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New Zealand's Residential Price Dynamics: Do capability to consume and government policies matter?

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Abstract

The objectives of this paper are to provide empirical evidences on whether i) government policies represented by mortgage rate and loan-to-value ratio are associated with the dynamics of the New Zealand Residential Price Index, ii) macroeconomic factors such as house price to income ratio and inflation rate that proxy capability to consume, as well as population growth rate are the driving forces of housing market dynamics of the country. After testing a battery of statistical assumptions, this study adopts the Autoregressive Distributed Lag (ARDL) cointegration method to examine data from Quarter 1, 2009 to Quarter 2, 2019 for the short and long-run relationships among the variables. Findings show that mortgage rate, loan-to-value ratio, and inflation rate have negative long-run relationship with Residential Price Index. On the other hand, population growth rate and house price to income ratio are shown to have positive long-run impact on housing price. Results obtained from Error Correction Model reveal that whenever there is a short-run shock in the residential price dynamics, the Residential Price Index will take about three quarters to fully restore back to its long-run equilibrium. Additionally, mortgage rate, population growth rate, loan-to-value ratio and house price to income ratio are found to significantly Granger-cause New Zealand's residential price dynamics during the study period.

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1. Introduction

The credit crunch as a result of the US housing crisis in 2008 has a prolonged negative effect on the financial health of the world. An important lesson learned from this financial crisis is stability of asset prices and resilient of financial institutions played key roles in promoting a sustainable economic environment. On the micro level, housing price dynamics have crucial effects on the affordability, purchasing and investment decisions. Studies found that in addition to important macroeconomic indicators, various forms of monetary and macroprudential policies employed by government could intervene and thus stipulate significant impact on the dynamics of the housing market (Armstrong *et al*. 2019, Aldridge 2018, Bruneau *et al*. 2018, Tang *et al.* 2018, and Viziniuc 2017).

Residential housing prices in New Zealand experienced tremendous growth after the Global Financial Crisis. The strong housing boom has led to overvaluation of housing properties with a house-price-to-income multiple of 6.5 for the nation and 9.3 for Auckland as at September 2018 (Demographia 2019). Immigration policy, interest rate policy and loan-to-value ratio are some of the popular measures employed to moderate the dynamics of residential housing prices.

Understanding the reasons behind the rapid increases in housing prices and whether policies implemented are effective are essential in determining New Zealand's housing strategy for the 21st century. According to the literature, capability to consume affects affordability and subsequently influences demand and asset prices. People's biases in asset allocation and macro environment could also put pressure on the demand side and further enhance the existing inequilibrium. Large mortgages and high leverages in the housing sector can put a country's financial and macroeconomic stability at risk as illustrated in the previous 2008 housing crisis. In response to the financial risk associated with rapid rising housing prices and to prevent potential housing crisis, the Reserve Bank of New Zealand (RBNZ) has employed monetary policy by raising Official Cash Rate (OCR) by twenty-five basis points for three consecutive times in 2014 and implemented three rounds of restrictions using loan-to-value ratio (LVR) microprudential policy to help alleviate pressures on the interest rate policy between 2013 and 2016.

Generally, there is limited amount of empirical evidence available on the extend of capability to consume proxies and government policies' impacts have on residential housing prices in New Zealand. Besides, not many has studied the New Zealand residential housing market after the Global Financial Crisis. Against this backdrop, this study intents to: (i) assess whether government policies represented by mortgage rate and loan-to-value ratio are associated with the dynamics of the New Zealand Residential Price Index; and (ii) seek answers on whether macroeconomic factors such as house price to income ratio and inflation rate that proxy capability to consume as well as population growth rate are the driving forces of housing prices of the country. To achieve these objectives, this study then follows other economic and finance literature which uses the Autoregressive Distributed Lag (ARDL) cointegration method to examine the short-run and long-run relations among variables after fulfilling all the statistical requirements. The rest of the article is structured as follow: The next section describes related literature; followed by outlines on the data and empirical model, empirical findings and finally a brief conclusion on the topic under study.

2. Related Literature

New Zealand's housing market experiences significant changes whereby housing prices have outpaced inflation since the late 1980s. According to Stuart *et al*. (2004), this phenomenon was driven by increased borrowing capacity and positive migration which has resulted in a higher demand than supply capability. In addition, the much slower growth in national income relative to the housing prices has also led to a decline in home ownership. Speculations and irrational housing investment activities have added more pressure on the affordability of New Zealand housing (Smith and Searle 2010, and Chong 2018). Nonetheless, there is a paucity of empirical research to determine how the various factors have impacted the housing market.

Eaqub (2016) states that housing prices in New Zealand are steep in relative to household income. Furthermore, record low interest rates have created an upward spiral in borrowing and investing activities, whilst increase in migration which lead to population growth also adds pressure on demand and escalates housing prices to an unaffordable level. Based on descriptive statistics, Eaqub (2016) concludes that policies introduced to combat housing crisis including providing state housing for the vulnerable have been ineffective as housing are becoming more unaffordable and therefore, a change in thinking is needed.

Numerous studies contend that long-term housing price are determined by affordability and the population size (Mayer 2011). House price to income ratio (PIR) is commonly used as a barometer to rate housing affordability and any market with PIR of 5.1 and above is categorised as severely unaffordable (Demographia 2019). House price to income ratio is defined as the median house price divided by gross annual median household income. When house prices are high relative to household income, affordability for housing decline and vice versa (Krakstad and Oust 2014). New Zealand has a house price to income ratio of 6.5 as at the third quarter of 2018 and a house price to income ratio of 9.3 in the city of Auckland. According to a survey done by the IPSOS, 42 percent of New Zealanders consider housing and the price of housing as the top issues facing the country while 61 percent of the respondents believe they cannot afford to purchase a house in the country. To mitigate housing unaffordability crisis, the New Zealand government has stepped up emergency aids to provide accommodation to low-income households in motels (Hercock and Duddling 2019). Population growth due to migration and increase in birth rates intensifies the demand of housing. Immigration is the key to New Zealand's population growth since 2012 whilst the current birth rate is 1.8 (Stats NZ 2019). A rapid population growth would increase the demand of housing and push housing price to greater heights. A recent study by Fukac *et al*. (2018) contends that the asset price boom in housing was motivated by migration inflows and market sentiment which breach the efficient market hypothesis. This assertion was in line with those of McDonald (2013) and Coleman and Landon-Lane (2007) which posit that an additional of 1 percent in population can be associated to 8 percent increase in housing price. Using data between 2001 to 2011, Nistor and Reianu (2017) study the determinants of housing prices of Ontario, Canada. They found that interest rate, immigration and income were some of the main factors driving housing prices. Ding (2019) reports high population growth rates in urban China contributes to approximately 10 percent of the upward trend in real housing prices. A similar study in Australia finds short – run influence of population growth on housing affordability for the study period of 1985 to 2010 (Worthington and Higgs 2013). Generally, the relationships between variables identified and housing prices vary across countries, time period of study and methodology used.

Inflation rate is another factor associated with housing market dynamics. Anari and Kolari (2002) use autoregressive distributed lag (ARDL) models to analyse US data from 1968 to 2000 when investigating the relationship between non-housing goods and services prices and housing prices. Results indicate that these two variables are cointegrated and therefore real estate is an effective and robust inflation hedge in the long term. Similar studies that support inflation hedging ability of real estate as housing prices predicting inflation include Hong *et al.* (2013), Qiu (2011) and Goodhart and Hofmann (2008). Conversely, Arestis and González (2014) and Bjørnland and Jacobsen (2010), document a negative association between inflation and housing prices. Brunnermeier and Julliard (2006) posit that if people suffers from money illusion, a decline in inflation can cause housing prices to escalate. Money illusion happens when people tend to view wealth and income in nominal instead of real terms. Nonetheless, there is also a strand of literature that finds no relationship between housing prices and inflation (Christou *et al*. 2018, and Gilchrist and Leahy 2002). Consumer Price Index (CPI) is an indicator of inflation rate that measures the changing purchasing power of the goods and services consumed by households. Housing price is not included in the CPI calculation. Basically, the higher the CPI, the less purchasing power a society possesses. Hence, a higher CPI impairs saving which in turn exerts a negative impact on the capability to consume and decreases the demand for housing, ceteris paribus. When the price of money i.e. interest rate rises due to inflation, home buyer may reconsider about borrowing money to invest or purchase houses. With fewer buyers in the housing market, housing prices will decrease. Furthermore, it is more difficult for people to purchase housing in a weak economy as income growth stagnates whilst more money will have to be allocated to cope with escalating prices of goods and services (Guerra 2019). However, this relationship might be different in a strong economy.

Several researchers have documented the importance of controlling the boom and bust of the housing cycle using macroprudential policy such as the loan-to-value (LVR) policy alongside the traditional monetary policy such as manipulating the OCR. LVR expresses the ratio of a loan value to the value of an asset that a financial institution would finance. This macroprudential restriction plays a crucial role in limiting the speed of credit growth which subsequently impact asset prices such as residential houses. In examining whether corporation between monetary and LVR macroprudential policies can better stabilize Romanian's economy, Viziniuc (2017) discovers that LVR measure is effective in stabilising economy with a smaller cost. A later study by Bruneau *et al.* (2018) on the impact of microprudential policies on Canada's housing dynamics suggests that a countercyclical LVR ratio is a useful policy to reduce instability when applied to address housing market boom-bust cycles. High household debt relative to income coupled with the fact that high proportion (40-60 percent) of New Zealand's banking asset are made up of housing loans have prompted RBNZ to use LVR restrictions on top of the interest rate policy to mitigate potential vulnerabilities that emerge from housing crisis. Despite the benefits of LVR in moderating the risk of a housing crisis and the vulnerability of bank balance sheets, it was unsure as to what extend could LVR mitigate this systematic risk in New Zealand (Fukac 2018). A recent study by Armstrong *et al.* (2019) investigates LVR ratio restrictions and house prices in New Zealand using samples from January 2013 to May 2017 obtained from CoreLogic. Based on the difference-in-differences method, they showed that by tightening and loosening LVR, policy makers were able to exert effects on the house price growth in the short-run.

3. Data and Empirical Model

This study uses quarterly data from Quarter 1, 2009 until Quarter 2, 2019. The performance of residential property price denoted as Residential Price Index (RPI) is represented by quarterly RPI for the whole New Zealand and is obtained from CoreLogic, New Zealand. About 90 percent of the mortgage borrowers opt for the fixed interest rate regime therefore, mortgage rate (MR) is proxied using fixed rate together with loan-to-value ratio (LVR), inflation rate (INF) and housing price to income ratio (PIR) are obtained from the Reserve Bank of New Zealand. Population growth rate (PGR) is obtained from Statistics New Zealand. RPI is transformed into common logarithmic form with the resultant series is denoted as LRPI. On the other hand, MR, LVR, INF, PGR which are measured in percentage and PIR in ratio are deployed as they are.

Based on the literature review discussed earlier, MR, INF and LVR are expected to have a negative relationship with LRPI while PGR and PIR are predicted to be positively associated to LRPI. To explore the empirical relationships of these variables, this study deploys the Autoregressive Distributed Lag (ARDL) bound testing approach (Pesaran *et al.* 2001). This approach allows for simultaneous examination of long-run and short-run relationships among the variables. The ARDL model for this study can be conventionally expressed as:

$$\Delta LRPI_t = \alpha + \sum_{i=1}^{k1} \gamma_{1i} \Delta LRPI_{t-i} - \sum_{i=0}^{k2} \gamma_{2i} \Delta MR_{t-i} + \sum_{i=0}^{k3} \gamma_{3i} \Delta PGR_{t-i} - \sum_{i=0}^{k4} \gamma_{4i} \Delta LVR_{t-i} - \sum_{i=0}^{k5} \gamma_{5i} \Delta INF_{t-i} + \sum_{i=0}^{k6} \gamma_{6i} \Delta PIR_{t-i} + \beta_1 LRPI_{t-1} - \beta_2 MR_{t-1} + \beta_3 PGR_{t-1} - \beta_4 LVR_{t-1} - \beta_5 INF_{t-1} + \beta_6 PIR_{t-1} + \varepsilon_t, \quad (1)$$

where *LRPI* = Logarithm of Residential Price Index;

MR = Mortgage rate;

PGR = Population growth rate

LVR = Loan-value ratio;

INF = Inflation rate;

PIR = House price to income ratio;

t = time period in quarter; and

ε = stochastic error term

α, β and γ = parameters to be estimated; and

ki = optimal lag length, for *i* = 1,2,3,4,5.

Long-run cointegration relationship exists among the variables if all $\beta's$ are statistically significant. In this respect, the Wald test is employed. If the *F*-statistics of the Wald test obtained is greater than the critical values provided by Pesaran *et al.* (2001), then it can be concluded that these variables are cointegrated. Under the presence of cointegration, the following error correction model (ECM) could be estimated to examine the short-run and long-run dynamics:

$$\Delta LRPI_t = \alpha + \sum_{i=1}^{k1} \gamma_{1i} \Delta LRPI_{t-i} - \sum_{i=0}^{k2} \gamma_{2i} \Delta MR_{t-i} + \sum_{i=0}^{k3} \gamma_{3i} \Delta PGR_{t-i} - \sum_{i=0}^{k4} \gamma_{4i} \Delta LVR_{t-i} - \sum_{i=0}^{k5} \gamma_{5i} \Delta INF_{t-i} + \sum_{i=0}^{k6} \gamma_{6i} \Delta PIR_{t-i} + \rho EC_{t-1} + \varepsilon_t, \quad (2)$$

where EC = error correction term;and

ρ = speed of adjustment to be estimated.

However, the ARDL approach is only valid when the variables in the model are integration order of zero or one or a mixture of both. Hence, the order of integration needs to be predetermined and this calls for a unit root test. If the variable is stationary at level, it is integrated at order zero, *I* (0). On the other hand, the variable is integrated of order 1, *I* (1) if it achieved stationary only after first differencing.

In this study, the Augmented Dickey-Fuller (ADF) unit root test (Dickey and Fuller, 1979) is used to test the integration order of the series. In the ADF test, possible deterministic components and lag lengths are taken into consideration. Constant and linear trend will be included in the test equation for estimation only if the coefficient of the trend component is shown to be significant at 10 percent level. Otherwise, the ADF test will be conducted with constant (intercept) specification only. The test is first conducted in level. If the variable is found to be stationary at level, then the variable is identified as an *I* (0) variable. Otherwise, the ADF test is applied to the first difference of the variable, or even the second difference if necessary. As for the optimal lag length of the ADF test, it is determined by the Akaike Information Criterion (AIC) (Akaike 1979). Liew (2004) conducts a simulation study and reports that AIC is superior over a few other information criteria for sample size of 60 and less in identifying the true autoregressive lag length.

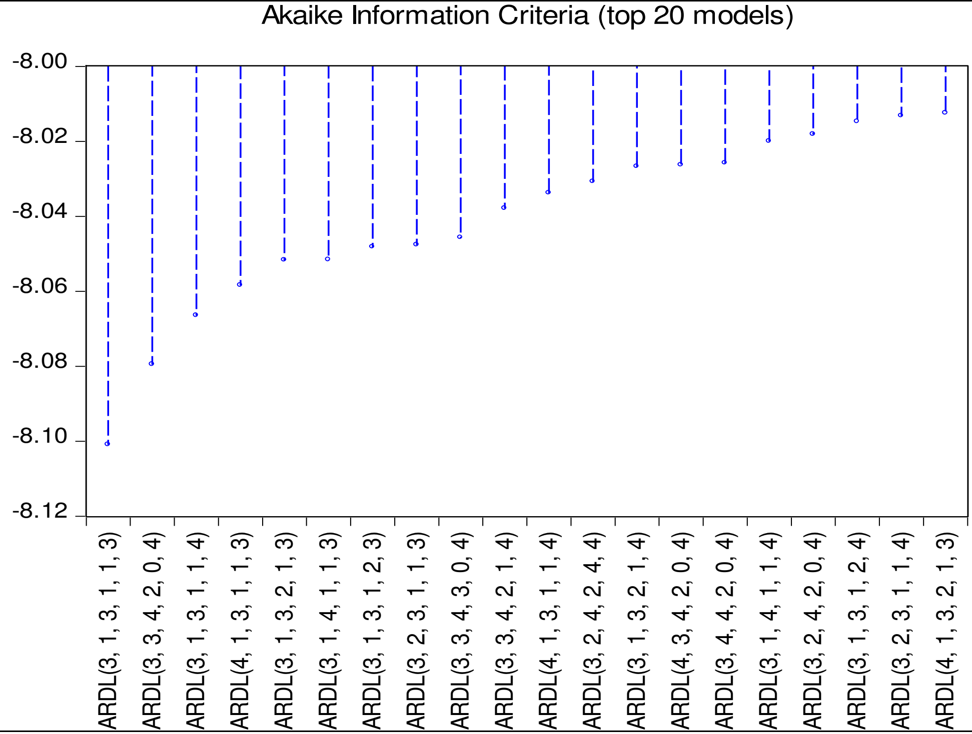
4. Empirical Findings

Table 1: Augmented Dickey-Fuller Test Results

Variable	Level		First Difference	
	Constant	Constant + Trend	None	Constant
LRPI	-	-1.841[0]	-	-5.020[0]**
MR	-	-3.941[3]*	-	-
LVR	-1.267[0]	-	-6.245[0]**	-
INF	-2.608[8]	-	-4.871[7]**	-
PIR	-	-3.890[0]*	-	-
PGR		-3.736[5]*	-	-
Critical Values				
1%	-3.61	-4.21	-4.26	-3.61
5%	-2.94	-3.53	-3.55	-2.94
10%	-2.61	-3.19	-3.21	-2.61

Notes: *LRPI, MR, LVR, INF, PIR* and *PGR* refer to, in that order, Residential Price Index (log form), mortgage rate, loan-value ratio, inflation rate, house price to income ratio and population growth rate. Optimal lag length selected by Akaike Information Criterion (AIC) are reported in square brackets. Meanwhile, * and ** denote rejection of the null hypothesis of non-stationary series at 5% and 10% significantly respectively.

The ADF unit root test results are summarized in Table 1. From the results shown in Table 1, it is evident that the null hypothesis of non-stationary series cannot be rejected for Residential Price Index (LRPI), loan-to-value ratio (LVR), and inflation rate (INF). However, these variables are stationary in their first difference, therefore, they are *I* (1) variables. On the other hand, mortgage rate (MR), house price to income ratio (PIR) and population growth rate (PGR) are determined as *I* (0) variables as they attained stationary at level. With that, we can conclude that the variables in the model are a mixture of *I* (0) or *I* (1) and there is no variable of higher integration order. Hence, it is legitimate to employ the ARDL bound testing approach. In deciding the optimal lag length for the ARDL model, the Akaike Information Criteria (AIC) is used, and the outcome for the top 20 models is summarized in Figure 1. From Figure 1 we can see that the optimal lag lengths for LRPI, MR, LVR, INF, PIR and PGR are in this order, 3, 1, 3, 1, 1 and 3. This ARDL (3,1,3,1,1,3) model has minimum AIC value.



Notes: The order of the variables in the ARDL models are: *LRPI, MR, LVR, INF, PIR* and *PGR*. A total of 4×5×5×5×5×5=12,500 models have been evaluated and the top 20 models with the corresponding AIC values are reported here.

Figure 1: AIC values for the Top 20 ARDL Models

The estimated results for the ARDL Bounds Test are presented in Table 2. Referring to Table 2, this estimated model has passed through a battery of residuals diagnostic tests except that the residuals are heteroscedastic at 5 percent significant level. However, as the model is estimated with heteroscedasticity and autocorrelation corrected (HAC) standard errors, the *t*-statistics are valid for interpretation. Besides, this model is stable based on the results of stability diagnostics results reported in Figure 2. The bound test *F*-statistics is 15.976, which is greater than the 1 percent upper bound critical value of 4.15. Hence, the null hypothesis of no long-run cointegration among the variables can be rejected. This implies LRPI has long-run relationship with MR, LVR, INF, PIR and PGR. The estimated long-run relationship, which is of interest, can be represented as:

$$LRPI_t = 2.808 - 0.331MR_t - 0.028LVR_t - 0.004INF_t + 0.110PIR_t + 0.206PGR_t \qquad (3)$$

As expected, Equation (3) shows that MR, LVR and INF have negative long-run relationship with LRPI, whereas PGR has positive long-run impacts on LRPI (see Bruneau *et al.* 2018, Viziniuc 2017, Arestis and González 2014, Bjørnland and Jacobsen 2010, and Brunnermeier and Julliard 2006). Referring to the findings in Table 2, these long-run relationships are all significant at 1 percent significance level while LVR is significant at 10 percent level. Moreover, Equation (3) reveals that a 1 percent change in mortgage rate can be associated with a 0.331 percent change in Residential Price Index in the opposite direction. Likewise, a 1 percent change in loan-to-value ratio and inflation rate are negatively associated with a 0.028 percent and 0.004 percent change in the dependent variable respectively. On the other hand, a

1 percent change in population growth rate can be associated to an increase of 0.206 percent in the Residential Price Index. This supports Ding (2019), Worthington and Higgs (2013), McDonald (2013) and Coleman and Landon-Lane (2007)'s finding of a positive relationship between population growth and housing price.

Table 2: Estimated ARDL Long-Run Model and Bounds Test Results

Dependent Variable: DLRPI

Conditional Error Correction Regression

Variable	Coefficient	*t*-Statistic	Probability
C	0.996	6.985	0.000
LRPI(-1)	-0.355	-6.378	0.000
MR(-1)	-0.117	-4.577	0.000
LVR(-1)	-0.010	-1.837	0.081
INF(-1)	-0.001	-1.775	0.091
PIR(-1)	0.039	4.446	0.000
PGR(-1)	0.073	4.989	0.000
D(LRPI(-1))	-0.068	-0.723	0.478
D(LRPI(-2))	-0.321	-3.342	0.003
D(MR)	0.031	0.514	0.613
D(LVR)	0.001	0.152	0.881
D(LVR(-1))	0.012	1.729	0.099
D(LVR(-2))	0.045	6.637	0.000
D(INF)	-0.005	-4.400	0.000
D(PIR)	0.023	3.704	0.001
D(PGR)	0.012	1.402	0.176
D(PGR(-1))	-0.054	-5.760	0.000
D(PGR(-2))	-0.048	-6.601	0.000

Notes: Notes: $D(y)$ denotes the first-differenced form of y. $D(y(-i))$ is the ith lag of $D(y)$.

Levels Equation

Case 2: Restricted Constant and No Trend

Variable	Coefficient	*t*-Statistic	Probability
MR	-0.331	-3.961	0.001
LVR	-0.028	-1.925	0.069
INF	-0.004	-2.844	0.010
PIR	0.110	10.736	0.000
PGR	0.206	3.976	0.001
C	2.808	32.786	0.000

ARDL Bounds Test:

F=15.976 1% critical values (*k*=5): I(0)=3.06, I(1)=4.15

Diagnostic Test	Statistics	Probability
Breusch-Godfrey Serial Correlation LM Test[4]	*F*=1.982	0.145
Heteroskedasticity Test: Breusch-Pagan-Godfrey	*F*=2.243	0.043
Ramsey RESET Test	*F*=0.102	0.753
Jarque-Bera (JB) Normality Test	*JB*=0.098	0.952

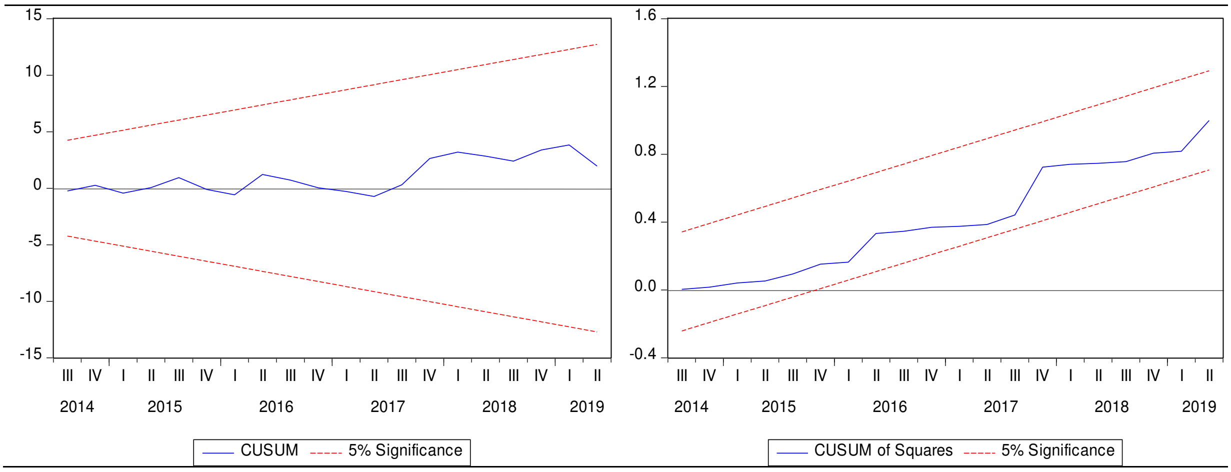


Figure 2: Stability Diagnostics Results

Table 2 also shows that house price to income ratio (PIR) is positive and significantly related to the Residential Price Index. The co-trending behaviour of these two-housing-price related variables is shown in Figure 3. When house price to income ratio increases, housing affordability declines and this is obvious when the increment in housing price happens faster than the growth of household income and wealth (see Figure 4 where per capita GDP growth represents household wealth). The finding of New Zealand's housing affordability that has deteriorated over the study period is in line with Eaqub (2016) and Stuart *et.al.* (2004)'s assertions that the growth in national income of New Zealand is much slower than that of the housing price and this phenomenon has a negative impact on affordability.

Figure 3: Co-trending between log of Residential Price Index and house price to income ratio

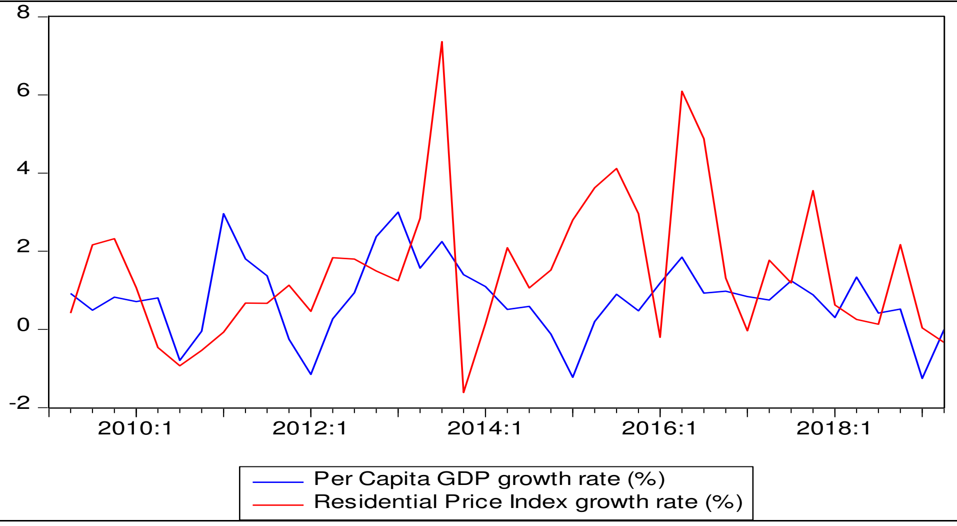


Figure 4: Percentage growth rates of Residential Price Index and per capita GDP growth rate

Further assessment using correlation analysis is performed to identify factors affecting the growth of house price to income ratio (affordability). The results in Table 3 show that house price to income ratio has significant and positive relationship with population growth rate, a weak negative relation with inflation rate and a negative but insignificant relationship with per capita GDP growth rate (PCIGR). These findings provide support that increasing demand due to population growth plays a more influential role in supporting the upward trend of house price to income ratio. Conversely, inflation has little effect whilst per capital GDP growth rate has no effect on the movement of house price to income ratio. Therefore, despite a growing house price to income ratio which implies lower housing affordability to the public in New Zealand during the study period, housing price continues to increase when there is demand for houses due to growing population.

Table 3: Correlation analysis of house price to income ratio with macroeconomic variables

Variable	***LRPI***	***INF***	***PGR***	***PCIGR***
Kendall's tau-*b*	0.823	-0.210	0.472	-0.082
Probability	0.000	0.056	0.000	0.451

Note: *LRPI, INF, PGR* and *PCIGR* refer to Residential Price Index (log form), inflation rate, population growth rate and per capita GDP growth rate.

The estimated results for the ARDL Error Correction Model are exhibited in Table 4. The estimated coefficient of the error correction term, which represents the speed of adjustment, is – 0.355 (probability < 0.01). This shows that it has the correct negative sign and is significant at 1 percent level. This result reinforces the existence of long-run relationship as identified by the estimated long-run ARDL model. Besides, its magnitude implies that whenever there is a short-run shock in the residential price dynamics, Residential Price Index will bear the blunt to reinstate long-run equilibrium determined by its long-run determinants. This adjustment occurs at a speed of 35.5 percent, implying that it takes about 3 quarters to fully restore to the equilibrium.

Table 4: ARDL Error Correction Regression

Dependent Variable: *D(LRPI)*

ECM Regression

Case 2: Restricted Constant and No Trend

Variable	**Coefficient**	***t*-Statistic**	**Probability**
D(LRPI(-1))	-0.068	-0.936	0.361
D(LRPI(-2))	-0.321	-4.257	0.000
D(MR)	0.031	0.706	0.488
D(LVR)	0.001	0.196	0.847
D(LVR(-1))	0.012	2.643	0.016
D(LVR(-2))	0.045	9.428	0.000
D(INF)	-0.005	-5.683	0.000
D(PIR)	0.023	5.733	0.000
D(PGR)	0.012	1.802	0.087
D(PGR(-1))	-0.054	-7.670	0.000
D(PGR(-2))	-0.048	-8.179	0.000
*EC(-1)**	-0.355	-12.057	0.000
R-squared	0.894	Mean dependent var	0.006
Adjusted R-squared	0.849	S.D. dependent var	0.008
S.E. of regression	0.003	Akaike info criterion	-8.432
Sum squared residual	0.000	Schwarz criterion	-7.915
Log likelihood	172.215	Hannan-Quinn criteria	-8.248
Durbin-Watson stat	1.914		

Notes: Notes: $D(y)$ denotes the first-differenced form of y. $D(y(-i))$ is the ith lag of $D(y)$.
$EC = LRPI_t - 2.808 + 0.331MR_t + 0.028LVR_t + 0.004INF_t - 0.110PIR_t - 0.206PGR_t$

Table 5 reports the Granger short-run causality test performed within the Error Correction Model. It is noticed from Table 5 that all variables are significantly Granger-cause Residential Price Index in the short-run, except for inflation. The results also reveal the significance of the lagged dependent variable. This suggests Residential Price Index is endogenously affected by the momentum of its own lagged values in the short-term, apart from other exogenous variables.

Table 5: Short-run Causality Test Results

Dependent Variable: *D(LRPI)*

Variable	***F-Statistic of Wald Test***	**Probability**
D(LRPI)	12.957	0.000
D(MR)	9.453	0.000
D(LVR)	10.992	0.000
D(INF)	0.247	0.624
D(PIR)	179.08	0.000
D(PGR)	48.979	0.000

Notes: $D(y)$ denotes the first-differenced form of y.

In sum, this study finds that mortgage rate, loan-value-ratio, house price to income ratio and population growth rate have significant short-run causality effect and long-run cointegration effect with Residential Property Index. As for inflation rate, it only displays a significant long-run effect on Residential Property Index.

5. Conclusion

The aim of this study is to investigate the short-run and long-run impact of interest rate policy, loan-to-value restrictions (macroprudential policy), population growth rate, house price to income ratio have on the Residential Pricing Index of New Zealand. Using quarterly data from Quarter 1, 2009 to Quarter 2, 2019, we analyse the relationships of these variables using Autoregressive Distributed Lag (ARDL) bound testing approach. Empirical findings show significant short and long- term impact of proxies for capability i.e. inflation rate and house price to income ratio on Residential Pricing Index. Furthermore, population growth rate, loan-to-value restrictions and interest rate policy are found to have significant impact on the Residential Pricing Index of New Zealand. These empirical findings have not only provided further support to the existing literature on the impact of capability to consume on residential property prices but also further endorse on the effectiveness of monetary and microprudential policies in stabilising the boom and bust of housing cycle in New Zealand during the study period.

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