index than a time series of Paasche, Fisher, and Törnqvist price indexes.

The main characteristic of the Laspeyres index is that the weights used are taken from the base period. So, in this study, Q1 2008 is selected as a base year for the analysis. In practice, quantities might not be observable or meaningful for some index. Thus in practice the Laspeyres formula can be estimated using value shares to weight price relatives. If price relatives are used then value weights must also be used. On the other hand, if prices are used directly rather than in their relative form, then the weights must be quantities.

An enhanced house price index (HPI) is constructed to enhance the existing HPI model in Malaysia by introducing new variables inclusive of demand and supply variables. The HPI is modelled by using the multiple regression technique. This analysis shows the relationship between the HPI and the selected independent variables. In order to test this relationship, this study proposed the use of ARDL analysis. The application of a regression analysis using ARDL will help to determine the variables that give significant impact on house prices. The coefficient values from the ARDL are used to

calculate the weighted for each selected variable. Consequently, for each quarter period, this weighted are used to calculate the new enhanced HPI number by using the Laspeyres approach. Then, the computation of house price indices has been structured so that the index number equals 100.0 in the base year (Q1 2008).

5. FINDINGS AND ANALYSIS

This section explains the results of the methodology used in this study. We first tested the descriptive analysis of this study and the results are presented in Table 3; then the stationarity of all the variables used have been tested by using unit root test. The results of the methodology used are discussed in the following sub-section.

5.1 DESCRIPTIVE ANALYSIS

TABLE 3
Summary of Descriptive Analysis

	LNHPI	LNEMP	OPR	CPI	CCI	LNLSI	LNHLN
Mean	4.832	2.524	2.937	105.120	96.908	4.518	3.104
Median	4.841	2.536	3.000	104.900	98.322	4.528	3.078
Maximum	5.125	2.648	3.500	112.600	104.758	4.889	3.480
Minimum	4.529	2.367	2.000	99.500	89.181	4.118	2.401
Std. Dev.	0.186	0.102	0.458	3.554	4.986	0.191	0.289
Skewness	-0.064	-0.350	-0.937	0.410	-0.113	-0.400	-0.920
Kurtosis	1.806	1.727	2.909	2.418	1.682	2.451	3.180
Jarque-Bera	1.922	2.813	4.684	1.349	2.386	1.257	4.562
Probability	0.383	0.245	0.096	0.509	0.303	0.533	0.102
Sum	154.620	80.781	94.000	3363.830	3101.056	144.565	99.318
Sum Sq. Dev.	1.068	0.320	6.500	391.596	770.503	1.134	2.595
Observations	32	32	32	32	32	32	32

The table of descriptive analysis shows that the mean and median values for all variables vary with minimal standard deviation and suggest that the data are distributed evenly.

5.2 UNIT ROOT TEST

The unit root test is arguably the most vital test in time series analyses. The test is carried out on all the selected variables to examine the

stationarity of the variables. A null hypothesis indicates the presence of a unit root, while an alternative hypothesis indicates the absence of a unit root.

TABLE 4
Summary of Unit Root Test

Variables	I(0) level		I(1) 1st Difference	
	Intercept	Trend & Intercept	Intercept	Trend & Intercept
HPI	-0.221	-2.580	-5.022***	-5.353***
EMPT	-1.886	-1.623	-5.731***	-5.790***
CPI	0.021	-11.728***	- 4.971***	-5.279***
OPR	-1.327	- 5.065**	-5.384***	-5.343**
CCI	-2.012	- 3.570*	-6.724***	-6.651***
LS	-1.487	-1.253	-5.609***	-5.635***
HLN	-2.670	-1.452	-4.625***	-5.097**

Null Hypothesis (H_0): There is a unit root.
Notes: *, **, *** indicate level of significance at 10%, 5% and 1%, respectively.

Table 4 presents the results of the unit root test for the variables in the study. The results show that only three variables are significant at order 0 while all the selected variables are significant at order 1.

5.3 RESULTS OF THE ARDL MODEL

Table 5 shows the analysis of the computed *F*-statistics for the model of HPI. It suggests that there are cointegrating relationships among all the selected variables at the selected lag length. The results indicate that HPI is significantly influenced by the independent variables in the long run. Then, the following step is to estimate the long-run coefficients of the ARDL model.

TABLE 5
Results of Bound Testing Procedure

Cointegration Hypotheses	*F*-Statistics
F(HPI|EMPT, CPI, OPR, CCI, LS, HLN)	6.912***

Notes**:** *** indicates 1 percent level of significance. *F*-statistics exceeds the 1 percent upper bounds; the relevant critical value bounds are taken from Narayan's (2005).

TABLE 6
Results of Long Run ARDL Model

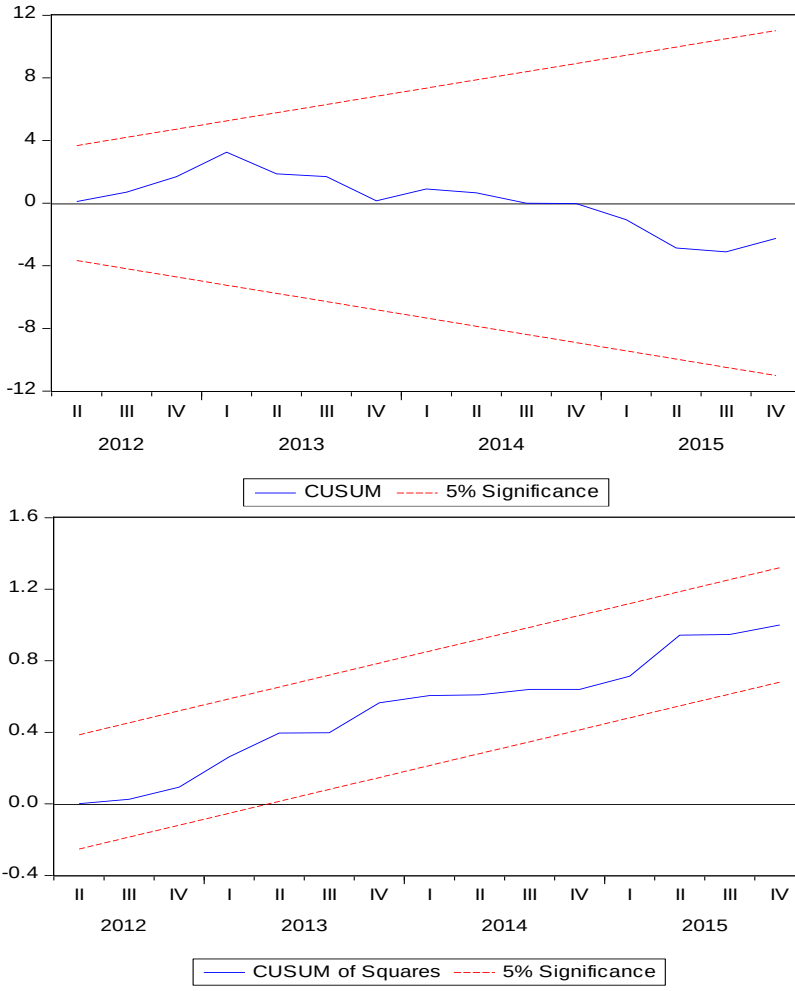
	Coefficient	SE	Prob.
$EMPT$	0.856	0.169	0.000***
OPR	0.156	0.025	0.000***
CPI	0.029	0.003	0.000***
CCI	0.001	0.002	0.603
LS	0.302	0.091	0.005**
HLN	-0.198	0.085	0.034*
C	-1.662	0.589	0.013*

Notes: *, **, *** indicate level of significance at 10%, 5% and 1%, respectively.

Table 6 demonstrates the findings for each model. Based on Table 6, the analysis revealed that the selected variables such as EMPT, OPR, CPI, LS and HLN are found to be significantly related to HPI. Besides that, it also shows that in the long run, all the independent variables except CCI are related to HPI. The finding that CCI is not significant in determining HPI is supported with the study conducted by Hoxha and Salaj (2004), which found construction cost is not a significant determinant of housing prices in Kosovo. Meanwhile, Xu and Tang (2014) explain the construction cost is less sensitive compared with other countries in the UK.

Surprisingly, land supply factor which is from the supply side is found to be significant in determining HPI. This outcome is in line with Yan et al., (2010), Glindro et al., (2011) and Craig and Hua (2011) who proved that land supply has a major impact on house prices. Besides that, Matongela (2015) also explained that the increasing in house prices is due to the insufficient or lack of serviced land. The shortage of serviced land applies an upward pressure on prices resulting in the house price increase. Thus, the institutional factor (housing loan) analyzed in this study is also discovered to be significantly related in determining the HPI. To test for the long run stability of both models, the CUSUM and CUSUMQ tests are applied on the model. The results in Figure 3 suggest that there is no evidence of any significant structural instability.

FIGURE 3
CUSUM and CUSUMSQ Tests for HPI



5.4 LASPEYRES APPROACH

The new enhanced house price index (HPI) is developed based on the researchers' calculation using the Laspeyres formula according to weights so that the HPI that is currently published by the National Real Estate Research Coordinator (NAPREC) will be more reflective of the macroeconomic fundamentals as well as housing market variables. Table 7 shows the new enhanced HPI from Q1 2008 until Q4 2015.

TABLE 7
An Enhanced House Price Index

Year	Quarter (Q)	New HPI	HPI (NAPIC)
2008	Q1	100.0	126.3
	Q2	99.4	125.5
	Q3	102.1	128.9
	Q4	100.4	126.8
2009	Q1	73.4	92.7
	Q2	75.1	94.8
	Q3	76.6	96.7
	Q4	76.2	96.2
2010	Q1	76.3	96.4
	Q2	80.9	102.1
	Q3	81.6	103.0
	Q4	82.6	104.3
2011	Q1	85.0	107.4
	Q2	87.7	110.7
	Q3	89.9	113.5
	Q4	92.0	116.2
2012	Q1	95.3	120.4
	Q2	98.7	124.6
	Q3	102.4	129.3
	Q4	104.7	132.3
2013	Q1	104.3	131.7
	Q2	107.8	136.2
	Q3	112.2	141.7
	Q4	114.2	144.3
2014	Q1	115.11	145.4
	Q2	120.65	152.4
	Q3	124.05	156.7
	Q4	125.24	158.2
2015	Q1	125.32	158.3
	Q2	128.01	161.7
	Q3	132.20	167.0
	Q4	133.15	168.2

The variables (employment rate, overnight policy rate, inflation rate, construction cost, land supply, and housing loan) are used to compute the enhanced HPI. The application of a regression analysis will help to determine the significant variables that give significant impacts on house prices. Then, for each quarter period, the regression coefficients are computed and are used to calculate the current period index number using the Laspeyres approach.

FIGURE 4
Trend of New House Price Index and Current HPI (NAPIC)

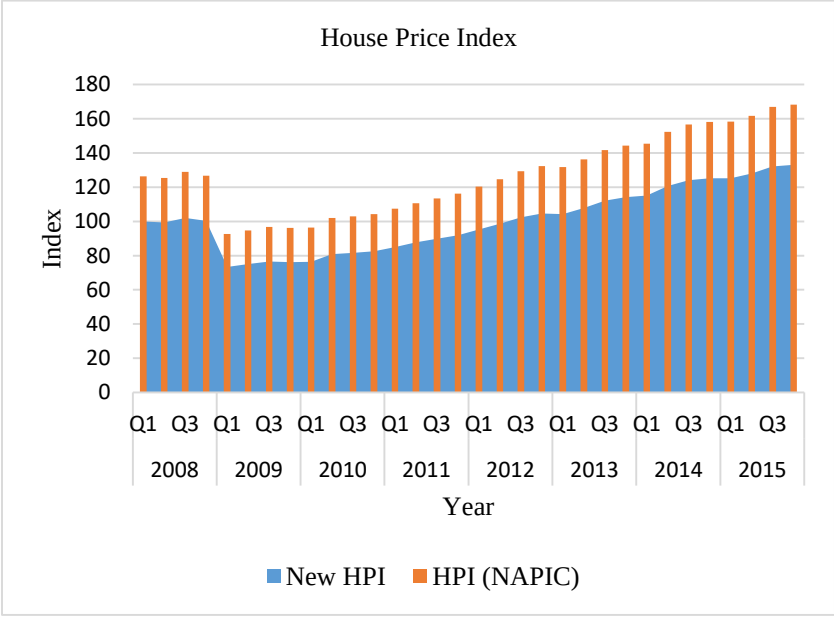


Figure 4 shows the trend of MHPI constructed by NAPIC and the newly developed enhanced HPI for the period from Q1 2008 until Q4 2015. As depicted, there is an increasing trend of HPI in Malaysian residential property, while the enhanced HPI also recorded the same trend but with a lower value of prices as compared to the current MHPI. This thus suggests that the inclusion of the new variables of demand and supply as well as institutional factors needs to be incorporated in determining HPI in Malaysia for the index to become more reflective of the housing market and the macroeconomic fundamentals in Malaysia. The HPI is therefore more robust and accurate to be used as a benchmark for the nation's housing market.

6. CONCLUSION

A credible and accurate house price index (HPI) is very important in order to accurately measure the changes in house prices. Hence, this study proposed an enhanced HPI in Malaysia which incorporate both the demand and supply factors. By applying ARDL analysis technique, the selected variables (employment, OPR, CPI, construction cost, land supply and housing loan) was tested. The findings of this study highlight that there are long run significant relationships between the Malaysian House Price Index (MHPI) and employment, OPR, CPI, land supply and housing loan. Meanwhile, the construction cost index is found insignificant with the MHPI. This could indicate that the construction cost factor does not influence the MHPI. Then, the regression coefficients are computed and used to calculate the current period index number using the Laspeyres approach. The outcome of this study implied that the inclusion of supply variables in determining the HPI in Malaysia is necessary as it would be more accurate and precise to serve as a benchmark for the nation's housing market. Besides that, it is hoped that the enhanced HPI model may reflect the real situation of housing market in Malaysia and it is expected to improve the affordability of society in fulfilling their basic needs such as owning a house.

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