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The relationship between Malaysia's residential property price index and residential property loan supply

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This paper examines the linkages between residential property prices and residential property loans in Malaysia from 1999 to 2015. Even though residential properties are a basic necessity, there are few studies that estimate the long-run and short-run relationships between loans and price levels in residential properties in Malaysia. The estimations are divided into two parts: the detection of long-run relationships and the estimation the long-run and short-run elasticities from an ARDL model. The results support the hypothesis that the loan supply has a positive impact on residential price levels; the robustness test and Granger causality test also support this conclusion. This suggests the importance of closely monitoring the housing loan activities of banks via monetary or macroprudential policy to control residential property prices.

Keywords: *Residential property prices; residential property loans; Malaysia*

JEL classification: O18; R30, G21

Introduction

The property market demonstrated its significance in various occasions. Properties not only provide shelter for people, they also play prominent roles in the modern financial markets and economy. First, houses have been used as collateral to obtain investment loans from banks. A prosperous housing market also has positive impacts on personal consumption. Subsequently, economic performance will be positively boosted. Second, houses are also a popular tool for increasing and storing personal wealth. Third, changes in property prices will also affect the prices of other assets, such as equity and bonds. For example, the positive sentiment that follows a rise in housing prices can increase the desire to invest in the equity market. However, higher property prices can also be detrimental. An excessive upswing in housing prices could reflect a bubble economy, which caused the economic crisis in 2008. Furthermore, unaffordable housing prices can also discourage new businesses and undermine the ability of citizens to purchase and own real estate.

The global economy has experienced turbulent times since the global financial crisis that began in the United States in 2008. Nonetheless, housing prices in many countries (including emerging countries in Asia) have continued to rise on a consistent basis. The main reason is that ample liquidity has been available in financial markets following a series of quantitative easing in developed countries. According to Cho and Rhee (2013), housing prices in Hong

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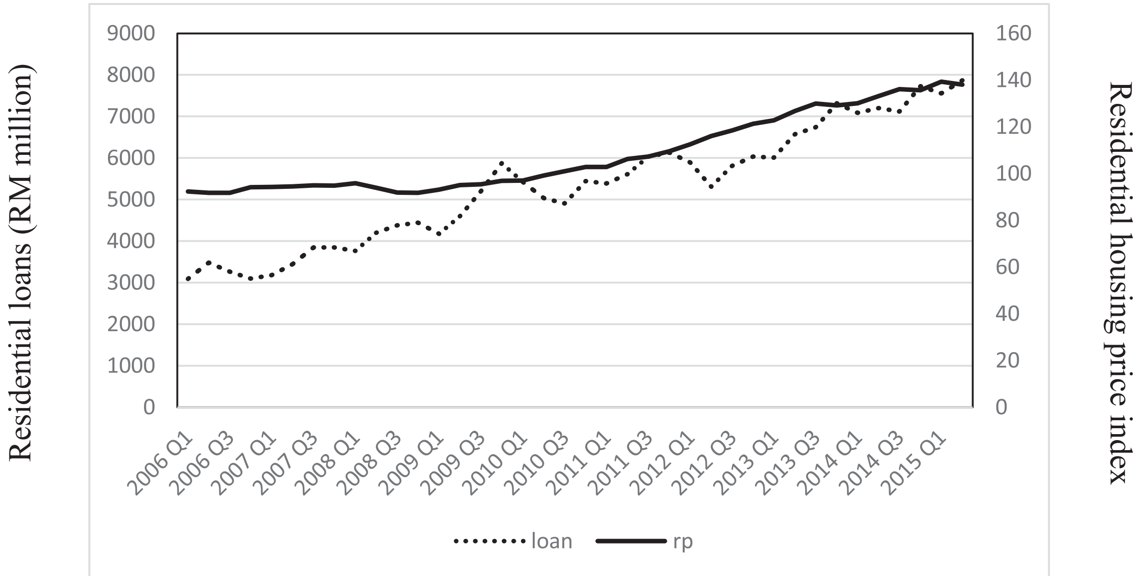

Data Source: Monthly Bulletin Statistics, BNM and the Bank for International Settlement

Figure 1. Residential property price index and housing loans in Malaysia

Kong and India increased by almost 100 percent between 2008 and 2012, while Singapore and China saw increases of nearly 20 percent and 50 percent respectively from 2008 to 2011.

A general increase in housing prices can also be observed in Malaysia. The data from Bank Negara Malaysia (BNM, 2012) shows that housing prices and financing for property purchases increased by 9.1 percent and 41 percent respectively from 2010 to 2012. Being one of the most crucial types of real estate, residential properties also experience the same trend. Figure 1 shows a consistent increase in housing prices in the residential market. Meanwhile, loans for residential house have been fluctuating in a more volatile pattern, but we can still observe an overall upward trend in the loan supply. The issues in the residential housing sector are more urgent because household debts, including housing loans, are higher in Malaysia compared to other countries in the region. To make the situation worse, the higher ratio between household debts and the gross domestic product (GDP) compared to regional peers has negatively affected foreign investors' overall confidence level in the Malaysian economy.

In order to control housing prices and property financing, BNM implemented a series of macroprudential policies that aimed to prevent the occurrence of a system-wide crisis due to asset price bubbles. For example, BNM launched a 70% loan-to-value policy for homebuyers that have already owned two properties (BNM, 2012). Following these steps and weaker economic performance, the housing sector's development has stagnated lately.

Although both facts and theories have already pointed out the importance of residential properties, there is still a lack of extensive coverage on residential properties, as we will discuss in more detail in the next section. The housing loan market impacts property prices by influencing the demand for and supply of residential houses through changes in the amount of financing available to buyers and builders. But the impact can also come from the opposite direction. For instance, changes in housing prices due to shocks such as output shocks can decrease the amount of housing loans available in the market. This is because the price fluctuations do not only deter banks from approving housing loans; it also reduces the ability of investors to seek financing from banks for the purpose of buying houses for wealth creation. This situation is even more severe if houses have been pledged as collateral for new loans.

This paper applies an autoregressive distributed lag (ARDL) model to illustrate the short-run and long-run relationships among the variables. One of the advantages of this method is that ARDL reduces the endogeneity issue by including lags in their explanatory variables.

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In addition, the ARDL model enables us to determine the existence of long-run relationships among variables without knowing the order of integration of the variables through Wald statistics. The identification of the order of integration is only made necessary when Wald statistics fail to confirm that the variables are connected in the long-run (Narayan, 2004). Although Ng (2006) and Ibrahim and Law (2014) have examined a similar issue by testing data from Malaysia, this paper is able to overcome the estimation issue of Ng. Moreover, we estimate the structural relationships between the loans for residential markets and residential property prices in Malaysia by incorporating the long-run information that has been ignored by Ibrahim and Law in much of their research. In addition, to the best of my knowledge, this is the first paper that examines the impact of residential house loans. Previous studies have focused on the aggregate of housing loans (see the literature review section for further discussion). The following discussions are arranged in the following sequence: literature review, data description, the methodology and model that is applied and tested in this paper, and then the discussion of the results. The last section is the conclusion.

Literature Review

This review of prior research begins with several papers that examine the issues related to international and domestic housing prices, especially its determinants in developed countries. Kim (2004), for example, summarised the positive linkages between house prices with credit growth in South Korea, citing that the market value and credit supply demonstrated positive correlation from 1996 to 2003. Furthermore, there are bi-directional relationships between loans and general price level. Next, O'Donovan and Rae (1997) analysed the housing price equation in New Zealand individually and together with the house supply equation and the consumption equation. Their findings show that the numbers of the population segment between 20 to 35 years old and the level of household consumption have the most significant impact on housing prices compared to the other variables examined. Furthermore, this regional comparison fails to connect housing prices with proximity between the different regions. In fact, housing prices are more closely linked to the demography and economics performance in each region.

Wadud, Bashar, and Ahmed (2012) used a structural vector autoregression model (VAR) to conclude that house prices in Australia are affected by inflation and interest rates. Panel data from nine Asia-Pacific countries were tested by Glindro et al. (2008) and the findings indicate that housing prices react to real output, real mortgage rate, land supply index, the ratio of mortgage credit to GDP, exchange rate, equity, and institutional factors, as well as in the short-run and long-run. Fitzpatrick and Mcquinn (2007) examined the relationship between domestic bank credit and house prices in Ireland by applying several tests, such as ordinary least squares (OLS) and dynamic OLS. Their data consisted of demand-side, supply-side, and demographic factors. They found that bank credit is only crucial in the long run.

Oikarinen (2009) also applied a VECM model on Finnish data. He found that the more housing loans were given, the higher the property prices in Finland. Additionally, housing prices also affect consumer loans and housing loans. Eliasson and Petursson (2009) examined the dynamics in housing prices following the liberalisation in the mortgage loan markets, when more sources of mortgage loan funding became available and refinancing without actual transaction was made permissible in 2004. Simulations of the impact of the new policy were done by assuming the size of changes in the long-term real mortgage rate and the credit supply due to the policy. The main finding in their paper is that housing prices react positively to the new, looser policy.

On the other hand, Brissimis and Vlassopoulos (2009) conducted a vector error correction model (VECM) study and found no cointegration between housing prices and housing loans in Greece. In addition, the statistical insignificance of housing loans in the VECM equation also suggests that housing loans as a variable is weakly exogenous. Nonetheless, the output from a differenced VAR model suggests that both variables affect each other in the short run. Gupta, Jurgilas, and Kabundi (2010) used the factor augmented autoregressive method to determine the effect of monetary policy on housing price growth in South Africa. The hypothesis of the housing price puzzle is rejected and the reaction of luxury houses to interest rate is larger compared to middle and affordable houses. This suggests that the high-income group is more sensitive to a change in interest rate. Using the same method as Gupta et al. (2010), De Bandt, Barhousmi, and Bruneau (2010) found evidence that the global housing price factor reacts to the changes in housing prices in the United States (US). Eventually, the housing price factor affects the domestic price in Australia, Spain and the UK. Moreover, there are also direct effects from US housing prices to foreign house prices.

Housing prices are also connected to other financial assets. Ibrahim (2010) explained that increases in stock market returns encourage the demand for housing through the wealth effect. This positive connection takes place when houses are considered to be consumption goods and secondarily there is need for portfolio rebalancing. An alternative theory called the credit channel indicates that housing prices drive equity prices because the former contributes to cheaper credit via the improvement of balance sheet conditions among homeowners. Ibrahim tested both effects on Thai data with VECM and VAR; he concluded that the wealth effect could be detected. There is another strand of discussion that solely focuses on the residential housing segment. Bandyopadhyay and Saha (2011), for instance, investigated how borrower and property characteristics impacted demand for residential houses in India; the borrowers' income and the size of the houses were found to play the most significant role. Nonetheless, very few of these studies focused on the effect of financing upon property prices.

Some studies have examined the non-linearity in the dataset. Nneji, Brooks, and Ward (2013) found evidence that the determinants of housing price growth in the US are different during boom, steady-state, and crash periods. In general, their findings suggest that most of the examined determinants have no impact on housing price growth when the housing market deviates from a steady-state. Zhang, Hua, and Zhao (2012) tested the housing data in China by considering the non-linear relationships among the variables by using a nonlinear autoregressive moving average with exogenous inputs. They put forth the conclusion that the determinants of housing price are not the same with the estimations under the assumption of linearity. The study by Zhang et al. included seventeen relatively large macroeconomic variables.

Many studies have attempted to define the determinants of housing prices in Malaysia, such as Aziz (2011), Ng (2006), and Tang and Tan (2015) using either bivariate or multivariate models. There have also been several papers that test the same issue using disaggregated data such as Ibrahim and Law (2014). These studies identify several significant variables in their estimations. For instance, Aziz (2011) and Tang and Tan (2005) found cointegration relationships between house prices and interest rate. Moreover, Dziauddin, Alvanides, and Powe (2015) and Nazir, Othman, and Nawawi (2015) examined the factors that drive housing prices in Malaysia with the Hedonic pricing model. Dziauddin et al. (2015) emphasised the impact of the public transportation system while Nazir et al. (2015) examined the role played by green facilities, in particular the Botanical Garden. Both papers show positive impacts from both factors. Liew and Nurul (2013) conducted a survey to determine respondents' opinions on factors that affect housing prices in Malaysia. The factors examined in their study can be categorised into market condition, economics factors, cost factors, regulations, demography changes, geographic, and the quality of the surrounding area. In general, all the shortlisted factors play crucial roles in price determination, especially the costs of construction. Finally, previous studies have also tried to determine the dynamics between housing prices and stock prices, covering national and state level data in Malaysia. Those papers found a positive relationship between house prices and equity returns (Lean,

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Table 1. Variables Indicators and Data Sources

Variables	Indicators	Data Sources
Residential property prices	Residential property price index (base year=2010)	Bank for International Settlements
Loans for residential property purchases	Loans disbursed for residential properties	Monthly Statistical Bulletin, Bank Negara Malaysia
Income level	Gross Domestic Product (current price)	Monthly Statistical Bulletin, Bank Negara Malaysia

2012; Lean & Smyth, 2014).

The previous reviews indicate that not much research has been done upon the residential property market in Malaysia. Although the paper by Teck-Hong (2010) emphasises this specific area, his focus is on the influences of base lending rate and housing price index on the transaction volume in the residential market by analysing state-level panel data. His findings prove that there is an inverse relationship between base lending rate and transaction volume. The current paper attempts to fill this gap of knowledge by examining the linkages between residential prices and residential loans. There have been limited studies about the impact of housing loans on housing price levels in Malaysia. Among the empirical studies this field are Ibrahim and Law (2014) and Ng (2006). Ng focuses on investigating the determinants of the house prices using the Engle-Granger estimation; he concludes that the long-run impact of loan supply on the properties prices is positive. Nonetheless, his study has two weaknesses. First, the conclusion of cointegration based on the unit roots test on the error terms in the Engle-Granger estimation are influenced by dependent and independent variables; the impact is more obvious when more than two variables are examined. Second, the Engle-Granger test involves two-step estimation. If the error terms are erroneous in the first stage estimation, it will lead to a wrong conclusion. On the other hand, the estimations of Ibrahim and Law (2014) focus on the differenced variables and the total housing loans. The level data is only used to estimate Granger Causality output. This indicates that the long-run information was eliminated from most of the estimations. Furthermore, instead of examining the impact of real total loans upon different segments of residential properties according to the method used by Ibrahim and Law, the relationships between bank loans and residential properties prices can be better examined by focusing on the residential loans only. The changes in the total loans could be due to the demand for other purposes, such as production expansions, private consumption and vehicle financing.

Research Methods

Data Descriptions

This paper includes two potential determinants of residential price levels, namely GDP and loans for residential properties. These variables have been frequently tested in similar studies. This paper also includes dummies that measure the impact of the US subprime mortgage crisis upon Malaysia's residential market.[1] Table 1 shows the indicator for each variable and the data sources. The tests used quarterly data from the first quarter of 2006 to the second quarter of 2015. All variables are seasonally adjusted using the Census X-13 technique and are transformed into natural logarithms.

The residential property prices in question cover all types of new and existing dwellings in Malaysia. The loan for residential properties, on the other hand, refers to the loans for residential properties from the Malaysian banking system. Gross domestic product (GDP) is a common indicator of a country's income level in many prior studies. In contrast to residential property prices (which are measured as a price index with 2010 as the base year), the loan

[1] Although interest rate has been tested frequently as well, this paper excludes this variable due to the data size limitation. Besides, Oikarinen (2009) argues that interest rate tends to be mean-reverting, so the variable should have a very limited influence upon housing prices.

Table 2. Descriptive Analysis of the Data

	RP	LOAN	GDP
Mean	95.25303	163266.9	164613.6
Median	87	140854.8	157542
Maximum	155	395538.2	289371
Minimum	65.8	36165.67	67576
Std. Dev.	25.59351	105032.3	68128.6
Skewness	1.002857	0.624278	0.238998
Kurtosis	2.82419	2.205964	1.723531
Jarque-Bera	11.14795	6.020814	5.109094
Probability	0.003795	0.049272	0.077727
Sum	6286.7	10775616	10864496
Sum Sq. Dev.	42576.8	7.17E+11	3.02E+11
Observations	66	66	66

Note: RP is the residential house price index, LOAN is residential loans and LGDP is the GDP.

and GDP are expressed in Malaysian Ringgit (millions). All estimations are conducted using EViews 9. Table 2 lists the most important statistical results from the examination of the data. The number of observations studied here is 66. Furthermore, the average value of loans, residential price index, and GDP are RM163,266.9 million, 95.25, and RM164,613.6 million, respectively.

Methodology and Model Specification

While many potential variables were proposed in previous research, this paper limits the examined variables into two potential determinants of housing prices, namely housing loan and output level. This is due to a relatively small sample size and to preserve the degree of freedom. The explanations below illustrate the steps used in EViews9 to make the ARDL estimations.

First, an ARDL (p,q,r) model, as illustrated by the following equation, is estimated:

$$LRP_t = \delta_0+\sum_{i=1}^{p}\omega_0 LRP_{t-i}+\sum_{i=0}^{q}\omega_1 LGDP_{t-i} +\sum_{i=0}^{r}\omega_2 LLOAN_{t-i}+\omega_3 CRISIS+\vartheta_t \quad (1)$$

where p, q, and r are the numbers of lag. The model is estimated using OLS estimation procedure and the number of lag in equation (2) is determined by Akaike information criterion (AIC); the model with the lowest AIC will be selected.

The following step is to conduct the bound test by constructing an unrestricted error correction model that can be illustrated by equation (2).

$$\Delta LRP_t = \alpha_0+\beta_1 LRP_{t-1}+\beta_2 LLOAN_{t-1} +\beta_3 LGDP_{t-1}+\sum_{i=1}^{p-1}\theta_{1i}\Delta LRP_{t-i} +\sum_{i=0}^{q-1}\theta_{2i}\Delta LGDP_{t-i} +\sum_{j=0}^{r-1}\theta_{3i}\Delta LLOAN_{t-i} +\theta_4 CRISIS+\varepsilon_t \quad (2)$$

where Δ denotes the first differential of variables, α_0 is the constant, *LRP* is the natural logarithm of the residential price index, *LGDP* is the natural logarithm of GDP, *LLOAN* is the natural logarithm of residential loans, and *CRISIS* are dummies representing the subprime mortgage crisis. According to Frankel and Saravelos (2012), the impact from the subprime mortgage crisis was the most severe from the third quarter of 2008 to the first quarter of 2009. The number of lag included into the lagged differenced explanatory variables in the equation (2) is one lag lesser than the number of lag included in the long-run ARDL model.

In order to test the existence of a long-run relationship, the F-statistic or Wald test is applied to test the null hypothesis of $\beta_1=\beta_2=\beta_3=0$ against the alternative hypothesis of $\beta_1\neq\beta_2\neq\beta_3\neq 0$. The failure to reject the null hypothesis means there are no long-run relationships among the variables in the model. However, the F-statistics do not have standard distribution, therefore this

Table 3: F-statistic Output

F-statistic	4.4015
Critical Value	
1%	I(0)= 4.068 I(1)=5.250
5%	I(0)= 2.962 I(1)=3.910
10%	I(0)= 2.496 I(1)=3.346

Note: Restricted intercept and no trend (k=3, n=60), available from Narayan (2005)

study applies the critical values of F-statistic generated by Narayan (2005) that are appropriate when the number of observations in a study range from 30 to 80. There are two bounds of critical values: the upper bound where all variables are I(1) and the lower bound where all variables are I(0). There is evidence that the variables have long-run relationships if the F-statistic value is higher than the critical values. The opposite conclusion is arrived if the F-statistic value is below the critical value. Nonetheless, the outputs are inconclusive when the F-statistic value falls between the bounds. As mentioned in the introduction, we can skip the unit root tests if there are long-run relationships among the variables.

There are two important outputs from the ARDL equation: long-run and short-run elasticities. The long-run equation has the following general form.

$$LRP_t = \phi_0 + \phi_1 LGDP_t + \phi_2 LLOAN_t + \phi_3 CRISIS_t + \upsilon_t \quad (3)$$

We apply the following formulae to measure the long-run elasticity of GDP (ϕ_1), residential properties loan (ϕ_2), and crisis (ϕ_3), respectively.

$$\phi_1 = \left(\frac{\sum_{i=0}^{q} \omega_1}{1 - \sum_{i=1}^{p} \omega_0} \right)$$

$$\phi_2 = \left(\frac{\sum_{i=0}^{r} \omega_2}{1 - \sum_{i=1}^{p} \omega_0} \right)$$

$$\phi_3 = \left(\frac{\omega_3}{1 - \sum_{p=1}^{p} \omega_0} \right)$$

On the other hand, the short-run equations can be illustrated below:

$$\Delta LRP_t = \delta_0 + \sum_{i=1}^{p} \delta_1 \Delta LRP_{t-i} + \sum_{j=0}^{p} \delta_2 LGDP_{t-j} + \sum_{k=0}^{p} \delta_3 LLOAN_{t-k} + \delta_4 CRISIS + \delta_5 \upsilon_{t-1} \quad (4)$$

where υ_{t-1} is the error correction terms (ECT) and is derived from equation (2). The coefficient of ECT represents the speed-of-adjustment or how many percent of the disequilibrium in the house price returns to its long-run value in next period. The Hendry general-to-specific method is applied to determine the appropriate lag length. The error terms should be statistically significant and have a negative sign; this is important because it means any deviation from the long-run equilibrium in the short term will be eliminated. The following diagnostic tests are conducted to ensure the fitness of the model: Jarque-Bera normality test, Breusch-Godfrey serial correlation LM test, Breusch-Pagan-Godfrey serial heteroskedasticity test, and Ramsey-Reset test. In addition, the stability of the error correction model is also tested by observing the roots of the equation.

Results and Discussions

ARDL Estimation

The discussion of results begins with the F-statistics from the unrestricted error correction model. Table 3 illustrates this statistical value and the relevant critical values at 1%, 5% and 10% significance levels. The result indicates that the null hypothesis is rejected at the 5% significance level. Hence, there is a cointegration relationship among the variables. Afterwards, an ARDL (p, q, r) model is constructed and the optimal lag length is decided using the AIC. As discussed above, the model with the smallest value of AIC compared to other com-

Table 4. ARDL (4,0,4) model

Variable	Coefficient	Std. Error
LRP(-1)	0.925***	0.132
LRP(-2)	0.290*	0.157
LRP(-3)	-0.038	0.168
LRP(-4)	-0.213*	0.125
LGDP	-0.028	0.017
LLOAN	0.138	0.087
LLOAN(-1)	-0.277	0.187
LLOAN(-2)	0.285**	0.126
LLOAN(-3)	-0.272***	0.094
LLOAN(-4)	0.161***	0.041
CRISIS	-0.015***	0.005
C	0.095	0.094

Note: Heteroskedasticity and Autocorrelation consistent standard errors are reported. ***, **, * represent the statistical significance of 1%, 5%, and 10%, respectively.

Table 5. Long-run elasticities from ARDL (4,0,4)

Variable	Coefficient	Standard Error
LGDP	-0.807	0.515
LLOAN	0.999***	0.385
CRISIS	-0.421*	0.220
C	2.703	2.316

Note: ***, * represent the statistical significance of 1%, and 10%, respectively.

binations of lags will be selected. Based on this selection criterion, this paper examines ARDL (4,0,4) where four lags are included for LRP and LLOAN.

Table 4 contains the estimation outputs of the ARDL (4,0,4) model while the long-run elasticities of the independent variables are generated and presented in Table 5. The results in Table 5 show that only the residential property loans and the global financial crisis have statistically significant impacts upon residential pricing at the 1% and 10% significance level, respectively. In particular, a 1-percent rise in residential property loans raises residential price by 0.99%, which is almost a proportional increase. On the other hand, the global financial variable negatively affects the residential price by decreasing it by 0.42%. In particular, an increase in the loan supply could raise the ability to own a property through bank borrowing, which subsequently pushes up the residential price level if the house supply is inelastic. This is also in accordance to the demand-pull inflation contributed by credit supply. The occurrence of economic crises is expected to arouse negative sentiment among property buyers and investors. This inevitably reduces their appetite for the properties, including residential dwellings, which is in accordance with the risk aversion hypothesis.

The next discussion focuses on the error-correction model from the ARDL (4,0,4) model where short-run elasticities can be obtained; the results are displayed in Table 6. The results in the table show that in residential prices are only affected by residential loans in the short run. The absence of short-term impacts from the subprime mortgage crisis implies that the negative effects of the crisis emanated from weaker economic conditions and bank performances in the long-run. The ECT also has a negative statistically significant sign. However, the speed-of-adjustment is rather slow where only 3.9% of the disequilibrium in the residential housing prices is corrected in the next month. This is not surprising if we consider the fact that housing prices have been relatively sticky compared to other assets. The error correction model also passes the diagnostic tests of normality, autocorrelation and heteroscedasticity. The model also fails to reject the null hypothesis of Ramsey RESET test at the 5% significant level. Finally, the dynamic stability of the model is confirmed when all the inverse roots are inside the

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Table 6. Error correction model from ARDL (4,0,4)

Variable	Coefficient	Std. Error
ECT(-1)	-0.039***	0.010
D(LRP(-1))	-0.07	0.121
D(LRP(-2))	0.145	0.113
D(LRP(-3))	0.271**	0.117
D(LGDP)	-0.03	0.052
D(LLOAN)	0.136	0.095
D(LLOAN(-1))	-0.177*	0.091
D(LLOAN(-2))	0.097	0.072
D(LLOAN(-3))	-0.164***	0.044
CRISIS	-0.005	0.006
C	0.001	0.007
Jarque-Bera normality test	0.0789 (0.9613)	
Breusch-Godfrey (AR2)	3.7602 (0.1526)	
Breusch-Godfrey (AR4)	4.4011 (0.3544)	
Breusch-Pagan-Godfrey	12.1444 (0.2755)	
Ramsey RESET	3.4885 (0.0618)	
Inverse roots of the associated characteristic equation		
0.801667, -0.379974 ± 0.567706i, 0.683132		

Note: ***, **, * represent the statistical significance of 1%, 5%, and 10%, respectively. The values in the parentheses are the p-values of respective tests.

Table 7. Long-run elasticities from ARDL (4,1,4)

Variable	Coefficient	Standard Error
LGDP	-1.131	0.799
LLOAN	1.217***	0.607
CRISIS	-0.310	0.212
C	3.908	2.896

Note: *** represents the statistical significance of 10%.

unit circle.

This paper tests the robustness of the results by using the adjusted R-squared criterion to determine the lag length of the ARDL (p1, p2, p3) where the highest adjusted R-squared will be selected (Ebbeler, 1975). It is possible that the different lag length will affect the long-run and short-run elasticity of the variable. The adjusted R-squared criterion proposes that ARDL (4,4,1) is suitable. According to Table 7, the sign of the estimated coefficients is the same as the first estimation. However, only the property loans have a statistically significant coefficient while the crisis is no longer statistically significant. This confirms the findings that residential property prices are linked to residential property loans.

Next, the error correction model from ARDL (4,1,4) is estimated and presented in Table 8. The error correction term is found to be negative and statistically significant while the speed-of-adjustment is similar to that of ARDL (4,0,4). Furthermore, the dynamic linkages among the variables are also detected in this error correction model. In short, the results from ARDL (4,0,4) are largely supported by ARDL (4,1,4) and the ECT is also similar to the initial estimation (3.6%). The null hypothesis of the RESET test where the model is fit is again not rejected at the 5% significance level. Normality and the non-existence of autocorrelation and heteroscedasticity are confirmed by the Jarque-Bera normality test, Breusch-Godfrey, and Breusch-Pagan-Godfrey, respectively. The model also fails to reject the null hypothesis of Ramsey RESET test at the 5% significance level. Finally, the inverse roots show that the model is stable.

Additional Estimation: Granger Causality

This paper also reports Granger causality outputs to verify the relationship between the residential house prices and the loans. The test is carried out by modelling both variables in a VAR. The dummy of the 2008 subprime mortgage crisis is also included. A total of five lags

Table 8. Error correction model from ARDL (4,1,4)

Variable		Coefficient	Std. Error
ECT (-1)		-0.036***	0.009
D(LRP(-1))		-0.072	0.120
D(LRP(-2))		0.179	0.110
D(LRP(-3))		0.271**	0.116
D(LGDP)		-0.013	0.050
D(LLOAN)		0.162*	0.096
D(LLOAN(-1))		-0.165*	0.091
D(LLOAN(-2))		0.101	0.072
D(LLOAN(-3))		-0.168***	0.044
CRISIS		-0.005	0.006
C		0.002	0.007
Jarque-Bera normality test	0.0005 (0.9998)		
Breusch-Godfrey AR(2)	3.2028 (0.2016)		
Breusch-Godfrey AR(4)	3.5432 (0.4727)		
Breusch-Pagan-Godfrey	11.1333 (0.3472)		
Ramsey RESET	3.3632 (0.067)		
Inverse roots of the associated characteristic equation			
0.801667, -0.379974 ± 0.567706i, 0.683132			

Note: ***, **, * represent the statistical significance of 1%, 5%, and 10%, respectively. The values in the parentheses are the p-values of respective tests.

Table 9. Granger Causality

Null Hypothesis: LLOAN does not granger cause LRP	
Chi-squared	21.514 (0.001)
Null Hypothesis: LRP does not granger cause LLOAN	
Chi-squared	1.419 (0.922)

Note: Degree of freedom of the chi-squared statistics is five.

are included and the LM autocorrelation test indicates that the AR(2) and AR(4) autocorrelations do not exist. According to the Table 9, there is a unidirectional effect from the residential properties loan to the house price. This is also in line with the conclusion in the long-run estimations.

Conclusions

The objective of this paper is to estimate the impact of residential property loans on the residential price index in an ARDL model. In addition to those variables, income level and the occurrence of the subprime mortgage crisis are included as control variables. This study is significant due to the importance of residential housing prices to the economy and the lack of attention given to this segment. Four conclusions can be drawn from the results of our analysis. First, there is a positive long-run linkage between residential property loans and residential property prices, supporting a direct linkage between the two variables. Second, the subprime mortgage crisis causes a reduction in residential property prices in the long run. Third, dynamic short-run linkages are found with the detection of negative and statistically significant error correction terms. Except for the second conclusion, the other two conclusions are supported by the robustness test. Finally, the Granger causality test from a bivariate VAR also indicates the same findings as the long-run equation. The results suggest that policymakers should emphasise policies that will slow down the loan supply for the purchase of residential houses if they intend to limit excessive appreciation in residential property prices. This includes higher interest rates on residential mortgage loans, tight macroprudential and microprudential policies such as higher loan-to-value ratio, increasing the quality of bank capital, and tighter screening to filter out unqualified borrowers. Although these measures might reduce the ability of genuine homebuyers to afford private properties, these policies will reduce the household debt-to-GDP ratio and ensure the stability of the overall banking sector.

Alternative steps such as launching regulations that protect the right of tenants will temporarily alleviate the inflationary pressure on the prices of residential houses.

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