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The Effect of Ageing Population on House Prices in Malaysia. An Autoregressive Distributed Lag (ARDL) Cointegration Approach

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Abstract--- *The past decade has witnessed a notably increase in the housing prices across countries which raises concern on its impact on social and economic aspects. Although property investment being an essential role in supporting the growth of economics through its influence on the aggregate demand level, however, a continuous increase in the housing prices may bring towards serious economic consequences. Hence, understanding the potential factors that contribute towards the significant increase in the housing prices is useful for policy implications. The main objective of this study is to investigate the effects of ageing population on housing prices in Malaysia. By utilizing the annual time series data from 1988 to 2017, the empirical analysis which is conducted using the Autoregressive Distributed Lag (ARDL) modelling approach reveals that in the long run, all the variables are found to be statistically significant with house prices whereby gross domestic product, inflation, stock market and ageing population are positively associated with house prices, while the rest of the variables are positively related. These findings are provide some guideline for a policy formulation to moderate the increase in the housing prices in order to maintain the economic stability of the country and indirectly help the government in realizing its vision in becoming a high-income country.*

Keywords--- *House Prices, Ageing Population, ARDL.*

I. INTRODUCTION

In 2019, the Malaysian population has exceeded more than 32 million, and demographic change is a true problem because it is advancing much quicker than many other nations. It took France 115 years to move from ageing to an aged nation, but it will take Malaysia only 25 years to do so (Rabi, 2018). By 2020, those aged 65 and older will constitute 7per cent of its population, and by 2045 (Ismail, Rahman, and Hamid, 2015), Malaysia will become an older country with 14per cent of its inhabitants aged 65 and older (Alam, Molla, Rahman, and Murad, 2017). Empirical studies indicate that ageing people can increase economic growth while others say the contrary. For instance, Beard and Bloom (2015) recognised significant negative financial effect when population ageing is advanced. In comparison, Tahir and Hamid (2015) discovered that population ageing process is positively and substantially linked to cross-country financial performance. Further to this, the life-cycle hypothesis of Ando and Modigliani (1963) reveals, people buy houses during their working age and sell them in their old age to support their retirement. By comparison, the ageing of big cohorts would place significant pressure on home prices and shifts in housing demand based on age and housing cost connection. It is to be anticipated, banks' lending behaviours,

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monetary policy and economic growth and so forth being underlying factors of house prices. However, the effect of ageing population cannot be overlooked either. Therefore, the aim of this study is to investigate the role of ageing population on house prices as this issue has not been given ample consideration in past studies in Malaysia.

II. LITERATURE REVIEW

The discourse of the ageing population impact on housing prices is mostly derived from empirical studies, and is still ongoing (Poterba 2014). The study on the link between house prices and demography changes has been initiated by Mankiw and Weil (1989), who predicted the demand for houses in United States will reach at highest in the 1980s due to the baby boomers, and the housing prices will eventually fall about 47 per cent by 2007. Saita et al. (2016) found that both in the USA and Japan, the price for the real estate is inversely interrelated with the region's ageing dependency ratio. In another study, Takats (2012) revealed that demography did affect real house prices significantly. Also, in an earlier study in United States, Takats (2010) discovered that ageing population affect real house prices significantly. Yanan (2017) argued that the ratio of the ageing ratio had a significant impact on the housing prices in Macau. Besides, Jäger and Schmidt (2017) found that the overall effect of the demographic transition on house prices has been negative. In China, Wang, Hui, and Sun (2018) found that an increase in the elderly dependency ratio by 1 per cent leads to a rise in housing prices by 0.368 per cent. However, Zheng (2017) revealed a contradicting result, whereby the elderly dependency ratio is negatively related to high-grade residential property prices in China. Also, the author found that the eastern region real estate price is most sensitive to the changes in the dependency ratio. However, Chen et al. (2012) found that population ageing is not likely the primary determinant of property prices in Scotland.Heo (2018) argue that the principal driver of a negative relationship between ageing and real house price comes from the later stage of life and not immediately after the age of 65 or retirement. Xu (2013) found the contributions of population ageing to the sharp rise in the U.S. house prices between 1994 and 2005. Then uwara, Hoang, and Siriwardana (2019) suggests that retiring baby boomers will not induce a house price meltdown in Australia. Apart from that Jichang (2016) concludes that ageing can increase urban housing demand China.

III. METHODOLOGY / MATERIALS

3.1 Data

This study will use house price index to represent house prices. The independent variables used in this study include gross domestic product, inflation, interest rates, population, money supply, stock market price and ageing population. This study will used real gross domestic product (GDP) to measure income (Malpezzi & Maclennan, 2001; Ibrahim & Law, 2014).In general, inflation rate is measured using Consumer Price Index (CPI). Thus,this study will use CPI to measure inflation by adapting the approach of Gounopoulos et al., (2012). Besides, Base Lending Rate (BLR)will be using to measure interest rate (Lean & Smyth, 2014). In addition, it is essential to include the total population in this study as well. Apart from that, we will use broad money (M2) to measure money supply and using Kuala Lumpur composite index as a proxy for stock market price as used by Lean& Smyth (2014). Furthermore, old dependency ratio will be used to measure ageing population as previously used by Takats

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(2012).All the data are obtained from National Property Information Centre (NAPIC), Department of Statistics Malaysia (DOSM), World Development Indicator (WDI) and Bank Negara Malaysia (BNM).

3.2 Empirical Model

In the preliminary test, this study conducts a unit root test to identify the stationary level of the variable. In the next part, the Auto-regressive Distributed Lag (ARDL) modelling approach will be employed to determine the short run and long run model. According to Pesaran et al., (2001), the ARDL procedure involves two phases. First, this study utilizes the ARDL bounds testing approach to determine the existence of a long run association among the variables (equation 1).

This test is useful since it allows lags in both the dependent and independent variable which indicates that the past values of the variable may help in identifying the present value of the variable since the changes in on variable may not always give an immediate effect on other variable and thus the lag variable is plausible to identify the issue. In addition, the ARDL bound testing is more flexible since it allows for different lags structure for different variables.

All of the variables which is in level have been transformed into natural logarithm in order to obtain a linearity and reduce the problem of heteroscedasticity in the model except for interest rate and ageing population.

$$\Delta LHP_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta HP_{t-i} + \sum_{i=1}^{p} \beta_2 \Delta LGDP_{Tt-i} + \sum_{i=0}^{p} \beta_3 \Delta LINF_{t-i} + \sum_{i=0}^{p} \beta_4 \Delta IR_{t-i} + \sum_{i=0}^{p} \beta_5 \Delta POP_{t-i} + \sum_{i=0}^{p} \beta_6 \Delta MS_{t-i} + \sum_{i=0}^{p} \beta_7 \Delta LKLSE_{t-i} + \sum_{i=0}^{p} \beta_8 \Delta AS_{t-i} + \sigma_1 LHP_{t-1} + \sigma_2 LGDP_{t-1} + \sigma_3 LINF_{t-1} + \sigma_4 IR_{t-1} + \sigma_5 LPOP_{t-1} + \sigma_6 LMS_{t-1} + \sigma_7 LKLSE_{t-1} + \sigma_8 AS_{t-1} + \varepsilon_t \quad (1)$$

Where HP, GDP, INF, IR represent house price, gross domestic product, inflation and interest rate respectively. POP, MS, KLSE and AS represent population, money supply, stock market price and ageing population respectively.

Based on the F-test, if the results based on the bound testing confirms the existence of the long run relationship, the second steps require the estimation of the following short run model in order to determine the long run and short run coefficients. The restricted error-correction model (ECM) of Equation (1) is specified as follows:

$$\Delta LHP_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta HP_{t-i} + \sum_{i=1}^{p} \beta_2 \Delta LGDP_{Tt-i} + \sum_{i=0}^{p} \beta_3 \Delta LINF_{t-i} + \sum_{i=0}^{p} \beta_4 \Delta IR_{t-i} + \sum_{i=0}^{p} \beta_5 \Delta POP_{t-i} + \sum_{i=0}^{p} \beta_6 \Delta LMS_{t-i} + \sum_{i=0}^{p} \beta_7 \Delta LKLSE_{t-i} + \sum_{i=0}^{p} \beta_8 \Delta AS_{t-i} + \lambda ECT_{t-i} + \varepsilon_t \quad (2)$$

Where λ is the speed of adjustment parameter which should be significant and carry a negative sign will support the existence of cointegration among the variables while ECT is one period lagged of the error correction terms. Apparently, ECT measures the speed of adjustment at which the house price returns to equilibrium due to changes in the explanatory variables (equation 2).

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IV. RESULTS AND FINDINGS

Table 4.1: Augmented Dickey-Fuller (ADF) and Philip Perron (PP) test

	Variable	ADF test statistic		PP test statistic	
		Intercept	Trend and intercept	Intercept	Trend and intercept
Level	LNHP	-2.372(1)	1.648(0)	-1.673(0)	-1.648(0)
	LNGDP	-2.022 (0)	-2.470 (0)	-3.997***(13)	-2.479 (8)
	LNINF	-2.393 (0)	-1.784 (0)	-3.665** (12)	-1.748 (7)
	IR	-1.928 (0)	-2.460 (0)	-1.894 (9)	-2.175 (11)
	LNPOP	-8.694*** (7)	-7.953*** (7)	-13.837***(3)	-1.329 (3)
	LNMS	-0.104 (0)	-1.748 (0)	-0.011 (3)	-1.748 (0)
	LNKLSE	-2.228 (0)	-3.376* (0)	-2.163 (3)	-3.447* (3)
	AS	2.538 (2)	-0.664 (6)	7.434 (0)	0.434 (5)
First difference	LNHP	-3.983***(0)	-3.907**(0)	-3.946*** (3)	-3.866** (3)
	LNGDP	-5.555*** (0)	-6.083*** (0)	-5.559*** (1)	-6.816*** (7)
	LNINF	-4.634*** (0)	-5.042*** (0)	-4.632*** (1)	-5.056*** (7)
	IR	-4.693*** (0)	-4.608*** (0)	-6.778*** (27)	-6.544*** (27)
	LNPOP	-3.077** (7)	-0.019 (7)	-0.847 (3)	-2.347 (3)
	LNMS	-5.235*** (0)	-5.220*** (0)	-5.240*** (3)	-5.336*** (5)
	LNKLSE	-7.206*** (0)	-5.281*** (1)	-7.639*** (2)	-7.454*** (2)
	AS	0.085 (6)	-4.685* (5)	-0.080 (22)	-2.227 (20)

Note: 1. ***, ** and * are 1%, 5% and 10% of significant levels, respectively.

2. Number in parentheses is standard errors.

This study has performed the Augmented Dickey-Fuller (ADF) test in order to determine the stationary of the variables. The optimal lag is chosen based on the Akaike Information Criterion (AIC). As shown in Table 4.1, the result of the ADF test supports that the null hypothesis of unit root is failed to be rejected for all the variables at level form except for house prices (LNHP), Kuala Lumpur stock exchange (LNKLSE) and population (LNPOP) which are found to be stationary either at 1 and 10 percent significance level. On the other hand, the findings at first difference support that all variables are stationary. Findings of this test indicate that house prices (LNHP), money supply (LNMS), base lending rate (IR), gross domestic product (LNGDP), inflation (LNINF) and ageingpopulation (AS) are integrated at order one, *I (1),* while, Kuala Lumpur stock exchange (LNKLSE) and population (LNPOP) have been found to be stationary at levels , *I (0).* Hence, the estimation of the long run model based on the Ordinary Least Squares (OLS) is not suitable since it will result in spurious estimation. Thus, it is confirmed that the ARDL approach to cointegration is the most appropriate analysis.

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Table 4.2: Results of Bound Test

Model	F Statistic	Result
(LNHP)	68.103***	Cointegration
Critical Values for F-statistics	Lower I(0)	Upper I(1)
1%	2.79	4.1
5%	2.22	3.39
10%	1.95	3.06

Note: *, **, and *** represent 10%, 5% and 1% level of significance, respectively.

Based on the result of the F-statistics presented in Table 4.2, the value of the test statistics is found to be greater than the upper bound level which confirms there is a cointegration between gross domestic product (LNGDP), inflation (LNINF), interest rate (BLR), population (LNPOP), money supply (LNMS), stock price (LNKLSE) and ageing population (AS) with the house prices which is significant at 1 percent significance level thereby the long run model could be estimated.

Table 4.3: Result of the Long Run Coefficient Estimates

VARIABLES	LNHP
LNGDP	-1.762* (0.083)
LNINF	-2.846** (0.049)
IR	-1.333** (0.021)
LNPOP	3.113*** (0.001)
LNMS	6.667*** (0.005)
LNKLSE	-0.714*** (0.004)
AS	-0.325*** (0.034)
C	486.789*** (0.001)

Note: (*),(**),(***) indicate significant at 10%,5% and 1% significance level respectively. Numbers in brackets represent standard error. The ARDL estimation outcomes is generated using AIC.

Based on the findings, all variables carry the mix sign whereby total population (LNPOP), money supply (LNMS), stock market price (LNKLSE) and ageing population (AS) are found to be statistically significant at 1 percent significance level while inflation (LNINF) and both interest rate (IR) found to be statistically significant at 5 percent significance level. Gross domestic product (LNGDP) found to be statistically significant at 10 percent significance level. In particular, the estimated coefficient for house prices (LNHP) found to be significant at 1 percent significance level for total population (LNPOP), money supply (LNMS), stock market price (LNKLSE) and ageing population (AS) while inflation (LNINF) and interest rate (IR) found to be significant at 5 percent significance level.

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The estimated coefficients of gross domestic product (LNGDP) is negative (-1.762) and significant at 10 percent significance level. Findings of this study imply that 10 percent increase in gross domestic product will result in 17.62 percent decrease in house prices. This result shows that, the price of houses has continued to increase despite the global financial crisis during 2008 (Yeap & Lean, 2017). This result could be one of the reason the gross domestic product (LNGDP) found to be negatively related with house prices (LNHP) with 10 percent significance level as well. Inflation (LNINF) is found to be negatively (-2.846) significant for house price at 5 percent significance level. This shows, 10 percent increase in inflation will result in 28.46 percent decrease in house prices. This result is consistent with the past studies which state that an increase in inflation decreases the demand for housing and subsequently decreases the housing prices (Feldstein, 1992; Poterba, 1992; Yeap & Lean, 2017). In addition, as argued by Feldstein (1992), an increase in inflation effects construction costs and housing payment to increase, which lead to a lower demand for housing. Apart from that, the interest rate (IR) is found to be statistically and negatively (-1.333)significant at 5 percent for house prices whereby 10 percent increase in interest rate will result in 13.33 percent decrease in house prices. This findings are in line with Yeap & Lean (2017). The inverse association is due to the lowest cost of borrowing encourageing house purchasers, resulting in higher demand for residential properties thus increase the price for houses (Li et al., 2018; Rubio & Gallego, 2016; Peng & Chen, 2016; Gaspareniene et al., 2017).In July of 2016, BNM announced the reduction of Overnight policy rate (OPR), which was a first reduction to happen in 7 years. The OPR reduction happened in light of the risks that were rising from Britain's withdrawal from the European Union (EU) that was also known as Brexit (BNM, 2017). This could be one of the reason for the negative relation as when the interest rate is too low for too long, the cost to get funding is cheaper and as such, people may tend to over borrow or a systemic slowdown can happen which then puts the house prices increase. In the case of total population, the estimated coefficients to be found carry a positive sign (3.113) for the house prices. It shows that, a 10 percent increase in total population will result in 31.13 percent increase in house prices. Besides that, the positive impact of total population (LNPOP) on house prices is not surprising and also consistent with the past studies which state that higher the population will increase the house prices. This is due to the growth in the population will increase the demand for the residential properties. This findings are therefore consistent with Ong (2013) and Wang and Rickman (2017).Besides that, the estimated coefficient of the money supply (LNMS) is positive (6.667)for house prices and found to be significant at 1 percent significance level. In particular, findings of this study reveal that a 10 percent increase in money supply will result in 66.67 percent increase in house prices. This result is consistent with the finding of Su et al. (2019), Zhang (2016) who argue that an increase in money supply would increase the price level of financial and physical assets. In addition, an increase in money supply will boost investment in the housing market, raising the demand and, thus the house prices. Apart from that, the estimated coefficient of stock price (LNKLSE) to be found carry a negative sign (-0.714)for house prices and significant at 1 percent significance level for house prices. In particular, findings of this study reveal that a 10 percent increase in stock price will result in 7.14 percent decrease in house prices. This result is consistent with the previous studies of Eichholtz & Hartzell (1996), Ayuso et al. (2006), and Ibrahim et al. (2009). The negative association of stock prices on house prices show a long-run substitution effect dominating the relationship between stock and house prices. Meanwhile, the estimated coefficient of the ageing population (AS) is negative (-0.325) for

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the house prices and found to be statistically significant at 1 percent significance level. This reveal that a 10 percent increase in ageing population will result in 3.25 percent decrease in house prices. This findings are similar with Guest and Swift (2010), Takats (2012), Park et al. (2017), Zheng (2017), Hiller et al. (2016) and Saita et al. (2016) who are claiming ageing population will give downward pressure on house prices due to the retirement of the baby boomers.

Table 4.4: Estimation of Short Run Restrictred Error Correction Model (ECM)

MODEL	ECT
HP	0.930***

Note: (*),(**),(***) indicate significant at 10%,5% and 1% significant level respectively.

As discussed in the previous section, since all the variables are found to be cointegrated, therefore, any disequlibrium that occurs in the model represents the short run phenomenon. The magnitude of error correction representation of the ARDL model indicates the speed of adjustment of any short-term deviation of the model towards the long run equilibrium. Based on the estimation result, the error correction terms for the entire model have a negative sign and significant at 1 percent significance. This findings confirm the result of the cointegration test that indicates the existence of a long run association among the variables. The coefficient of the error correction term indicates that any short-term deviation that occurs in the house prices (HP) will be adjusted by 93 percent in a year. The result imply that any short-term deviation in the house prices will take approximately 1 year to completely return to the equilibrium. This findings therefore contradict with Tang & Tan (2015) whereby they found slow convergence to the equilibrium which indicates inefficiency of property market in Malaysia.

V. CONCLUSION

The purpose of this study is to investigate the effect of ageing population on the house prices in Malaysia. This study also includes the role of gross domestic product, inflation, total population, money supply and stock price as the determinants of house prices. This study used an annual time series data which covers the period from 1988 to 2017. In order to answer the objectives of the study, firstly this study conducts the unit root test based on Augmented Dickey-Fuller (ADF) test and Narayan & Popp (2010) unit root test to determine the stationarity of the variables used in this study. Since the findings of the stationarity test suggests that there is mixed order of integration among the variables used in this study, hence, the Autoregressive-Distributed Lag (ARDL) modelling approach is the most suitable method that can be used in order to answer the research questions.As reported in the previous section, the findings based on the ARDL modelling approach on the long run impact reveal that long run relationship exists among the variables with total population and money supply exert a positive influence on house prices while gross domestic product, inflation, interest rate, stock market price and ageing populationare found to be inversely associated with house prices. The findings of the short-run model reveal that the speed of adjustment of house prices will take approximately 1 year to adjust back to the equilibrium.

Recommendation for the future studies

Due to the limitation of this study, further investigation is essential to provide more insight in the study of house prices. Firstly, in order to fully understand the issue of house prices at a global scale, further investigation should be

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carried out in other countries so that the outcome of the study can be compared. In addition, further analysis using a panel data is also useful to explore on how far the country's difference have impacted the house prices across countries. Secondly, this study focuses more on the demand side factors since it has been found to have dominant effects on the house prices model. Hence, the inclusion of more supply side determinants such as housing supply, cost of construction, housing stock and land prices would enable the researcher to investigate the behavior of both demand and supply side in affecting the house prices model. In addition, the investigation from the developers side also beneficial to get a better understanding on how the housing price is determined and form a basis for government to help tackle the housing affordability issue.Finally, the present study is the relatively small number of observations because it uses annual data, which were considered more appropriate in capturing the long-term effect of key macroeconomics variables on the house prices. Further research should use of quarterly data that would include more observations.

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