Is the relationship between housing price and banking debt symmetric or non-symmetric? evidence from Malaysia based on NARDL

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Is the relationship between housing price and banking debt symmetric or non-symmetric? evidence from Malaysia based on NARDL

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Abstract

The increasing price of housing property in Malaysia has become a concern as it increases the cost of living through debt payment by households. The purpose of the paper is to investigate whether the housing price has an asymmetric relationship with banking debt. The asymmetric relationship will be tested using the NARDL method. The research will aid the policymakers in deciding whether measures to control housing loan or alternatively, the initiatives and controls on the housing supply-side is better to curb increasing price of houses. The paper finds that the relationship between banking debt and housing prices is asymmetric in the short run and symmetric in the long run. However, we find that the relationship between housing debt and housing prices is asymmetric in both the short and long run. A positive change in housing debt will affect the housing price inflation more than a negative change. Through the causality tests, we find that policies should focus on the supply-side and price control policies to affect the housing price, rather than the controls on banking debt.

Keywords: housing price, banking debt, NARDL, Malaysia

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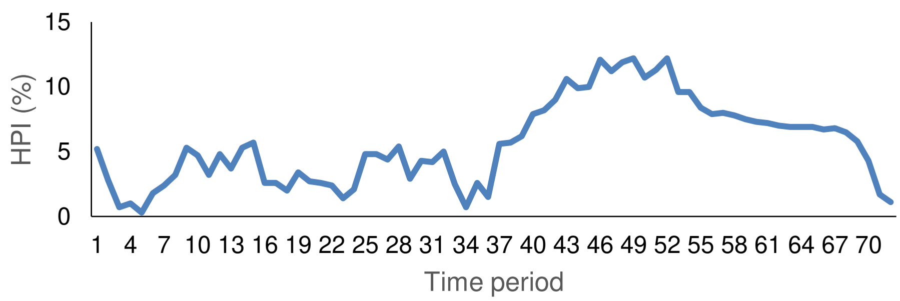
1.0 Introduction

The increase in housing prices and the issue of its affordability have gained considerable attention recently in Malaysia, in which home ownership is facilitated through banking debt. For Malaysia, 32% of the banking debt is based on housing loan and there had been an increase of 56% in housing loan in the last 5 years. This has caused a concern on the rising cost of living of Malaysian and hence, requiring the government and the central bank to intervene in the housing market and housing debt. On the macroeconomic perspective, the rising house prices can impact the marginal propensity to save and consume, as households avert their income in paying for their housing debt. The average cost of a Malaysian home was five times the annual median household income in 2016, above the global standard of three times (BNM, 2018). The issue is exacerbated on non-performing loans, where 23.4% of total non-performing loans comes from residential property loans.

Nevertheless, in recent times, the housing price inflation has dropped, an all-time low since post the global financial crisis, perhaps due to an increase in housing supply and unsold properties that is unable to meet the demands of consumers (Graph 1). The number of residential units which remain unsold nine months after completion rose 18% between 2017-2018 (NAPIC, 2019).

Graph 1: Year-on-year growth on Housing Price Index, 2011-2018



Recent policy response from the banking regulatory authority is to limit the loan-to-value ratio to 70% for third home loan. Previous research has shown that the lending policy is effective in reducing house price inflation by limiting the credit-fuelled housing demand channels (Armstrong, 2018). To help the lower income group, the banking regulatory authority has also created a special fund for affordable homes to help finance purchase of first homes. At the national government level, the National Housing Policy was launched early 2019 for more control on housing supply and housing prices that would meet the demands of low and medium income groups.

Housing prices can impact the lending practices of banks. An increase in housing prices will increase the banking asset size as well as the income obtained through the charging of interests or profits. On the other hand, the ease in borrowing and lending may also push the housing prices by encouraging the demand of houses in the short run where the supply-side will lag to respond to the increased demand. This shows that the causal linkages between housing prices and banking debt can run in both directions (Ibrahim & Law, 2014).

The previous literature thus far have shown contrasting results by using data from different countries and time period. Some studies have shown that housing prices and banking financing have symmetrical and proportional relationship in the short and long run (Lim and Lau, 2018). (Ibrahim and Law, 2014). On the other hand, some studies have shown that housing prices and banking debt have asymmetric relationship (Tan et. al, 2018).

Thus, the objective of this paper is to investigate the asymmetric relationship between house prices and banking debt. This study contributes to the literature by analysing the potential non-linearity and asymmetry between housing prices and banking debt by employing the Non-linear Autoregressive Distributed Lag (NARDL) method.

The government and banking regulatory authority can then decide on the appropriate policy response by considering the relative impact of their policy in controlling the housing prices. In addition, it will also show whether there is a cause of concern on the rising housing prices in Malaysia such that the high household debt can cause future instability.

The paper is structured as follows: Chapter 2 shows the findings and methods being used in previous literature, Chapter 3 discusses the theoretical framework, Chapter 4 outlines the data sources and methodology, Chapter 5 discusses the findings of the empirical results and Chapter 6 summarises the main findings, policy implications and possible directions for future research.

2.0 Literature Review

Numerous empirical research has been done to investigate the relationship between banking debt and housing prices. Some studies investigate their relationship in only one direction while others investigate their causal interactions. They have mainly used the cointegration tests of Johansen and Pedroni.

Testing on the data between 1970 to 2011 for OECD countries, Arestis & Gonzalez (2012) also employs the Johansen cointegration test, and finds mixed results for the OECD countries. While the short run relationship between housing price and banking debt is significant in Nertherlands, New Zealand and United States, it is not significant in Norway. In particular, a rise in housing prices only exert a positive effect on credit in only half of the OECD countries under investigation. The researchers also found long run relationship on countries which had suffered a bust on the housing market bubble, for example Spain and Finland. For Japan, there is low incidence of housing prices on demand for banking debt.

In the Asia region. Collyns and Senhadji (2002) finds that banking debt growth has a significant impact on residential property prices for Hong Kong, Korea, Singapore and Thailand, and hence conclude that the bank debt contributed significantly to the real estate bubble in Asia prior to the 1997 East Asian crisis. Bank debt is seen to have a positive relationship with housing price in the long run in Malaysia between the years 1999 to 2011. By using the cointegration test of Johansen-Juselius, Ibrahim & Law (2014) finds that the long run house prices are mainly shaped by the availability of bank debt and lending rate. In particular, a 10% increase in lending is related to an increase in housing prices by 7.2%. Meanwhile, a 1% increase is lending rate is related to the decline in house prices by 8-9%. For China, Jiang et al (2018) finds in the long run, housing prices cause lending supply changes and indicate that credit policy at national level often lags in response to housing price changes. The researchers use the Pedroni cointegration test for the period 2003-2015, and finds that a long run equilibrium relationship exist between housing prices, banking debt and lending rates at the national level and city level. Che et. al (2011) also finds that there is a single long run relationship, while two long run relationship is only indicated for some cities in China.

The ARDL and the non-linear ARDL methods have been used recently to identify the relationship between housing price, banking debt and lending rate. Lim and Lau (2018) used the ARDL method and finds symmetry relationship between housing price, bank lending, construction output and interest rate in Malaysia. Sukmana and Setianto (2018) have also used the ARDL model and finds symmetry relationship between house prices, Islamic bank risk and macroeconomic variables in Indonesia. Tan et al (2018) used the NARDL method and finds that there is long run asymmetry between interest rate and housing price in Malaysia i.e. an increase in interest rate will increase the housing price, while an interest rate decrease is insignificant to influence housing price index.

The above literature applies different methodologies, either linear or non-linear framework, using different time series or panel datasets that results in different findings. Thus, there is no consensus on existence of long run relationship between house prices and other economic and financial fundamental factors. Hence, this paper will attempt to investigate the asymmetry relationship between housing price index and banking debt as well as housing debt by employing the non-linear ARDL. The paper will contribute to the discussion on the extent of the effect of banking debt to the housing price.

3.0 Theoretical Framework

The causal relationship between bank debt and housing price can run in both directions (Ibrahim & Law, 2014). The availability of bank debt is likely to increase the demand for houses as well as the housing price. This is because the increase of bank debt is caused by lower lending rates, future expectations on favourable economic conditions and relaxation of liquidity constraints faced by households (Oikarinen, 2009). The banks will then select the eligible borrowers based on their creditworthiness as well as the collateralisation value of the housing property, which will influence the lending rates. The cheaper and high volume of credit makes housing ownership more affordable and attractive, which increase the price of houses since supply of housing is fixed in the short run (Arestis & Gonzalez, 2012).

Further, the increase in house prices can also increase bank financing activities by stimulating credit supply or demand. With the traditional notion of 'dynamic monetised production economy', any flow of production needs the provision of debt, which drives and permits evolution of the economy. Here, the role of banks is to provide debt to the housing development market (Arestis & Gonzalez, 2012). The provision of debt is controlled by the central bank through controlling the monetary and liquidity position of the banking system. In addition, the central bank also controls standards on debts, which ensures the financing is growing at a sustainable rate without over-leveraging.

In addition, as the housing debt is part of the banking debt, an increase in house prices can improve the bank's balance sheet position and hence, bank's willingness to provide financing. Therefore, a burst in housing price will expose the bank to default risks which will curtail bank lending to housing properties.

However, the relationship between housing price and banking debt may be asymmetry i.e. a 1% increase in banking debt may not always lead to a x% increase in housing price, vice versa. Additionally, the housing market may not always adjust accordingly should there be an ease in the banking debt rate or lending criteria. The housing market is different from other financial markets as it has low quality information, insufficient market infrastructure, high transaction costs, less liquidity, low transparency and very rigid supply side (Herring et al., 2002). In addition, housing price may also respond to economic expansions and contractions differently.

4.0 Data and Methodology

For the empirical analysis, the study employs the quarterly data on House Price Index from National Property Information Centre. The period being studied is between Q4 2001 and Q3 2018 with 68 observations. The banking debt are represented by the data obtained on outstanding banking debts for both conventional and Islamic banks. Apart from the focus variables, banking lending rate, Consumer Price Index and Gross Domestic Product are added as control variables as these have long run cointegration with house prices. The basic equation employed in this study is as follows:

$$HPI_t = \beta_0 + \beta_1 BD_t + \beta_2 LR_t + \beta_3 CPI_t + \beta_3 GDP_t + \varepsilon_t$$

The following table summarises the variables used in the study.

Variable	Symbol
Housing Price Index	HPI
Banking debt	BD
Lending rate	LR
Consumer Price Index	CPI
Gross Domestic Product	GDP
Error term	ε_t

This study will adopt the cointegration test for time series techniques i.e. the autoregressive distributed lags model (ARDL) and non-linear ARDL. Time series techniques involve testing the long run relationship between variables and it does not assume causality as per standard linear regression analysis.

Firstly, unit root tests will be conducted on the level and differenced forms of the variables. This step is crucial as cointegration tests in the standard time series technique require all variables to be non-stationary. Stationary variables are defined as variable that have constant mean, variance and covariance. Three tests will be conducted, namely Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. ADF test (Dickey and Fuller, 1979) takes care of autocorrelation only whilst PP test (Phillips and Perron, 1988) takes care of both autocorrelation and heteroscedasticity. For both tests, the null hypothesis of both tests is that there is no cointegration between the variables. On the other hand, KPSS use null hypothesis of there is cointegration between the variables (Kwiatkowski et al., 1992).

Next, the VAR order selection is performed to determine the optimum number of lags for variables used in the study, corresponding to the highest value of AIC or SBC. Normally, the SBC will select a lower order of VAR as compared to AIC. The Engle-Granger cointegration test is performed. However, since the Engle-Granger test cannot identify the number of cointegrating vectors, we will perform the Johansen test. The Johansen test have several weaknesses, in which it requires all variables to be non-stationary. In addition, the Johansen test results is sensitive to the number of lags, as changing the number of lags will yield different results.

We will proceed to conduct the ARDL test introduced by Pesaran et al. (2001) which is a bound testing approach of the F-test that can be used for small sample size. The bound testing is based on an upper and lower critical value which has been determined by Pesaran et al. (2001). The ARDL can include both variables in I(1) and I(0) form. If the F-statistic found in ARDL is above the upper boundary, we can conclude that there is cointegration and that the variables move in the long run. From the ARDL technique, the linear ECM specification without asymmetry in short and long run dynamics takes the following form:

$$\Delta HPI_t = \mu + \sum_{i=1}^{r} \alpha_i \Delta HPI_{t-i} + \sum_{i=1}^{s} \beta_i \Delta BD_{t-i} + \rho_{HPI} HPI_{t-1} + \rho_{BD} BD_{t-1} + \varepsilon_t$$

Nevertheless, the ARDL also have weakness i.e. it assumes linearity and symmetric relationship between the variables. Linearity means there is proportionate change between the variables i.e. a 1% change in independent variable will lead to x% change in dependent variable at all times. Additionally, symmetry means constant speed of adjustment from equilibrium i.e. a variable will increase and decrease at the same speed. These assumptions are unrealistic as the economic variables and the finance-related variables are becoming erratic in view of the globalisation and does not reflect the structural changes or policy impact to banking debt or housing prices.

Hence, this study proposes the NARDL method for finding the asymmetric relationship between variables in the short and long run. The NARDL relaxes the assumption of linearity and symmetry adjustment. The NARDL can also differentiate the short and long run effects of regressors to the dependent variable. Thus, the NARDL can decompose the movements of the independent variables (i.e. banking debt and housing debt) into their negative and positive partial sums, as follows:

$$\Delta x_t^+ = \sum_{j=1}^{t} \Delta x_j^+ = \sum_{j=1}^{t} \max(\Delta x_j, 0) \text{ and } \Delta x_t^- = \sum_{j=1}^{t} \Delta x_j^- = \sum_{j=1}^{t} \min(\Delta x_j, 0)$$

Introducing the short and long run asymmetry into the standard ARDL model above, the equation for NARDL is as follows:

$$\Delta HPI_t = \mu + \sum_{i=1}^{r} \alpha_i \Delta HPI_{t-i} + \sum_{i=1}^{s} (\beta_i^+ \Delta BD_{t-i}^+ + \beta_i^- \Delta BD_{t-i}^-) + \rho_{HPI} HPI_{t-1} + \rho_{BD}^+ BD_{t-1}^+ + \rho_{BD}^- BD_{t-1}^- + \varepsilon_t$$

The short run asymmetry is captured by β^+ and β^- while the long run asymmetry is captured by ρ^+ and ρ^-. The short run analysis is intended to assess the immediate impact of changes in banking debt to housing price. On the other hand, the long run analysis is intended to measure the reaction time and speed of adjustment toward an equilibrium level. The short and long run asymmetry is tested against a Wald test. The non-rejection of either short or long run asymmetry will yield the following cointegrating NARDL for short and long run asymmetry respectively:

$$\Delta HPI_t = \mu + \sum_{i=1}^{r} \alpha_i \Delta HPI_{t-i} + \sum_{i=1}^{s} (\beta_i^+ \Delta BD_{t-i}^+ + \beta_i^- \Delta BD_{t-i}^-) + \rho_{HPI} HPI_{t-1} + \rho_{BD} BD_{t-1} + \varepsilon_t$$

$$\Delta HPI_t = \mu + \sum_{i=1}^{r} \alpha_i \Delta HPI_{t-i} + \sum_{i=1}^{s} \beta_i \Delta BD_{t-i} + \rho_{HPI} HPI_{t-1} + \rho_{BD}^+ BD_{t-1}^+ + \rho_{BD}^- BD_{t-1}^- + \varepsilon_t$$

The above model is repeated by replacing the banking debt with housing debt. This is to better understand whether a policy change on all types of banking debt or specific policy on housing debt will be more effective to curb housing price bubble.

While the focus of this paper is the NARDL model, a pertinent issue for the policy makers is the causality tests i.e. which variables can the policy makers adjust in order to bring economic and financial stability, while also encouraging sustainable growth in housing market and debt sector. In the causality tests, the Vector Error Correction Method (VECM) is conducted based on the ARDL test. Here, the error correction term is estimated to determine whether the variables are exogenous or endogenous. If the error correction term is found to be significant, then, the variable is endogenous. If not significant, the variable is found to be exogenous. The coefficient of the error term will show the speed of adjustment to equilibrium, where a higher absolute value would mean a faster adjustment. Further, a positive coefficient means that variable will move away from the equilibrium in the long run, while a negative sign means that the variable will return to equilibrium. As the VECM cannot determine the relative strength of exogeneity, we will proceed with the variance decomposition (VDC) to find the causal chain of the variables. The VDC can be performed using the generalised or orthogonalised VDC. The Generalised VDC is preferred as it does not depend on a particular ordering of the variable and when a variable is shocked, other variables in the system are not switched off. Next, the impulse response function (IRF) will be conducted to illustrate the VDC in graphical format.

The following section will discuss the results of each tests performed.

5.0 Analysis and Discussion

5.1 Non-stationary tests

To test the theoretical relationship between variables, the paper employs the non-stationary tests of Augmented Dicky-Fuller (ADF), Phillips-Perron (PP) and KPSS, descriptive tools performed to classify series as either stationary or non-stationary. This is critical as we need to ensure that the variables are non-stationary before cointegration test can be conducted. Firstly, variables are taken in the form of log to make the variance stationary. Then, the variables is made first differenced, as to test whether the variables are stationary in difference form.

The ADF test on log form of the variables in Table 1 shows that the t-statistics of the log form variables are smaller than the critical value (ignoring the minus sign). The null hypothesis of the unit root test cannot be rejected for all variables at log form, indicating that they are non-stationary. Repeating the ADF test on the first differenced form of the variables in Table 2 shows that t-statistics results are higher than the critical value (ignoring the minus sign), except in the case of SBC for DHPI. Hence, the null hypothesis of the unit root test can be rejected for other first differenced form variables, indicating that they are in stationary form.

Table 1: ADF test (Log Form)

	Variable	ADF	Value	T-STAT	C.V.	Result
LOG FORM	LHPI	ADF(3)=AIC	-36.5277	-1.8864	-3.3906	Non-stationary
		ADF(5)=SBC	-44.6802	-1.0154	-3.4408	Non-stationary
	LBD	ADF(4)=AIC	103.8262	-2.2527	-3.4235	Non-stationary
		ADF(1)=SBC	98.5192	-3.171	-3.4312	Non-stationary
	LLR	ADF(1)=AIC	149.9723	-3.0227	-3.4283	Non-stationary
		ADF(1)=SBC	145.593	-3.0227	-3.4283	Non-stationary
	LGDP	ADF(5)=AIC	140.0252	-1.715	-3.4408	Non-stationary
		ADF(5)=SBC	148.0252	-1.715	-3.4408	Non-stationary
	LCPI	ADF(4)=AIC	196.5524	-3.1441	-3.4235	Non-stationary
		ADF(1)=SBC	191.3071	-3.3481	-3.4312	Non-stationary

Table 2: ADF test (First Differenced Form)

	Variable	ADF	Value	T-STAT	C.V.	Result
1ST DIFF. FORM	DHPI	ADF(2)=AIC	-36.3741	-4.5067	-3.4472	Stationary
		ADF(5)=SBC	-44.4829	-2.9333	-3.4261	Non-stationary
	DBD	ADF(2)=AIC	100.5791	-7.5908	-3.4472	Stationary
		ADF(2)=SBC	95.1431	-7.5908	-3.4472	Stationary
	DLR	ADF(1)=AIC	142.6771	-4.7032	-3.469	Stationary
		ADF(1)=SBC	138.3283	-4.7032	-3.469	Stationary
	DGDP	ADF(5)=AIC	137.3296	-5.5402	-3.4261	Stationary

		ADF(4)=SBC	129.1699	-5.3711	-3.4653	Stationary
	DCPI	ADF(1)=AIC	189.9667	-8.612	-3.469	Stationary
		ADF(1)=SBC	185.6179	-8.612	-3.469	Stationary

We further conduct unit root tests of PP to the log and first differenced form of the variables in Table 3. In the log form, the PP test results indicate that the variables LHPI and LLR are non-stationary as the t-statistic is lower than the critical value which we cannot reject the null hypothesis of non-stationarity. On the other hand, the variables LBD, LGDP and LCPI are stationary as the t-statistic is higher than the critical value which we have evidence to reject the null hypothesis of non-stationarity.

Table 3: PP test (Log and First Differenced Form)

	Variable	T-STAT	C.V.	RESULT PP
LOG FORM	LHPI	-3.0463	-3.5351	Non-stationary
	LBD	-4.0726	-3.5351	Stationary
	LLR	-2.0271	-3.5351	Non-stationary
	LGDP	-3.8191	-3.5351	Stationary
	LCPI	-4.4782	-3.5351	Stationary
1ST DIFF FORM	Variable	T-STAT	C.V.	RESULT PP
	DHPI	-12.2031	-3.4744	Stationary
	DBD	-13.5127	-3.4744	Stationary
	DLR	-6.3267	-3.4744	Stationary
	DGDP	-13.6162	-3.4744	Stationary
	DCPI	-13.9911	-3.4744	Stationary

KPSS test is conducted as the third test on stationary of the variables and the results are outlined in Table 4. In the log form of the variables, the KPSS test results indicate that all variables are in stationary form in which the t-statistics are lower than the critical value. In the first differenced form, all variables are stationary except in the case of DHPI.

Table 4: KPSS test

	Variable	T-STAT	C.V.	RESULT KPSS
LOG FORM	LHPI	0.11395	0.1471	Stationary
	LBD	0.097226	0.1471	Stationary
	LLR	0.13394	0.1471	Stationary
	LGDP	0.147	0.1471	Stationary
	LCPI	0.08027	0.1471	Stationary
1ST	Variable	T-STAT	C.V.	RESULT KPSS

	DHPI	0.16893	0.1471	Non-stationary
	DBD	0.12659	0.1471	Stationary
	DLR	0.12058	0.1471	Stationary
	DGDP	0.12547	0.1471	Stationary
	DCPI	0.10214	0.1471	Stationary

The stationarity test is important for the policy makers as it enables the understanding of the trends. In the case of non-stationarity, $E\{\Delta \log x_t\} \neq 0,$ it indicates a constant deterministic growth over time. The non-stationary test on both the log and differenced form of housing price indicates that there is an increased trend over time and it does not have a mean-reversion characteristic. This could be reasoned as the outcome of demand and supply of housing properties and the lack of government control on the prices. As for the banking debt, the results mainly shows that it is stationary and hence, has a mean-reversion characteristic. This shows that the central bank controls the banking debt and avoids high financial leverage in the banking system, by requiring the banks to set aside capital to support the risks arising from banking debt.

5.2 VAR order selection

Further, we find the order of vector autoregression. From Table 5, AIC gives 5 lags, SBC gives 1 lag and adjusted LR test gives 1 lag.

Table 5: Order (lags) of Vector Autoregressive (VAR)

Order	AIC	SBC	p-value	C.V.
6	573.5644	405.0494	-	-
5	575.8634	434.5282	0.05	0.534
4	564.5863	450.431	0.05	0.124
3	566.2154	479.2399	0.05	0.178
2	567.4922	507.6966	0.05	0.213
1	553.192	520.5762	0.05	0.05

5.3 Cointegration tests

Next, we check whether our variables are cointegrated using the Engle-Granger, Johansen, ARDL and NARDL. The Engle Granger tests the cointegration of variables by examining the error term, where the residual of cointegrating relationship should be stationary if they are cointegrated. This is done by using the linear regression or the OLS method and choosing LHPI as dependent variable and the others as independent variables. From Table 6, the Engle-Granger statistical test shows that we cannot reject the null hypothesis of unit root due to the low test statistic as compared to the critical value. Hence, we can conclude that there is no cointegration between variables.

Table 6: Engle-Granger Statistical Test

ADF	Value	T-stat	C.V.	Result	Conclusion
ADF(5)=AIC	-45.3186	-2.369	-4.63	Non-stationary	No cointegration
ADF(5)=SBC	-51.8876	-2.369	-4.63	Non-stationary	No cointegration

Nevertheless, the Engle-Granger has some limitation where it only identifies a single cointegrating relationship and is a two-step procedure (i.e. one regression to estimate the residual series and another regression to test for unit root). Errors in the first estimation may be carried into the second estimation. Thus, we perform the Johansen's cointegration test.

From the Johansen's test results in Table 7, the null hypothesis of no cointegration is rejected at 10% significance level based on the trace of stochastic matrix method. In particular, it shows that there is one cointegration. However, it should also be pointed out that that the maximal eigenvalue method results show no cointegration at both the 5% and 10% significance level. We have also repeated the Johansen test by increasing the order of VAR as our order of VAR test also allows a higher selection. From the Johansen's test results, it shows that there is one cointegration at both the 5% and 10% significance level.

Table 7: Johansen Test

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix at Order of VAR=1

Null	Alternative	Statistic	95% Critical Value	90% Critical Value	Result
r = 0	r = 1	31.894	37.860	35.040	No cointegration
r<= 1	r = 2	21.883	31.790	29.130	

Cointegration LR Test Based on Trace of the Stochastic Matrix at Order of VAR=1

Null	Alternative	Statistic	95% Critical Value	90% Critical Value	Result
r = 0	r>= 1	83.236	87.170	82.880	1 cointegration at 90% critical value
r<= 1	r>= 2	51.341	63.000	59.160	

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix at Order of VAR=2

Null	Alternative	Statistic	95% Critical Value	90% Critical Value	Result
r = 0	r = 1	48.746	37.860	35.040	1 cointegration
r<= 1	r = 2	22.624	31.790	29.130	

Cointegration LR Test Based on Trace of the Stochastic Matrix at Order of VAR=2

Null	Alternative	Statistic	95% Critical Value	90% Critical Value	Result
r = 0	r>= 1	100.945	87.170	82.880	1 cointegration
r<= 1	r>= 2	52.199	63.000	59.160	

The Johansen's test also has some limitations, as it assumes that all variables are in I(1) form. Further, as we can see from the use of two order of VAR, it is sensitive to number of lags in the order of VAR as changing the number of lags will give different cointegration results. Therefore, we perform the ARDL test as it can be applied with both I(0) and I(1) type of variables.

We test the long run relationship between the variables and found that the F-statistics are all lower than the lower critical bound at both 90% and 95% level (Table 8). Thus, we cannot reject the null hypothesis of no long run relationship, and hence conclude there is no cointegration among the variables. Although this points to the fact that we cannot proceed to estimate the long run coefficients as they are not cointegrated, we will proceed, for completeness purposes, of using ARDL to estimate the long run coefficients as well as the fact that the Johansen's test results show cointegration of variables. In Table 9, the long run coefficient for LBD is 5.05 which means that a 1% increase in banking debt will increase the housing price by 5%, thereby highly influence the housing price. The housing developers and its supply chain may have imputed the cost of financing into their cost of materials and services, and hence, affect the housing price. But since the p-value is higher than 10% significance value, this indicates that there is no long run effect on housing price. Other variables have very high p-value and hence, the value of coefficient should be used with caution.

The issues faced with ARDL method indicates that we need to proceed with the NARDL method. In addition, ARDL model also has limitation as it assumes linearity and symmetry between variables.

Table 8: Autoregressive Distributed Lag (ARDL) cointegration test

Variables	F-statistics	p-value	Critical Lower Bound (90%)	Critical Upper bound (90%)	Critical Lower Bound (95%)	Critical Upper bound (95%)	Conclusion
DHPI	1.0735	[.389]	2.782	3.827	3.189	4.329	No cointegration
DBD	1.5853	[.186]	2.782	3.827	3.189	4.329	No cointegration

DLR	2.1094	[.084]	2.782	3.827	3.189	4.329	No cointegration
DGDP	0.47975	[.789]	2.782	3.827	3.189	4.329	No cointegration
DCPI	1.314	[.277]	2.782	3.827	3.189	4.329	No cointegration

Table 9: Long run coefficient estimates in ARDL

Regressor	Coefficient	P-value
LBD	5.0517	0.111
LLR	-2.5799	0.501
LGDP	3.0661	0.387
LCPI	-12.905	0.818

For purpose of NARDL test, this paper will only focus on two variables, namely the housing price and the banking debt, consistent with the overall objective of this study which is determining whether banking debt influences housing price in Malaysia, and specifically whether there exists a long run relationship between them and whether the relationship is linear or non-linear.

In this study, the long run cointegration of the NARDL test reveals that the F-statistics is higher than the critical upper bound at 10% significance level, hence null hypothesis of no cointegration is rejected. In other words, housing price and banking debt are cointegrated in the long run. Repeating the NARDL test by replacing the banking debt with housing debt reveals a higher F-statistics and is significant at 5% (Table 10).

Table 10: Cointegration test statistic for banking debt and housing debt

Variables	F-statistics	Critical Lower Bound I(0) at 10% sig. level	Critical Upper bound I(1) at 10% sig. level	Critical Lower Bound I(0) at 5% sig. level	Critical Upper bound I(1) at 5% sig. level	Conclusion
Banking debt	4.1688	3.17	4.14	3.79	4.85	Cointegration at 10% sig. level
Housing debt	7.3014	3.17	4.14	3.79	4.85	Cointegration at 5% sig. level

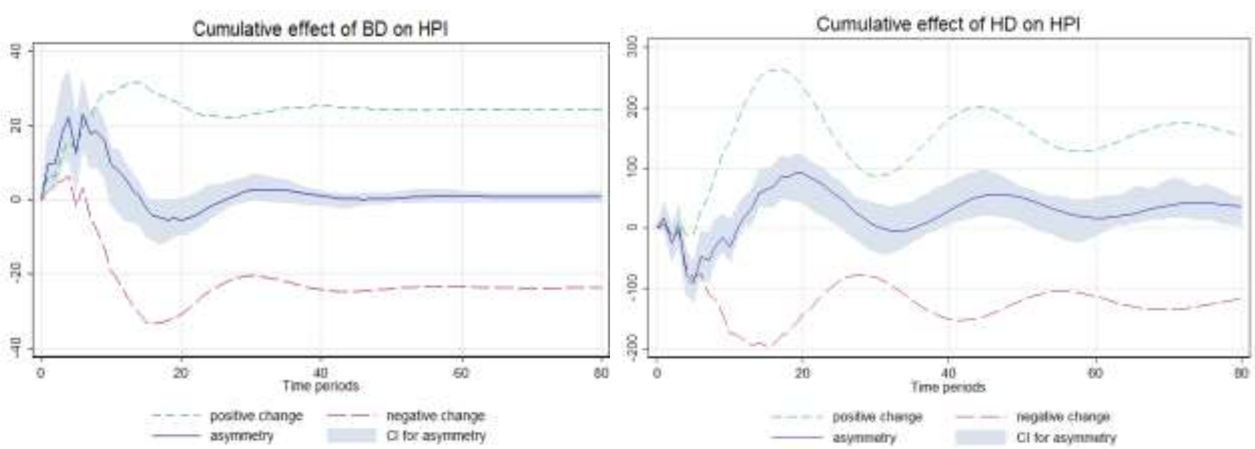
As for the Wald test for asymmetries in NARDL, it can be seen that the relationship between housing price and banking debt is symmetry in the long run as p-value is insignificant and hence, the null hypothesis of symmetry in the long run cannot be rejected. In the short run, the relationship between housing price and banking debt is asymmetric as the p-value is significant, and hence, the null hypothesis of symmetry in the short run can be rejected. Replacing the independent variable with housing debt reveals that the relationship between housing price and banking debt is asymmetric in both the long and short run, as the p-value is insignificant, and hence, the null hypothesis of symmetry in the short and long run can be rejected (Table 11). Therefore, the NARDL is more suitable in this study than the ARDL model.

Table 11: Wald test for long run and short run asymmetry

Independent: Banking debt	F-statistics	p-value	Selected specification
Long run	0.9319	0.339	Symmetry
Short run	7.12	0.010	Asymmetry
Independent: Housing debt	**F-statistic**	**p-value**	**Selected specification**
Long run	13.14	0.001	Asymmetry
Short run	12.75	0.001	Asymmetry

The graph below shows the cumulative effect of inflation on interest rate all lies within the confidence interval for asymmetrical relationship (i.e. shaded area).

Graph 2: Cumulative dynamic multipliers for banking debt and housing debt



The co-integration tests results above have several policy implications. In the short run, a positive or negative change to the banking debt will affect the housing price. As the housing price adjusts to these changes, the housing price will stabilize in the long run. An example of this is a monetary policy change which will affect the cost of fund for all types of banking debt. Nevertheless, this is different in the case of housing debt's effects on housing price. In the long run, the results show that a positive change in housing debt will increase the housing price greater, relative to a negative change in housing debt which will decrease the housing price less. Further, it is unlikely that a change in housing debt will stabilise the housing price. Thus, a policy change which focus primarily on housing debt will have a permanent effect on housing price. An example is the regulations on loan-to-value ratio of 70% for third home ownership which seeks to curb excessive investment and speculative activity in residential property market. Here, the paper finds that a curtail in housing debt will be more effective to reduce housing price, than the monetary policy change which affects all types of banking debt.

We proceed with the Long run Structural Modelling test, with the co-integration test we found in Johansen and NARDL test. Through the LRSM test of exact-identification by making the dependent variable equal to one, we found that the LLR is not significant as the t-statistic is lower than zero. We test this again using over-identification by making the LLR to be equal to zero. We found the result from this is 0.075 which is bigger than the critical value of 0.05. Hence, we accept the null hypothesis that the restriction is correct. This means that lending rate do not have a significant impact to the housing price i.e. the collateralisation value of the housing asset will do little to influence lending rate and hence, the housing price. Nevertheless, as we wish to find the causality of LHPI to LLR, we will proceed with using the LLR in the equation.

Table 12: Long run Structural Modelling (LRSM) results (Model 1 and Model 2)

Model 1		**t-stat**	**Result**
LHPI	1		
	NONE		
LBD	-6.8067	-6.091	Significant
	1.1175		
LLR	2.3836	1.69	Not significant
	1.4128		
LGDP	-3.8312	-2.09	Significant
	1.8296		
LCPI	26.7656	4.99	Significant
	5.3622		
Model 2		**t-stat**	**Result**
LHPI	1		
	NONE		
LBD	-6.5022	-5.89	Significant
	1.105		
LLR	0		
	NONE		
LGDP	-4.9492	-2.67	Significant
	1.8507		
LCPI	30.1601	5.41	Significant
	5.5708		

5.4 Causality tests

We will next proceed with the Vector Error Correction Model (VECM) to identify variables which are exogenous or endogenous. From Table 13, a p-value of less than 10% means the null hypothesis of exogenous variable is rejected, hence the variable is endogenous. We find that the dLHPI and dLBD is exogenous. The other variables are found to be endogeneous. Table 13 also indicates that the coefficients of dLLR, dLGDP and dLCPI are negative, means that the variables will return to its long run equilibrium value. The coefficient for dLHPI and dLBD is positive, indicating that it is on an increasing trend. Further, the coefficient will show the speed of adjustment to equilibrium once there is a shock. We can see that the dLHPI has the highest speed of adjustment. As VECM does not show the relative exogeneity or endogeneity on the variables being tested, we will proceed with the Variance Decomposition test.

Table 13: VECM Statistical Tests

ecm1(-1)	Coefficient	Standard Error	T-Ratio [Prob.]	C.V.	Result
dLHPI	0.2122	0.0799	2.6541[0.011]	0.1	Exogeneous (strong)
dLBD	0.004	0.0096	0.41797[0.678]	0.1	Exogeneous (strong)
dLLR	-0.0104	0.0045	-2.3058[0.026]	0.1	Endogeneous (weak)
dLGDP	-0.0109	0.0059	-1.8498[0.071]	0.1	Endogeneous (weak)
dLCPI	-0.0046	0.0022	-2.1180[0.040]	0.1	Endogeneous (weak)

In the Variance Decomposition (VDC), we can rank each variables according to how it is affected by its own past, or being affected by other variables. In Table 14, we will use the result of the generalized VDC given its strength over the orthogonalised approach. Housing price is the most exogeneous variable, followed by lending rate, GDP, CPI and banking debt. As this contradicts the finding in VECM, we will use the VDC results given its forecasting benefits of shocking all the variables. The causal chain from exogenous (left) to endogenous (right) is as per the following diagram:

Table 14: Generalised Variance Decomposition

HORIZON		LHPI	LBD	LLR	LGDP	LCPI	TOTAL	SELF-DEP	RANKING
	LHPI	73.03%	6.33%	4.84%	6.01%	9.78%	100.00%	73.03%	1
	LBD	33.05%	25.33%	4.50%	11.53%	25.59%	100.00%	25.33%	5
	LLR	2.25%	7.43%	71.90%	4.87%	13.56%	100.00%	71.90%	2
10	LGDP	23.57%	5.75%	14.23%	37.12%	19.32%	100.00%	37.12%	3
	LCPI	4.85%	16.18%	2.90%	49.07%	27.00%	100.00%	27.00%	4

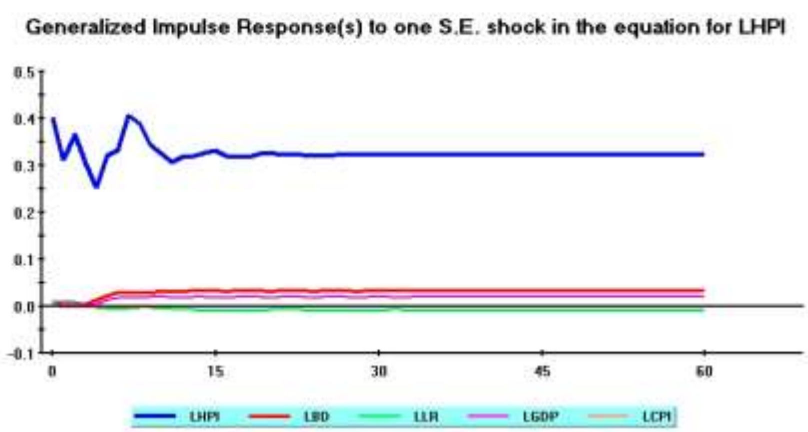
HORIZON		LHPI	LBD	LLR	LGDP	LCPI	TOTAL	SELF-DEP	RANKING
	LHPI	74.00%	6.34%	4.38%	6.00%	9.28%	100.00%	74.00%	1
	LBD	46.44%	11.96%	3.24%	6.84%	31.53%	100.00%	11.96%	5
	LLR	3.75%	9.65%	67.30%	2.72%	16.59%	100.00%	67.30%	2
20	LGDP	33.47%	4.43%	12.59%	26.96%	22.54%	100.00%	26.96%	4
	LCPI	2.87%	14.71%	1.91%	52.64%	27.87%	100.00%	27.87%	3

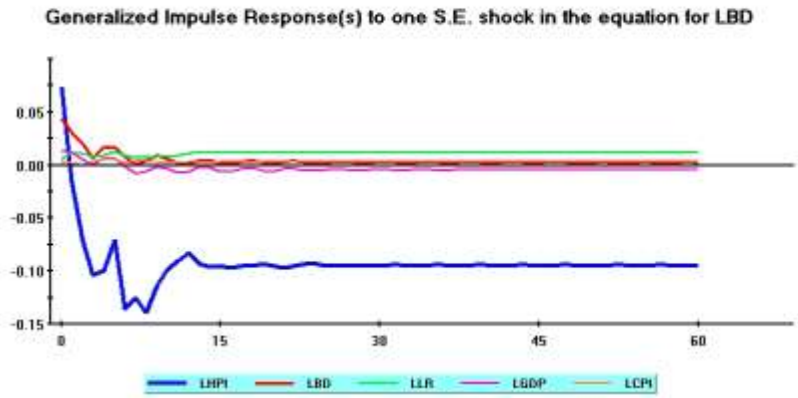
HORIZON		LHPI	LBD	LLR	LGDP	LCPI	TOTAL	SELF-DEP	RANKING
30	LHPI	74.40%	6.39%	4.13%	6.00%	9.09%	100.00%	74.40%	1
	LBD	50.22%	7.90%	2.93%	5.45%	33.49%	100.00%	7.90%	5
	LLR	3.66%	8.87%	55.67%	16.67%	15.14%	100.00%	55.67%	2
	LGDP	36.98%	3.64%	12.00%	23.49%	23.89%	100.00%	23.49%	4
	LCPI	1.81%	12.42%	13.38%	47.67%	24.72%	100.00%	24.72%	3

From the results of VDC, the result shows that it is the housing price that will ultimately impact the banking debt in the 10-30 time horizon. The result suggests that policymakers should focus on the supply and demand function of the housing price to improve the housing market. Further, this indicates that policies on banking debt will do little to affect the housing market, as the housing market will be determined by its own past values i.e. the housing demand and supply function.

We proceed with impulse response function, which is a graphical representation of VDC when an equation is shocked by one variable. When other variables are shocked, the housing price will become volatile until it approximately become stable in more than 15 quarters. On the other hand, for the shock in equation for the banking debt, we can see that the housing price will drop greatly. This indicates that in a financial crisis in which affects the banking debt, the housing price will plummet, as the housing market in Malaysia relies heavily on banking debt to finance house purchase and ownership.

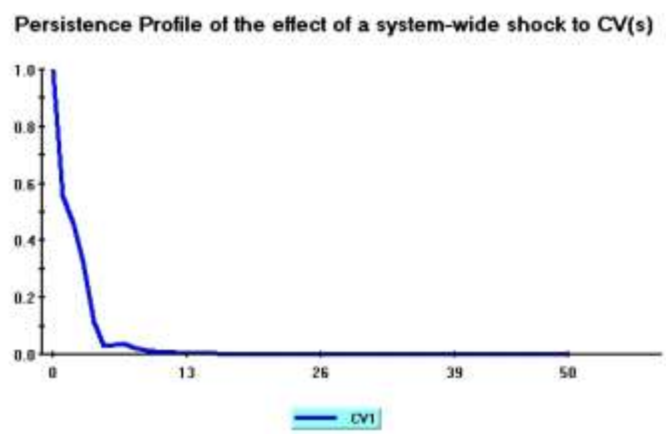
Figure 3: Impulse response functions





In the Persistence Profile of the variables of the effect of a system-wide shock, it indicates that the variables will be restored in equilibrium in about 13 quarters (about 3 years). This may happen when a financial crisis is systemic and lead to recession.

Figure 4: Persistence profile of the effect of a system-wide shock



6.0 Conclusion and Policy Implications

The empirical relationship between housing prices inflation and banking debt have received attention, due to the issue of affordability of home ownership and the provision of debt provided to the low and medium income groups in Malaysia. In this paper, we have contributed to this line of interest by analysing the empirical relationship using the NARDL method. We find asymmetry in the short run and symmetry in the long run for the relationship between housing prices and banking debt. We have also repeated the NARDL method for housing debt, and find asymmetry in both the short and long run, in line with the recent downward trend of housing price inflation from an all-time high level. Further, a positive change to housing debt will affect the housing price inflation more than a negative change. This shows that the NARDL method is more appropriate than the ARDL method, perhaps due to a recent downward trend in housing price inflation. We have also made use of causality tests of Vector Error Correction Method (VECM) and Variance Decomposition Method (VDC) to analyse the exogeneity of the variables. We find that the housing price inflation is the most exogenous and lead to a change in banking debt, in line with the findings from previous literature.

The findings in this paper have several policy implications. Primarily, the policy makers should focus on the supply-side policy and price control policy to have effect on the housing price inflation, particularly for the low and medium income groups. Care should also be taken on any unintended or intended policy implication, as a change in housing price inflation would influence the banking debt through a change in consumer price index and gross domestic product. Inversely, policy makers also have the macroprudential tool to focus on credit-related policies, where it should focus on the housing debt, rather than on banking debt as a whole. When there is a policy change to the housing debt, the policy makers should expect an asymmetric impact. An ease in lending limits and criteria will bring greater change in housing price inflation, while a restrictive lending policy will bring smaller change in housing price inflation.

The data limitations on breakdown of housing price inflation by value and supply of houses have not allowed further analysis. Hence, further research may be required on the impact of supply-side policy and price control policy to identify the most appropriate policy to encourage affordable housing.

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