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Predicting the Onset of Housing Affordability Problem

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A B S T R A C T

This paper aims to use threshold values of housing price index, economic growth and mortgage rate as guidance to predict the onset of housing affordability problem by recursive forecasting method using graphical and autoregressive distributed lag model. These threshold values are taken from the findings of our previous study entitled "Housing Affordability Dynamics", featured in the International Journal of Applied Business and Economic Research (November 2017). We define housing affordability index and its threshold value, 130, below which, there is housing affordability problem. Next, we obtained the threshold values respectively for housing price index which must be less than 162, economic growth more than 5.32% and mortgage rate less than 5.57% for housing affordability to prevail. Applying the research in the Malaysian context, the results show that Malaysia is still in the midst of housing affordability problem and through the current study, we come to the conclusion that we should use the autoregressive distributed lag model every quarter so that if housing affordability index is found to be between 117 and 143, legislation should be introduced and implemented to ensure that housing affordability does not fall into unaffordability zone. The implication of the research result is that with prior knowledge of the imminent onset of housing affordability, policymakers could initiate timely intervention measures to stabilize housing affordability and thus minimize the damaging effect brought about by housing unaffordability if not deflect the crisis from occurring altogether.

Keywords: Housing Affordability Problem, Threshold Values, Insightful Information, Consistency

Ⅰ. Introduction

Housing, an inalienable human right as declared by the United Nations, encompasses not only shelter, but also security, privacy, investment and wealth and personal identity. Demand for housing has been on the rise worldwide driven by various significant factors among which are the more commonly attributed reasons of high and rapid urban migration and population growth as reported by International Federation for Housing and Planning (IFHP, 2016) while sharp increase in housing prices presenting a lucrative investment opportunity has further fueled housing demand, one of the primary factors driving up housing prices. A report on the findings of the *sixth ING International Survey Homes & Mortgages 2017* reveals that even though there is widespread concern for rising prices, demand for housing will continue to grow, particularly in urban centers. Both real and speculative demand have together with other factors resulted in the rapid growth of housing prices. When the rate of increase in housing prices outpaces the

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rise in income, housing affordability problem sets in. And housing affordability problem has surfaced in many countries, both developed and developing nations since the last two decades and apparently a persistent and deteriorating issue as evidenced by the various points raised by the Executive Director of the UN Human Settlement Programme (UN-Habitat) in the 2017 World Habitat Day message. Worldwide 1.6 billion people live in inadequate housing and governments have been urged to place housing policies central in national policies planning. As elaborated in the message, housing is critical in social development – combating poverty, health and employment, and is linked to global issues of climate change, human mobility and resilience. Research and analysis reports have revealed the strong interconnection between housing affordability and both social and economic development (Berry, 2006).

On the social front, when affordable housing is unattainable, the alternative is adverse living conditions that could cast challenges to various dimensions of the social fabric. Due to the high cost of housing, households will be forced to live in more congested conditions, smaller houses or sharing with more residents. With housing expenses taking a greater share of the household income, less will be available for other living expenses as well as discretionary spending. Such conditions could impact the wellbeing of social institutions and networks, relationships and health.

As less income is available for non-housing expenses, people will be more cautious and scale back on their spending. As consumption falls, it will affect businesses which will lead to unemployment and slowdown in increment or even stagnation of wages. The purchasing capability of households will be further eroded and the effect will spread into the housing market, resulting in a saturated market. If this vicious cycle is prolonged, the housing bubble created in a heated market will inevitably collapse. As is well documented of past events and findings of studies on housing bubble, bursting of a housing bubble could result in very serious and wide spread economic damages. The calls of the United Nations urging countries deep in housing affordability crisis, such as Australia and Canada, to take serious measures to address the problem further demonstrate the urgency of the issue.

Housing affordability is now among the central issues that are on the agenda of governments and research topics of academics. A vibrant housing market is vital for the growth of the construction industry, the effect of which will have strong positive impact on many directly as well as indirectly related industries and contribute to the national economy. The economics of demand and supply means that there will be movements in housing prices. Nevertheless there need to be a balance between growth and affordability to ensure sustainability.

The analysis described above highlights the importance of housing as one of the key economic growth factors. As such, housing must be addressed and orchestrated with the overall national economic management whereby we need to solve all the issues related to housing particularly the housing affordability challenge which contributes to the severity of housing glut, formation of housing bubbles, the risk of bubble bust wreaking sever and far-reaching damages to national and global economy. However, we observe that most if not all reported efforts are focused on ways to solve protracted housing affordability problem (Ben-Shahar, et al, 2016; Cheah, et al, 2017), invariably after much complaints and negative reaction as well as impacts on society and the economy have surfaced and developed. Therefore should there be a means of forecasting or detecting the imminence of a housing affordability problem, this will enable policy makers to take timely and more effective interventions to diffuse the issue at the bud or at least slowdown the crisis onslaught and thus lessen its negative impact. However, our literature review shows such a system is still absent while research on this aspect too is practically not available so far to our knowledge. It is the aim of this proposed paper to attempt to develop such a detecting system by applying it in the Malaysian context.

A. Malaysian housing market scenarios

Following the slowdown in sales in the housing industry and the growing concern on escalating home prices making adequate and affordable housing out of reach of the people, particularly the middle and lower income group, the Malaysian government has put up stringent but cautious housing policy and regulations to monitor the housing market. In an attempt to alleviate the apparent shortage of affordable housing, the government has stepped in with various initiatives such as People's Housing Projects and the Malaysia My First Home Scheme to supply low-cost housing or subsidizing the cost of housing for the home buyers, particular for first time home buyers. The main target group, however, is the low income households and this inadvertently created a gap in the system whereby the growing concern of middle-income households who are neither eligible for social housing nor are able to afford private sector supplied houses. This issue is particularly prevalent in urban areas, the main cities like Kuala Lumpur where homeownership is only about 53.3%, compared to Malaysian national home ownership of 72.5% and urban homeownership of 69.1%. (Population and Housing Census, 2010). So, there is a serious discrepancy of home ownership among different localities. This discrepancy of home ownership is found to be closely correlated with housing affordability problem as shown in Table 1. What are the reasons for this difference? One of the reasons could be the issue of housing affordability and also on how it is defined and perceived. Is Malaysia facing a housing affordability issue? This is the issue that this study attempts to clarify.

We provide an outline of the answer to the above questions in this introductory section. In section III, we will examine the answer in more detail. First, we describe the definitions of housing affordability index. According to global standards, housing affordability is defined in terms of house prices and income. A specific housing market is said to be affordable if the median house prices is not more than 3 times the median annual household income, that is the median house price should be equal to or less than 3ϕ where ϕ denotes median annual household income (Angel et al, 1993; Angel, 2000). Thus, any multiple median house price larger than 3ϕ is considered as unaffordable. However, this housing affordability definition suffers from one serious weakness in that it uses nominal household income without considering other household expenditure. We would look into this weakness of the definition in the subsequent section. Table 1 shows the housing unaffordability for three cities in Malaysia for the period from 2009 to 2016.

Table 1. Housing affordability measure

Locality	3 x Annual income, ϕ	Unaffordability %
Kuala Lumpur	5.4ϕ	80
Penang	5.2ϕ	73
Malacca	3.0ϕ	0
Malaysia	4.4ϕ	47

Note: threshold affordability = 3 x annual income

Table 1 indicates in a simple way that Malaysia as a whole is facing housing affordability problem, 47% severity. But the question is: when did this state of unaffordability first surface? As indicated in Figure 1[1)], we have been facing affordability problem since the second quarter of 2009 and up to the end of the research period, for almost a decade long. Though much efforts have been expended to try to arrest the decline of housing affordability, the problem is still persisting. The common amelioration strategy is akin to "trying to cure a disease when it has developed, become vicious and spreading fast". And ironically, thus far according to our review of literature, the prospective of preventing the emergence of housing affordability problem seemed to have been overlooked. Since housing, consumption and the economy are interrelated, one of the aspects that we propose to investigate through this study is the use fiscal and monetary regulations to avert housing affordability problem when it is in its initial formation.

The rest of the paper is planned as follows: Section II presents a relevant literature review. Section III

1) Note: Table 1 and Figure 1 use the first and second definition of housing affordability index respectively.

discusses the various definitions of housing affordability. Section IV describes the methodology used in the analysis while section V presents the empirical and analytical analysis. Section VI concludes this paper.

Ⅱ. Literature Reviews

Literature on housing affordability abound. However, very often, the articles are driven mainly by the need to provide more affordable housing. As a result, most journal papers investigate, analyze housing affordability dynamics and put forward suggestions to overcome the housing affordability problem when the problem has become full blown. In recent years, governments in many countries have explored ways and means of using statutory land-use planning system to implement the provision of additional affordable housing more effectively (Paris, 2007). Many of these articles focus on how best to address this affordability issue (Gabriel et al., 2005). However success in solving the issue has been limited (Burke et al., 2007) as expounded by the fact that the issue is getting worse as the supply of affordable housing is low and falling (Chapman, 2006; Beer et al., 2007). This state of housing affordability is found in many countries including Malaysia and it is further reinforced by the findings of many journal papers researching in the Malaysian context which include:

Osman et al. (2017b) show that housing is mostly moderately unaffordable in the districts of Melaka; and Osman et al. (2017a) found that housing in all the districts in Johor were generally unaffordable with some districts recording severely unaffordable Housing Affordability Index (HA). However, the findings from both Osman et al.'s (2017a; 2017b) papers are restricted to the degree of unaffordability in different states. No research finding on the reasons for unaffordability and the commencing period.

Ben-Shahar and Warszawski (2016) found that housing affordability inequality Gini coefficient has considerably increased in the past decade, and that housing affordability inequality is found to positively correlate with average housing prices. Their findings are in agreement with part of our results, but they have not investigated on the aspect of why and when housing affordability sets in.

The findings of Baqutayan (2016) reveal that factors of transportation, housing quality and staying far away from one's workplace due to financial constraint contribute to the effect of housing stress among middle-income groups. In addition, the results from Said et al. (2016) suggest that areas with high utility degree best conform to the sustainable housing affordability factors in Sabah. These articles have suggested the reasons for the physical and logistic cause for unaffordability.

Using regression analysis, Wang and Jiang (2016) found that six explanatory variables (per capita disposable income, land transaction price index, construction cost, urbanization rate, CPI of residence and investment in real estate) have significant impact on housing prices in Shanghai. The results from Li et al. (2018) show that China land supply and other variables have negative effects on house prices, while financial mortgages for real estate have positive effects on house prices and the area of vacant houses as well as the area of housing sold. These two articles suggest determinants that have negative and positive effects on housing prices.

Rangel et al. (2017) discovered that in Malaysia even with government interventions through housing schemes development by the authorities specifically targeted to assist the lower income group to attain homeownership, there is still a lack of housing affordability improvement over time. Cheah and Almeida (2017) suggests that addressing the affordable housing issue requires a multi-pronged approach focusing on four key areas: i) increasing supply and reducing the cost of affordable housing; ii) establishing a central repository as a systematic way of monitoring and managing the demand and supply of affordable housing; iii) developing a thriving rental housing market; and iv) diversifying the sources of financing for affordable homes.

Lawson and Milligan (2007) in their paper entitled

"International trends in housing and policy responses" stated that in Australia, there is a marked increase in using new strategies to promote new investment in affordable housing to low- and moderate-income households.

In addition, the existence of social housing grant exerts a positive impact on the viability of a site for affordable housing by reducing the impact of a social housing target on residual land value (Gurran et al., 2007). In Ireland, national legislation was introduced through the Planning and Development Act (2000) to enable local authorities to compel developers to contribute to social and affordable housing (Brooke, 2001; Norris, 2006; Gurran et al., 2007). The act uses planning gain mechanisms to deliver housing for rent and sale to low income households (Norris & Shiels, 2007).

All the aforementioned research papers have omitted the aspect of when and why the phenomenon of declining housing affordability first developed. In perspective, this paper attempts to use the threshold values of key housing determinants that have direct bearing on housing affordability to help us to predict the onset of housing affordability problem at least one quarter forward. With the forward information obtained, we put up some suggestions to help prevent affordability problem from setting in.

Ⅲ. Definitions of Housing Affordability Index and Threshold Values

The most important quantity in this research is housing affordability index which has a number of definitions. We give reasons on why we select the particular definition for housing affordability study in this paper.

Households usually would have perceived what appropriate housing they require. In many cases, appropriate housing refers to socially imposed minimum standard of housing in the market. If households are not able to purchase this type of housing without assistance from the relevant authorities, we term those houses as unaffordable to them. In other words, as proposed by Milligan et al. (2004) housing affordability describes housing which is appropriate that requires government assistance for the lower income households to obtain and pay for without experiencing undue financial stress. Many definitions of housing affordability are made by categorizing and streamlining this condition of undue financial stress. Thus, without considering this undue financial stress, housing affordability very often refers to public, social or low cost housing. As a matter of practice, public, social or low cost housing always refers to or associated with the lower income group. This unwittingly results in households with moderate income seeming to have left out in the cold. They can neither be considered as low income nor upper middle-income households. Our first and second definition includes this category of moderate income group.

To-date, there is no universally accepted definition of affordability. The 30/40 rule of thumb is the most widely applied criteria for affordability. This rule refers to the standardized 30[2] percent of the gross income of a household in the lowest 40 percent of the income distribution groupings be allocated to and sufficient for housing costs and beyond this percentage amount housing is deemed unaffordable. Of course, this classification of affordability depends largely on how socially imposed minimum standard of housing is defined and accepted as some people may prefer a lower than minimum standard of housing. Additionally, there is the problem of leaving the lower middle income group out from the government housing aid program. Is this group included in the 30/40 rule of thumb? It is conceivable that the lower middle income group is within the bracket of the lowest 40 percent of the income distribution. Therefore, this 30/40 rule of thumb forms the principal criteria for defining housing affordability for lower and lower-middle income groups (Baqtaya et.al, 2016). Hence, all of the definitions are made to satisfy this principal criterion.

2) This 30% is fixed by consensus and accepted by many countries.

We consider and compare two widely used definitions of affordability index which are based on the 30/40 rule of thumb. We assume that socially imposed minimum standard of housing is well defined.

1. Definition 1 of housing affordability index

Firstly it is accepted that housing affordability is a function of house prices and income. We let ϕ represents the median annual household gross income and median house price be P. With this, using the rule of thumb, we can define the following relationship.

$$\mathrm{P} = 3\phi \tag{1}$$

In other words, ϕ is the maximum median house price, above which houses are deemed unaffordable. However, this definition has some serious weaknesses arising from its use of gross income as the principal measure for affordability. Thus, it is not appropriate as it has not taken into account of other household expenditure which is quite appreciably different for different households. Therefore, equation (1) is not a particularly accurate guideline. However, this definition is very easy to apply and handy and thus, one can get a fast conclusion from its application. In this study, we do not prefer the definition as specified in equation (1) as our objective priority is to aim for accuracy in our research. Nevertheless, definition in equation (1) is very suitable to practitioners.

As such, we work on the basic essentials that are consumption of food and beverages. With this as the basic consideration, and for the rest of the material we adopt the approach of Yip et al. (2017) on this second definition.

2. Definition 2 of housing affordability index

$$\text{Affordability index} = \frac{N}{0.7N - C} \times 100\% \tag{2}$$

Where N = income, C = combination of mortgage (and/or nonmortgage) commitment.

Based on the reasons given in Yip et al. (2017), we adopt this definition as in equation (2) to construct our housing affordability index. The graph in Figure 1 shows this housing affordability index. Using the rule of thumb of 30/40 of which 30% is the benchmark, we set affordability index 130 as the threshold value for affordability, beyond which is considered as unaffordable and above which, no affordability problem. Figure 1 shows the fluctuations of housing affordability index from 1994Q1 to 2015Q4 in the context of the Malaysian housing market. The graph suggests that housing affordability problem sets in starting from 2009Q2 and deteriorates from 2013 onwards. The index is still below 130 at the end of the data period in 2016Q4. This starting point at 2009Q2 of unaffordable housing is not absolute as our definition of housing

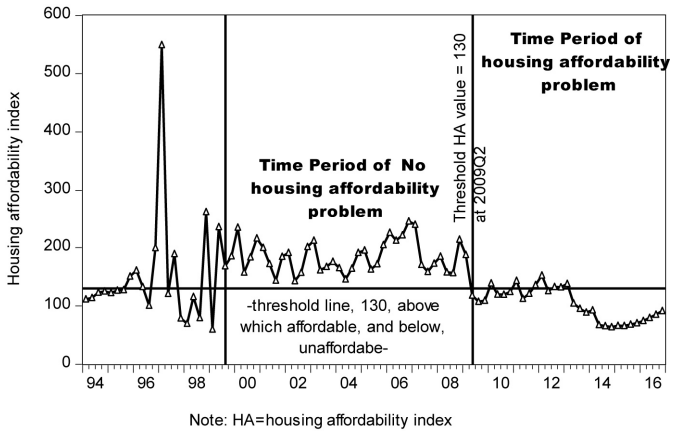

Figure 1. Changes in Housing Affordability Index

affordability is not absolute either. Thus, this starting point could vary within a 3-year limit (figure obtained from graphical analysis of Figure 1).

B. Threshold values of housing price, mortgage rate and economic growth

This subsection is a revisit of Yip et al. (2017). The objective of this revisit is to analyze the results from the paper which describes how the threshold values of housing price(HP), mortgage rate(MR) and economic growth(EG) are obtained. We update and improve the analysis so as to obtain appropriate results to guide us to conduct a proper forecast of the oncoming of housing affordability problem.

Initially, we attempt to find the nexus between threshold value of housing affordability index, housing price, mortgage rate and economic growth and then we draw a combined graph to ascertain the conditions of oncoming housing affordability problem. Then, we conduct forecasting.

We use three affordability determinants, EG, HP, and MR after comprehensive literature review as described in the beginning of this section (Yip et al., 2017). The followings are the results and findings of Yip et al. (2017). For housing unaffordability to happen, we should have:

$$HP > 162 \quad EG < 5.32\% \quad HA < 130 \quad MR > 5.57\% \qquad (3)$$

Ⅳ. Methodology

A. Graphical analysis:

After reviewing a number of housing affordability papers, for example, Baqutayan (2016), Meltzer and Schwatz (2015) and Olanrewaju et al. (2016), we are of the opinion that using a two-prong approach is more revealing and convincing. Our two-prong approach is to use graphical analysis first and then followed by selecting a suitable forecasting model for predicting the oncoming of housing affordability problem.

We use graphical analysis because it can reveal vividly the dynamic relationship of housing affordability (HA) with housing price (HP), economic growth (EG) and mortgage rate (MR). Take for example, the intersection point of the graphs can reveal at what housing price that HA starts to become unaffordable, and the trend

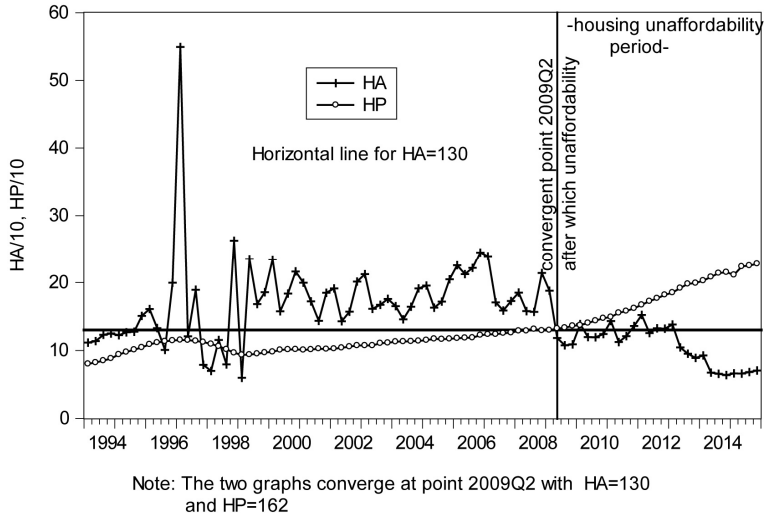

Figure 2. The Relationship between Housing Affordability (HA) and Housing Price (HP)

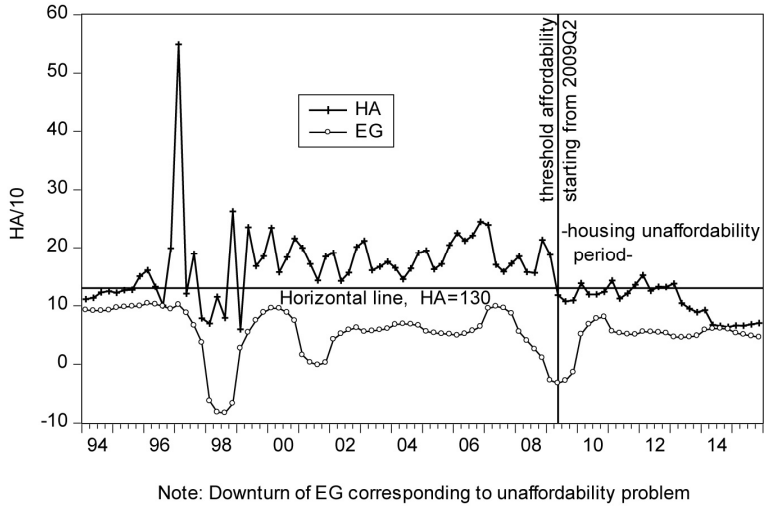

Figure 3. The Relationship between Housing Affordability (HA) and Economic Growth (EG)

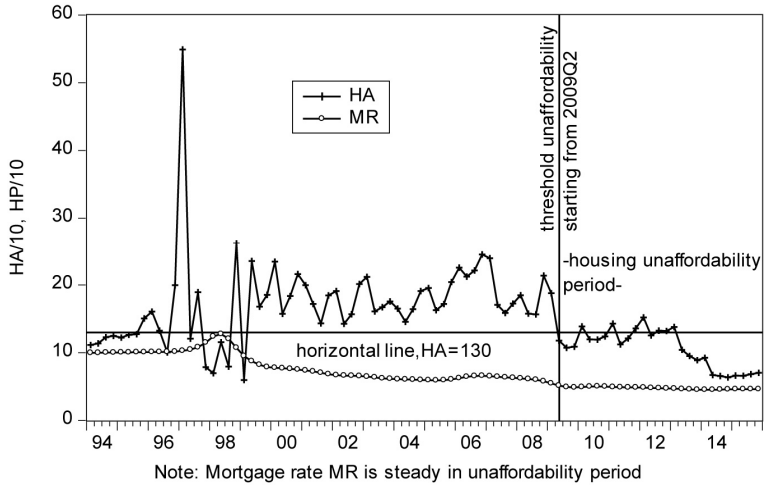

Figure 4. The Relationship between Housing Affordability (HA) and Mortgage Rate (MR)

of EG and MR around this critical point. Graphs in Figures 2-8 describing these correlations can be found in Appendix A where HA = housing affordability index, HP = housing price index, EG = economic growth and MR = mortgage rate.

Figure 2 contains graphs for HA and HP. The graph of HP is shown clearly intersecting HA at the turning point from affordable to unaffordable at HA = 130 and date 2009Q2. This indicates that HA is closely correlated with HP, suggesting that HP can be a major determinant for HA. This graph also verifies subtlely that HA = 130 has been well defined.

Figure 3 contains graphs for HA and EG. It shows that housing affordability changes into unaffordability at HA = 130, date 2009Q2 and also coincide with the lowest point for the economic growth cycle. The two graphs converge at around 2014, suggesting that

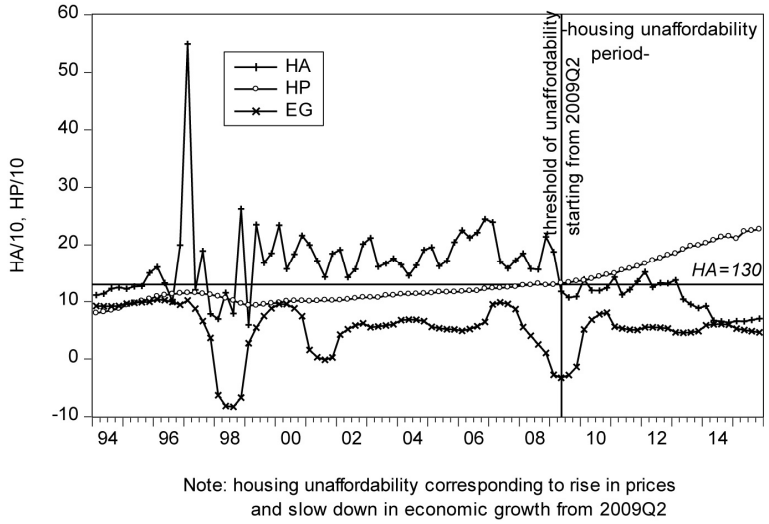

Figure 5. The Relationship between HA, HP and EG

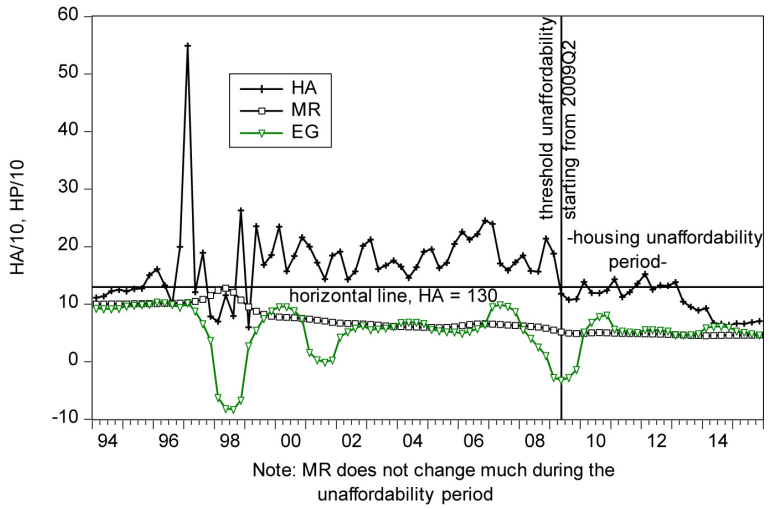

Figure 6. The Relationship between HA, MR and EG

at certain point of time, HA starts to improve but EG starts to come down which indicates that at certain time, decrease in economic growth can induce improvement in housing affordability, a situation that contradicts the established inverse relationship between housing affordability and economic growth. However, this could be a transitory phenomenon for the effect of the slower economy may take a while before it takes a toll on the income of households.

Figure 4 contains graphs of HA and MR. It shows that the period of affordability coincides with the coming down of MR. However, for the period of unaffordability, MR seems to be steady, almost constant without any change. Figure 5, 6 and 7 show that at the point where HA = 130 at 2009Q2, HP starts to move up substantially and the time coincides with EG at its turning point of a cycle while MR starts to stabilize. Figure 8 shows clearly that at HA = 130, HP starts to move up, EG at its minimum point of a cycle while MR comes to a steady state.

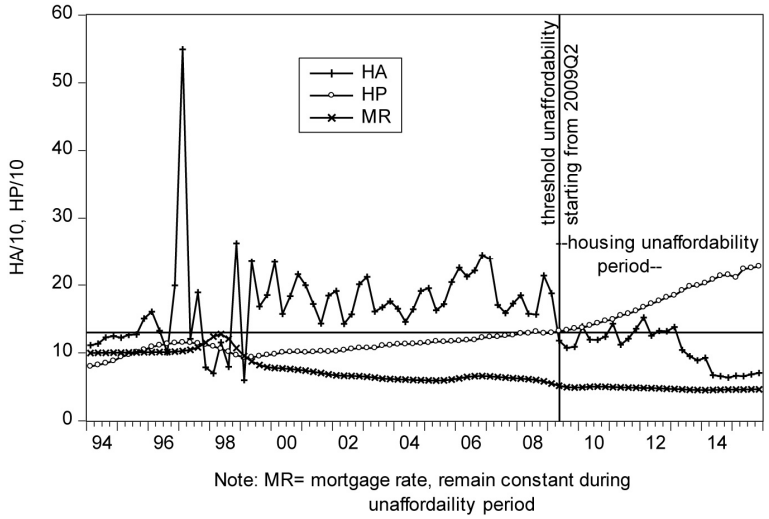

Figure 7. The Relationship between HA, HP and MR

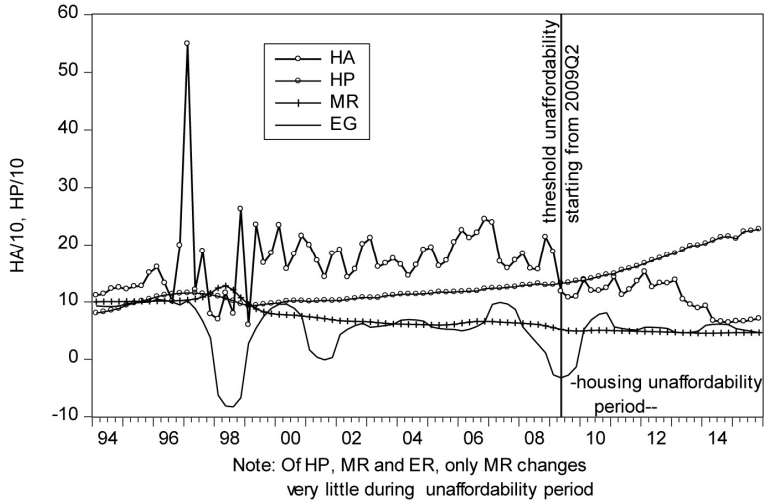

Figure 8. The Relationship Between HA, HP, MR and EG

In conclusion, from the graphical analysis, it is found that HA is affected substantially by HP, EG and MR. The trend of movement of HP, EG and MR is discernible at HA = 130.

B. Forecasting model:

There are many forecasting models in the literature, for example, AR, ARIMA, ARFIMA and many others. Our critical consideration for selecting forecasting model is that we need a forecasting model which can measure the delayed predictive ability of the independent variables on dependent variable (housing affordability, HA). The reason being that we are of the opinion that HA cannot be predicted by the current state of the independent variables. This is because house buyers usually take considerable time period before making up a decision to commit themselves to buy a house. Only the recent past values of independent

variables can have any credible predictive information about HA. Based on this argument, we select the autoregressive distributed lag model (ARDL) which consists of autoregressive and normal regression components. We construct our ARDL model as follows:

1. Formulation of AR component with suitable lag

The general AR autoregression model with lag n:

$$HA_t = \beta_0 + \beta_1 HA_{t-1} + \beta_2 HA_{t-2} + ... + \beta_n HA_{t-n} + u_t \quad (4)$$

where n is the maximum lag and u_t is the error term. We determine this maximum lag using Schwedt's formula as stated in equation (5).

$$n_{\max}(T) = \left[12 \cdot \left(\frac{T}{100} \right)^{0.25} \right] \quad (5)$$

where T is the sample size and $n_{max}(T)$ is an integrated part of the answer in the formula.

We perform the autoregressive computation with maximum lag. Then we use a general to specific approach to delete those lags which are not significant, one at a time. We start with deleting insignificant lag with the maximum p-value of t statistics, and then run the regression again. We repeat the process until all lags are significant. However, if the significant lag is too far from current time, we omit it because they contain little predictive information. The final autoregressive forecasting component model is shown in equation (6).

$$HA_t = \beta_0 + \beta_p HA_{t-p} + u_t \quad (6)$$

where p = 1, and 2 with all the coefficients significant.

2. Formulation of regression component with macro variables

Our second component of forecasting model is the macro variable regression model. We regress macro variables on housing affordability index. The macro variables are housing price index (HP), economic growth (EG) and mortgage rate (MR). These three macro variables are chosen based on literature review and logical deduction as described below.

C. Housing Price:

We expect housing price to be the primary determinant for housing affordability. The main reason is that when housing price is moving up much faster than household income, an unaffordability situation is created, in which case, many people cannot afford to purchase a house. Such situation can be avoided if developers build houses of prices that match the purchasing capability of households and assuming that such houses are of the accepted minimum standard, but then again, the demand for affordable houses is best measured by taking accurate consumer sentiment survey by a third party.

Housing price which is of one or two periods past usually contains the most predictive information about housing affordability. This is because we use recent past housing price to compute housing affordability index. Moreover, it usually takes about three or more months before a decision to purchase a house is made. As such, we use the first or second lag of housing price as a predictor for housing affordability (Asal, 2018).

D. Mortgage Rate:

Low mortgage rate will encourage people to commit on house purchase since the cost of their housing loan will be cheaper. Mortgage rate is one of the factors driving up demand for houses. However, the time gap between when the house buyers perceive that the mortgage rate is conducive and the real action of purchasing a house is at least one or two periods. Thus, the first or two lags of mortgage rate contains the most predictive information about housing affordability.

E. Economic Growth:

Increase in economic growth will spur the growth

of wages. However, improvement in wages may not be in tandem with the increase in housing price. Multiple factors could be attributed for this nonparallel growth of economy and wages, among which are low productivity of workers, rising cost and competition pressure on profit margins of employers. All these factors could check wage increment rates. Thus economic growth may not be the major determinant for housing affordability. After using general to specific approach for regression model and the argument described above, we obtain the following equation (7):

$$HA_t = \phi HP_{t-1} + \varphi MR_{t-1} \quad (7)$$

By combining equation (6) with (7), we obtain the final ARDL model with the first lag of HA term insignificant. Thus, the final ARDL model is shown in equation (8)

$$HA_t = \beta_0 + \alpha HA_{t-2} + \phi HP_{t-1} + \varphi MR_{t-1} \quad (8)$$

Ⅴ. Empirical Analysis and Results

The data used in the empirical analysis are all quarterly data starting from 1994Q1 to 2016Q4. We obtained these data sets, HA, HP, EG and MR from National Bank of Malaysia (BNM), Statistical Department and Department of Asset Evaluation (JPPH).

After performing the procedure as described in the Methodology section, we obtain the following three AR models. We use log of housing affordability index (LH) because it is tested that only housing affordability in the log form satisfies the normality criterion. Table 2 shows the three AR models of lag1, 2 and 3.

The best model is AR(2) since all its coefficients are significant and that it has the smallest Schwarz information criterion value, 0.6296 as compared to 0.7522 and 0.6878 for AR(1) and AR(3) respectively. Thus the best model is specified in equation (9).

$$LH_t = \underset{(0.013)}{1.288} + \underset{(0.002)}{0.317}\, LH_{t-1} + \underset{(0.000)}{0.422}\, LH_{t-2} \quad (9)$$

Values in the parenthesis are p-values for t statistics.

As for the regression model of macro variables, we find that economic growth EG returns an insignificant value of coefficient. However, we must keep in mind that EG is an important determinant for HA using economic analysis. The insignificance of EG could be due to the sample specific data sets. As such, we

Table 2. Autoregressive Distributed Models

Independent variables	Autoregressive Models		
	AR(1)	AR(2)	AR(3)
intercept	2.359**	1.288**	1.133*
lag 1	0.523**	0.317**	0.283**
lag 2		0.422**	0.399**
lag 3			0.087
Schwitz criterion	0.7522	0.6296	0.6878
R square	0.265	0.388	0.391
Adjusted R square	0.256	0.377	0.369
F Statistics	30.644	26.306	17.363
F(p-value)	0	0	0
Durbin W Statistics	2.413	2.065	2.002

Note: ** - 1% significant * - 5% significant

omit EG in our regression model. The regression model is shown in equation (10).

$$LH_t = \underset{(0.000)}{6.601} - \underset{(0.000)}{0.089}\, HP_t + \underset{(0.121)}{0.012}\, EG_t - \underset{(0.000)}{0.079}\, MR_t \quad (10)$$

However, as we argue out in the methodology section, we need first lag of HP and MR for forecasting purpose, and hence our final regression is given in equation (11).

$$LH_t = \underset{(0.000)}{0.714} - \underset{(0.000)}{0.094}\, HP_{t-1} - \underset{(0.000)}{0.077}\, MR_{t-1} \quad (11)$$

We formulate an autoregressive distributed lag model (ARX) by combining equation (9) and (11). The final forecasting model is given by equation (12) and the computation output is shown in Table 3. The results in Table 3 show two models, ARX(2) and ARX(1). The latter model, ARX(1), is preferred because it has the smallest Schwarz information criterion value 0.5069 compared to 0.5477 for ARX(2) model.

Table 4 shows the diagnostic test result of checking the validity of the model. All the major tests are significant except that normality test is insignificant at 5% level but significant at 10% level. Thus our final forecasting model would have an equation shown in equation (12).

Table 3. Autoregressive Distributed Models

Independent variables	Autoregressive Distributed Models	
	ARX(2)	ARX(1)
intercept	4.439**	5.008**
HA (-1)	0.101	------
HA (-2)	0.242**	0.258**
HP (-1)	-0.065**	-0.073**
MR (-1)	-0.049**	-0.055**
Schwarz criterion	0.5477	0.5069
R square	0.492	0.486
Adjusted R square	0.466	0.467
F Statistics	19.579	25.841
F(p-values)	0	0
Durbin W Statistics	2.011	1.81

Note: ** 1% significant * 5% significant

Table 4. Diagnostic Test Results

Diagnostic Tests	Probability F Stat
Breusch-Godfrey Serial Correlation LM Test	0.6195 **
Heteroskedasticity Test: ARCH	0.4122 **
Ramsey RESET Test	0.4452 **
Quandt-Andrews unknown breakpoint test	0.5122 **
Jarque Bera normality test	0.0623 *

Note: **5% significant and * 10% significant

$$LH_t = \underset{(0.000)}{5.008} + \underset{(0.015)}{0.258}\, LH_{t-2} - \underset{(0.000)}{0.073}\, HP_{t-1} - \underset{(0.008)}{0.055}\, MR_{t-1} \quad (12)$$

For one period forward forecasting, we increase t by 1 unit resulting equation (13).

$$LH_{t+1} = \underset{(0.000)}{5.008} + \underset{(0.015)}{0.258}\, LH_{t-1} - \underset{(0.000)}{0.073}\, HP_{t} - \underset{(0.008)}{0.055}\, MR_{t} \quad (13)$$

We use recursive forecasting method which has been shown to have a relatively small forecasting error. This forecasting method works like this: after 1 period forecasting, we add the forecast value into the series and then perform similar 1-step forecasting with the sample size increased by 1 unit. With this recursive forecasting, we obtain the forecasted results as shown in Table 5 where HA is the housing affordability index.

Since we are interested to forecast the oncoming of HA problem, we consider only the average forecasted values for the year. This is a more plausible method since we take the average value for the four quarters which will smoothen the differences and thus making it more accurate for practical purpose. The last column in Table 5 shows that the average value of forecast for the year 2016 is 60.161 which is far below the threshold value of 130, and moreover it differs from the average actual HA, 58.527 by as little as 1.644 unit or the difference is about 2.81%, meaning the forecasting model is accurate within an error margin of 3%. However, concerning the accuracy of the forecasting model, we need only to estimate the onset of HA and not its accurate values (Kim, 2016). Thus we need the maximum fluctuation of HA around its threshold value of 130 and this interval of fluctuation must be stable. Using the highest absolute deviation, 8.22 % as shown in Table 5 as a guide, and also since we would like to work on the concept of preventing housing affordability problem to set in rather than to cure after it happens, we tolerate 10% forecasting error which is used to estimate the onset of HA. Thus, in terms of forecasting interval, we should set the following forecasting interval based on 10% error.

$$117 < HA < 143 \quad (14)$$

Based on the forecasting interval in equation (14), if we get any forecast value within the interval, we have to take remedial steps to increase HA like lowering the mortgage rate some more or step up the construction of more affordable housing. The forecasting model needs to be applied every quarter and if the average forecasting value is within the range of 117 and 143 for three consecutive quarters, then it indicates the oncoming of housing unaffordability. However, a word of caution is needed - the housing affordability threshold HA =130 with range 117 to 143 in Malaysia depends largely on whether EG (economic growth) equals or is larger than 5.32% and MR (mortgage rate) equals or smaller than 5.57%. Nevertheless, EG (5.32%) is not the main determinant for HA directly. It is household income which is generated and hopefully increased in tandem with EG that is influencing HA positively. Just increasing household income is not good enough, inequality among household income need also to be minimized (Do Nguyet, 2017). A similar situation is also true for MR (5.57%) as MR can effectively be brought down only when EG is growing at a pace comfortable with other determinants like unemployment and housing price. On top of this, EG(5.32%) and MR(5.57%) are computed from a sample consisting of 88 data for each variable and as such, these two conditions are sample specific, meaning

Table 5. Forecast values of housing affordability for the year 2016 using recursive procedure

Forecast period	2016Q1	2016Q2	2016Q3	2016Q4	Average forecast for the year 2016
Estimated HA values	65.687	61.007	58.086	55.863	60.161
Actual values of HA	60.698	59.244	57.790	56.335	58.517
Absolute deviation	4.989	1.763	0.296	0.472	1.644
Absolute deviation in %	8,22	2.98	0.512	0.838	2.81

Note: Estimated (forecast) HA values are compared to the actual HA values for each period in 2016.

the values are not stable. In view of the instability of the two conditions (EG>5.32%, MR<5.57%), and the uncertain nature of economic environment, the threshold values of both EG and MR are expected to be stable only under certain economic conditions which we have limited control. To overcome the instability of the forecasting interval, we resort to using averaging technique to minimize the uncertainty (Baek et.al, 2015). This is also one of the reasons why we choose 10% as the fluctuation limit for HA. As a result, we resolve to take the average HA value of three quarters as the final measurement. The period of 3 quarters is used so that any necessary legislation that need to be introduced to ameliorate or arrest the emerging housing affordability problem could still be in time to go through the annual budget debate in parliament.

Ⅵ. Conclusion

Graphical analysis shows that a clear-cut point for housing price for affordability problem to set in is 162, based on the threshold of housing affordability to be 130. At around this point, economic growth is at the turning point of a downward cycle at about 5.32% and that mortgage rate is about 5.57%. Judging from the first three graphs, we are in the midst of housing affordability issue and that it started on 2009Q2.

By using recursive forecasting method, it is found that housing affordability problem is still serious which is in line with our graphical analysis. For detecting the oncoming of housing affordability problem, we perform forecasting every quarter and then followed by 4 quarters forecast recursively. Then we obtain the average housing affordability index for the year. If the value of *HA* is between 117 and 143, then this result should serve as an alarm bell that housing unaffordability is about to come.

Initially, we intend to use logit model to compute the probability of housing unaffordability. But through the process of computation, we realize that the data size is not conducive for estimating probability model with reasonable degree of accuracy. Thus, we select autoregressive distributed lag (ARDL) model for the computation. By using economic analysis, we find that ARDL is suitable for forecasting housing affordability and moreover, the empirical results are within the acceptable margin of error. For further research, we suggest to use an extended VAR as the forecasting model.

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References

Angel, S. (2000). *Housing Policy Matters: A global analysis*. Oxford University Press.

Angel, S., Mayo, S. K., & Stephens, W. L. (1993). The housing indicators program: A report on progress and plans for the future. *Journal of Housing and the Built Environment, 8*(1), 13-48.

Asal, M. (2018). Long-run drivers and short-term dynamics of Swedish real house prices. *International Journal of Housing Markets and Analysis, 11*(1), 45-72, doi:10.1108/IJHMA-08-2017-0070

Baek, C., Dodd, C., & Fogelberg, L. (2015). Estimating the Length of the Excess Earnings Period. Global Business & Finance *Review, 20*(1), 43-52. doi:10.17549/gbfr.2015.20.1.43

Baqutayan, S. M. S. (2016). Is affordable housing an issue? A Case Study of Housing Stress among Middle-Income Group in Malaysia. *International and Multidisciplinary Journal of Social Sciences, 5*(1), 26-50. doi:10.17583/rimcis.2016.1871

Baqutaya, S., Ariffin, A. S., & Raji, F. (2016). Affordable

housing policy: Issues and challenges among middle income groups. *International Journal of Social Science and Humanity, 6*(6), 433-436.

Beer, A., Kearins, B., & Pieters, H. (2007). Housing affordability and planning in Australia: the challenge of policy under neo-liberalism, *Housing Studies, 22*(1), 11-24.

Ben-Shahar, D., & Warszawski, J. (2016). Inequality in housing affordability: Measurement and estimation. *Urban Studies, 53*(6), 1178-1202.

Berry, M. (2006). *Housing affordability and the economy: a review of macroeconomic impacts and policy issues*, AHURI Research Paper No. NRV3-4, Australian Housing and Urban Research Institute Limited, Melbourne, https://www.ahuri.edu.au/research/nrv-research-papers/nrv3-4.

Brooke, S. N. (2001). Social housing for the future: can housing associations meet the challenge?

Burke, T., Pinnegar, S. P. P, Neske, C., Gariel, M., Ralston, L., & Ruming, K. (2007). Experiencing the housing affordability problem: blocked aspiration, trade-offs and financial hardships, *National Research Venture 3: Housing affordability for lower income Australians, Research Paper No 9*, Australian Housing and Urban Research Institute.

Chapman, P. (2006). Housing affordability in Australia. *Research and Policy Bulletin* (Melbourne: AHURI).

Cheah, S. L., & Almeida, S. J. (2017). Demystifying the affordable housing issue in Malaysia, In Outlook and Policy in 2017, *Annual Report 2016*. Bank Negara Malaysia.

Do Nguyet, A. (2017). The Impact of Earnings Volatility on Earnings Predictability. *Global Business & Financial Review, 22*(2), 82-89. doi:10.17549/gbfr.2017.22.2.82

Gabriel, M., Jacos, K., Arthurson, K., Burke, T., & Yates (2005). Conceptualizing and measuring the housing affordability problem, National Research Venture 3: *Housing affordability for lower income Australians Research Paper No. 1*, Australian Housing and Urban Research Institute.

Gurran, N., Milligan, V., Baker, D., & Bugg, L. (2007). International practice in planning for affordable housing lessons for Australia. *Positioning Paper*, Australian Housing and Urban Research Institute, Sydney.

International Federation for Housing and Planning (2016) *Housing affordability and segregation: Europe and North East Asia*. Denmark: Copenhagen. Retrieved from http://www.ifhp.org/sites/default/files/staff/affordability_and_segregation_one.pdf.

Kim, J. (2016). Determinants and Predictive Powers of Bankruptcy Models for Firms in Korea and the U.S. *Global Business & Finance Review, 21*(2), 65-85. doi:10.17549/gbfr.2016.21.2.65

Lawson. J., & Milligan, V. (2007). *International trends in housing and policy Responses*. Final Report, AHURI, Sydney.

doiLi, Z. Y., Razali, M. N., Fereidouni, H. G., & Adnan, Y. M. (2018). Macro-economic index effect on house prices in China. *International Journal of Housing Markets and Analysis*. P. 1753-8270. doi:10.1108/IJHMA-03-2017-0025

Meltzer, R., & Schwartz, A. (2015). Housing affordability and health: Evidence from New York City. *Housing Policy Debate, 26*(1), 80-104.

Milligan, V., Phibbs, P., Fagan, K., & Gurran, N. (2004). A practical framework for expanding affordable housing services in Australia: Learning from experience, *Final Report No. 65*, Australian Housing and Urban Research Institute.

Norris, M., & Shiels, P. (2007) Housing affordability in the Republic of Ireland: is planning part of the problem or part of the solution? *Housing Studies, 22*(1), 45-62.

Norris, M. (2006). Developing, designing and managing mixed tenure estates: implementing planning gain legislation in the Republic of Ireland. *European Planning Studies, 14*(2), 199-218.

Olanrewaju, A., Yeow, S., & Lim, L. (2016). Rethinking affordable housing delivery: An analytical insight. *MATEC Web of Conferences, 47*, 04002.

Osman, M. M., Ramlee, M. A., Samsudin, N., Rabe, N. S., Abdullah, M. F., & Khalid, N. (2017a). Housing affordability in the State of Johor. Planning Malaysia, *Journal of the Malaysian Institute of Planners, 5*(1), 347-356.

Osman, M. M., Rabe, N. S., Abdullah, M. F., Rosli, N. F., & Zainudin, F. E. (2017b). Housing affordability in the state of Melaka. Planning Malaysia: *Journal of the Malaysian Institute of Planners, 15*(1), 255-260.

Paris, C. (2007). International perspectives on planning and affordable housing, *Housing Studies, 22*(1), 1-9.

Population and Housing Census. (2010). *Malaysian Department of Statistics*.

Rangel, G. J., Ng, J. W. J., Thiyagarajan, M., & Poon, W. C. (2017). A micro-level view of housing affordability in Malaysia using an age cohort-housing type analysis. *Proceedings 2nd ISI Regional Statistics Conference*, 20-24 March 2017, Indonesia.

Said, R., Majid, R. A, Alias, A., Adnan, Y. M., & Razali, M. N. (2016). Sustainable housing affordability in Sabah. Planning Malaysia. *Journal of the Malaysian Institute of Planners,* Special Issue: 65-76.

Town and Country Planning Act (1990). England.

Wang, Y., & Jiang, Y. (2016). An empirical analysis of factors affecting the housing price in Shanghai. *Asian Journal of Economic Modelling, 4*(2), 104-111.

Yip, C. Y., Au-Yong, H. N., & Abdelhak, S. (2017). Housing affordability dynamics: On the contribution of economic growth shocks, credit constraints, and house price changes – For the case of Malaysia. *International Journal of Applied Business and Economic Research, 15*(24), 1-13.