QUANTITATIVE EASING AND THE AUSTRALIAN HOUSING MARKET

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ABSTRACT

Contrary to the market economists' predictions, the Australian national median house prices performed exceptionally well during most of the COVID-19 lock down periods with a hefty annual increase of 16.1% to $656,694.00 since June 2020. The traditional housing market drivers such as population growth and GDP growth were experiencing either negative or lacklustre growth for the same period, signifying the Australian housing market may have experienced unprecedented shift in its performance dynamic. The rebound in house prices was said to have been supported by the unconventional Reserve Bank of Australia monetary policy, namely Quantitative Easing (QE), in response to the COVID-19 pandemic crisis. The increased levels of liquidity and the lower mortgage rate due to the QE measures may have impacted the housing markets and this unprecedented and fundamental shift in the housing market dynamics require immediate attention to better understand the implications and its effects on market participants.

Keywords: Housing economics, Australian housing market drivers, monetary policy, quantitative easing.

1.0 Introduction and Motivation for Study

In Australia, housing remains central in stakeholder considerations, for individuals and state and federal governments alike. For the former, homeownership remains pivotal in the Australian dream and most households aspire to own at least one home. The benefits of homeownership for individuals are manifold, including security of shelter, wealth effects, prestige, to name a few. For the latter, housing and its affordability are so crucial that they have been deciding factors in federal elections, amid multiple federally commissioned housing affordability enquiries (ABC, 2021). House prices is the most significant indicator of housing trends. For all stakeholders, it provides a quick, reliable insight into housing performance, market sentiment and likely future trends. For these reasons, house price growth trends have garnered significant interest.

Since the GFC ended in 2008, Australian house prices trended upwards until late 2017. Figure 1 demonstrates the quarterly residential property price index analysis from March 2008 to June 2021, based on (ABS, 2021b)'s data for eight Australian capital cities (weighted average), Melbourne and Sydney.

Towards the end of 2017, the residential property prices for Australian cities experienced the first major downturn since Global Financial Crisis 2008. The weighted average of eight capital cities residential property prices declined from a peak of 147.60 in December quarter 2017 to the low of 134.80 in June 2019, representing a drop of 8.67% from peak to trough. The decline in housing credit in the form of tightening loan criteria targeted mainly at the investors had exerted negative pressure on the Australian housing market subsequent to the infamous Royal Banking Commission enquiry in 2018 (Wong et al., 2020).

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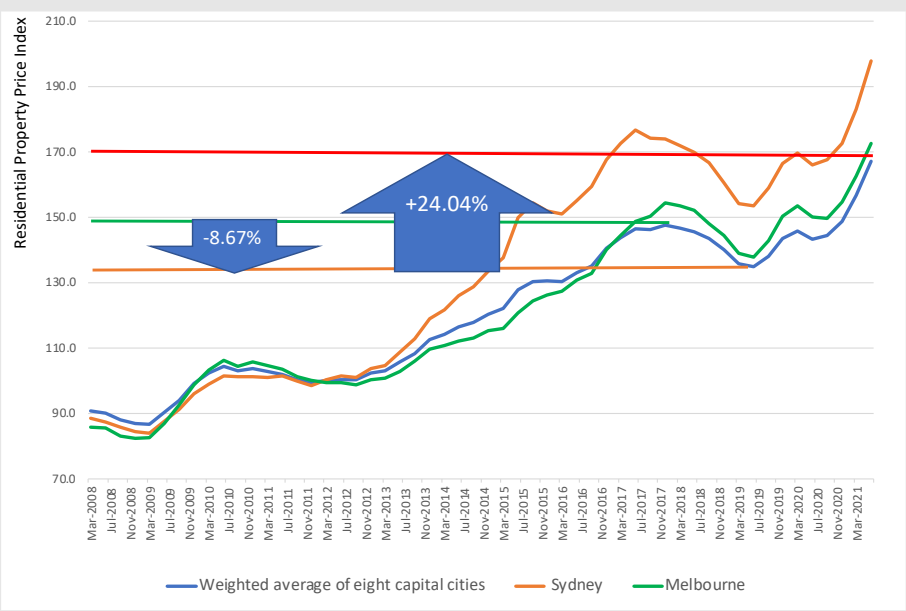
Figure 1: Australia Residential Price Index 2008 to 2021



Source: Author 2021

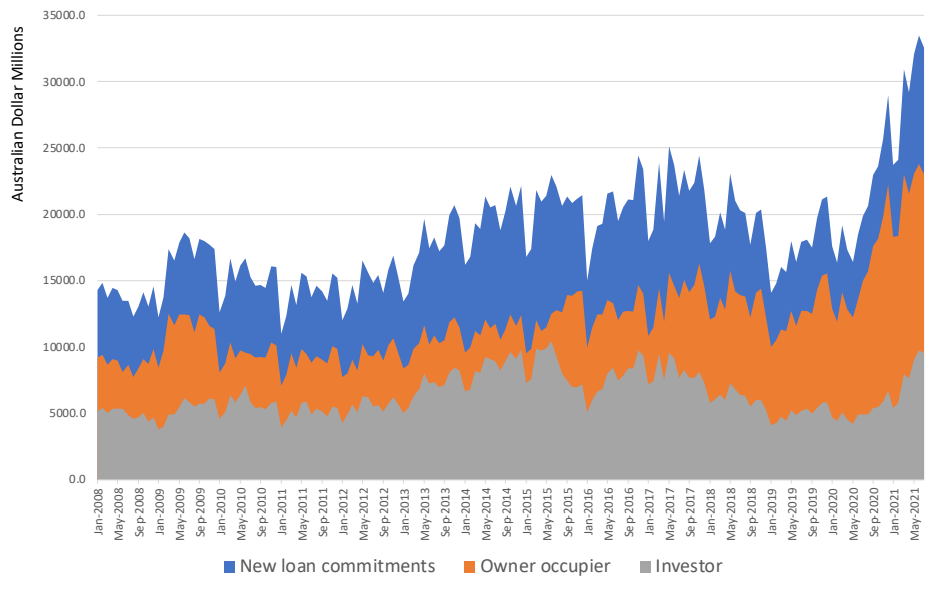
This short and sharp downturn that lasted for approximately 7 quarters ended in the September quarter of 2019. The weighted average index of the eight cities' house prices jumped 24.04% from 134.80 in September quarter 2019 to 167.20 in June quarter 2021. Whilst the Melbourne's residential price index demonstrated similar trend as the eight capital cities weighted average index, Sydney's house price index jumped 28.93% over the same period of time. According to Lawless (2021) the median house price for the combined capital (i.e. the 8 capital cities) stood at AUD751,014.00 in August 2021, representing an annual increase of 20.9% since September 2020. During this period the median house price in Sydney jumped 23.8% breaching the AUD1mil mark, and stood at AUD1,039,514.00. Melbourne median house prices, although facing the Covid-19 lock down challenges for a prolonged period of time, increased 16% to $769,968.00.

Housing finance trended similarly over the same timeframe. Figure 2 depicts the visual comparative analysis on Australia Bureau of Statistics housing finance growth path (ABS, 2021a) since 2008.

Since GFC 2008, the Australian housing finance for new loan commitment experienced its first significant decline towards the end of 2017. From a peak of AUD 21.83 billion per month in December 2017, the monthly new loan commitments declined, averaging AUD 18.42 billion per month for approximately 20 months period subsequently. In August 2020, the new loan commitments returned to above AUD 20 billion. The total new loan commitments in Australia continued its ascending trend and reached AUD32.58 billion in July 2021, far exceeding the previous peak in December 2017 of AUD21.83 billion, representing a hefty 49.19% increment. This upward trend of house prices in Australia since the 2018 downturn, as shown in Figure 1 above, defied expert expectation. As noted in Wong et al., 2020, house prices were expected to continue trending downwards, despite traditional macroeconomic indicators such as unemployment and interest rates remaining low, usually signifying an upward trend. Their paper therefore explored the determinants of the housing market beyond the traditional market drivers and found that the 2018 downturn is attributable to depreciating capital liquidity, excess

housing supply and diminishing foreign investors. In the wake of this downturn, house prices began trending upwards again, and the COVID-19 pandemic occurred – a black swan event of comparable or worse economic impact to the GFC.

Figure 2: Australia Housing Finance 2008 to 2021



Source: ABS (2021a)

The anticipated impact of COVID-19 on the housing market was that as jobs are lost and savings fall, demand for housing would tumble, with many experts predicting an up to 10% reduction in house prices (Heath, 2020). For an economy that is among the most housing exposed in the world, with banks that are among the world's most mortgage exposed (IMF, 2017, Heath, 2020), this posed significant worry for all stakeholders. Coupled with the fact that the residential construction sector has forward linkages to job creation in the construction sector (Community Housing Industry Association, 2020), addressing this negative anticipated impact was of significant relevance towards the economic recovery of Australia.

Consequently, the Australian government launched the $680 million Homebuilders Grant program in June 2020 in response to the COVID-19 pandemic. The goal of the policy was to "support confidence in the residential construction sector" and "encourage … purchases or renovations (of homes delayed due to) COVID_19" (Treasury of Australia, 2021). Similarly, The Australian federal Government instituted the mortgage deferrals policy aimed at granting relief to numerous homeowners facing financial hardships due to Covid-19. Under the mortgage deferral policy, homeowners facing financial hardships could defer scheduled loan repayments, switch to interest-only repayments, add overdue repayments to balance of loan and extend the mortgage term to reduce the repayment amounts (Homeloan Experts, 2020). This was aimed at avoiding decreased house prices due to oversupply which would have emerged if foreclosures had occurred as a result of mortgage defaults. These were among a suite of policies implemented by state and federal governments to avoid a house price slump. Additionally, the RBA in November 2020 announced a $100 billion quantitative easing program over the next 6 months. In February 2021, after the completion of the initial purchases in mid-April, the RBA further announced the purchase of an additional $100 billion of bonds. These QE measures aimed to provide the much-needed finance liquidity in the market weathering the negative economic impacts resulting from the pandemic.

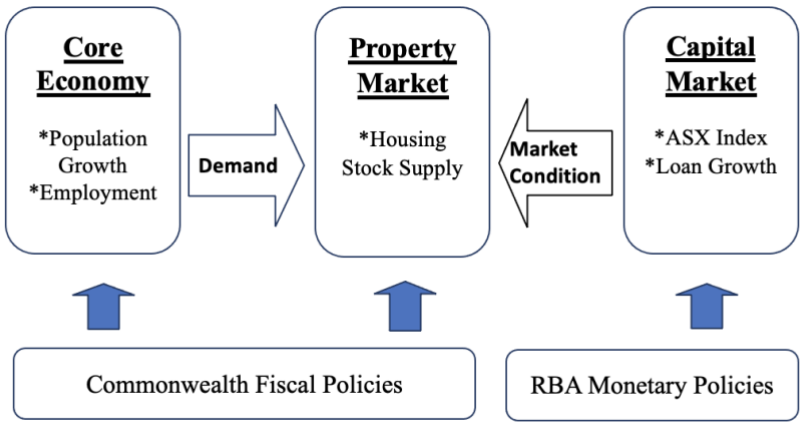
As a result of these interventions, housing loans, among other things, became more affordable and accessible, increasing effective demand. Consistent with economic principles, house prices soared and continued to outstrip affordability. We, in this paper, attempt to study the determinants of property price changes in Australia from the period March 2004 through June 2021. This will shed light on the determinants that actually influence house prices in Australia, and whether the sustained rise in house prices were indeed occasioned by the government's monetary and fiscal policy efforts.

The closest to this study is Wong et al. (2020). Our new paper, essentially, extends that study by empirically examining the house price dynamics since 2004 till 2021, accounting for the onset of COVID-19 and the resultant quantitative easing and other government interventions.

2.0 Research Model

Theoretically, Archer and Ling (1997) argued that the entire real estate market is sub-divided into three-markets including space market, property market and capital market. Adapting the three-markets framework Figure 3 depicted the research model established in this investigation to provide guidance on the research work and at the same time, a representation of the Australian housing market determinants:

Figure 3: Property Market Model



Source: Adapted from Archer and Ling, 1997

Increased or decreased demand for houses leading to house price changes due to economic performance affecting the incomes of individuals and households constitutes the core economic activities of nations. The increasing demand for dwellings by both individuals and households, with supply constant, puts pressure on house prices, leading to an overall increase in prices. Similarly, economic performance signifies the ability of individuals and households to afford homes, hence builders supply housing in anticipation of speculative demand. As supply either increases or decreases, with demand constant, house prices change in response. The capital market serves as a catalyst to propel the market in a specific direction, particularly relating to financial sector regulatory policies. For example, the availability of mortgage loans and rate of interest can either spur activity in the housing market or douse demand, resulting in either an upward or downward price movement in the housing market. Underpinning the entire housing market performance is the initiation of Government policies influence the country's market

condition and change the economic activity impacting both demand and supply. The Reserve Bank of Australia (RBA) on the other hand, drives the monetary policies impacting the capital market to shape market activities, with an overall outcome of house prices variations. Thus, government fiscal and monetary policies are being regarded as the heartbeat of the entire hosing market. As a result, any change in government policy has significant implications on the entire housing market.

3.0 Data

This study evaluates the performance of the residential property market in Australia. The data captures performance at the national level across all states and territories; as well as the Sydney and Melbourne markets between 2003 and 2021 at quarterly intervals.

All macroeconomic and demographic indicators such as residential property price indices, population, housing finance, value of residential work commenced and the unemployment rate are freely available from the Australian Bureau of Statistics (ABS) while interest rates such as the lending rate and 10-year bond rates were obtained from the Reserve Bank of Australia (RBA). Lastly equity market performance as measured by the ASX200 index was acquired from the Australian Stock Exchange (ASX).

A range of explanatory variables were examined including measures relating the residential property prices, macroeconomic performance, the costs of obtaining finance as well as demography. These variables are summarised in **Error! Unknown switch argument.**.

Table 1: Variables and their descriptions.

Variable	Code	Description
Residential Property Price Index	RPI	Comprised of the House Price Index and the Attached Dwellings Price Index, the Residential Property Price index measures the total value of Australia's dwelling stock based on a weighted average of the nation's 8 largest capital cities. It is also available at the state level.
Population	POP	Australia's estimated resident population (ERP) includes all people who usually live in Australia (regardless of nationality, citizenship or visa status), with the exception of people present for foreign military, consular or diplomatic reasons. The latest ERP is based on adjusted 2016 Census counts, updated with quarterly estimates of births, deaths, overseas and interstate migration.
Housing Finance	FINANCE	The variable measures borrower-accepted commitments made for the purposes of owner occupied housing. Data is sourced from all Authorised Deposit-taking Institutions (ADIs) and Registered Financial Corporations (RFCs) that have significant lending activity in Australia for the purposes of housing, personal or business lending. The collection is administered by the Australian Prudential

		Regulation Authority (APRA) on behalf of the ABS and the RBA.
Value of work commenced on residential properties	RESI	This variable provides estimates on the value of residential work commenced by the private sector using chain volume measures. Data is compiled from the quarterly Building Activity Survey. The Building Activity Survey is a national survey of builders, other organisations and individuals engaged in building activity.
Lending rate	LEND	Lending rates are those quoted for loans to owner-occupiers and are a weighted average of the rates across all reporting lenders. The weights correspond to the value of credit outstanding or funded in the month for a given type of finance. Data is sourced from the Economic and Financial Statistics (EFS) collection undertaken by the Australian Prudential Regulation Authority (APRA), the Australian Bureau of Statistics (ABS) and the Reserve Bank of Australia (RBA).
Unemployment rate	UNEMP	The unemployment rate is derived from data collected via the monthly Labour Force Survey. It is computed as the number of unemployed individuals as a percentage of the labour force. The labour force is the sum of employed and unemployed individuals. The monthly Labour Force Survey (LFS) provides information about the labour market activity of Australia's resident civilian population aged 15 years and over. The conceptual framework used in Australia's LFS aligns closely with the standards and guidelines set out in Resolutions of International Conferences of Labour Statisticians.
Stock market index	ASX200	The index for the ASX200 indicating overall performance for the 200 largest companies listed on the Australian Stock Exchange by way of market capitalisation. The index was logged prior to modelling.
10-year Bond rate	BOND	Yields on 10 year Australian Commonwealth Government Securities. This variable was used as a proxy for the risk free rate and is available from the RBA.

Table 2: Variables and their descriptions. Unless otherwise stated, variables were measured at quarterly intervals between 2003 and 2021. With the exception of the ASX200 index, bond rates and lending rates, all variables were obtained from the Australian Bureau of Statistics (ABS). The remaining variables are widely available from official sources such as APRA, RBA and ASX.

Source: Authors, 2021

The following table contains summary statistics for annualised growth rates of selected variables:

Variable	Mean	Median	Maximum	Minimum	Std. Dev.
RPI: ALL	4.67%	4.98%	18.13%	-7.42%	5.65%
RPI: SYD	5.93%	6.23%	25.21%	-9.39%	7.46%
RPI: MEL	4.48%	3.68%	19.88%	-10.30%	7.49%
Population	1.55%	1.57%	2.19%	0.14%	0.34%
Housing Finance	6.54%	6.29%	55.36%	-27.80%	16.57%
Residential work	2.00%	2.74%	41.05%	-27.22%	12.84%
Lending rate	6.46%	6.44%	9.46%	4.52%	1.26%
Unemployment rate	5.36%	5.42%	7.35%	4.06%	0.61%
ASX200	5.10%	7.74%	36.11%	-41.29%	15.90%
10-year bond rate	3.94%	4.10%	6.59%	0.89%	1.64%

Table 3: Summary statistics for annualised growth rates of RPI, population, housing finance, value of residential work commenced and the ASX200 index. The lending rate, unemployment rate and 10-year bond rate were also expressed as annual percentages.

Source: Authors, 2021

In Table 2, summary statistics is shown for all variables. The mean, median, maximum, minimum and standard deviation for Sydney, Melbourne and national over the modelling period indicates are summarily reported. The median RPI for Sydney, Melbourne and both cities combined over the modelling period shows 6.23%, 3.68% and 4.98% respectively. The maximum RPI for Sydney, Melbourne and national over the modelling period shows 18.13%, 25.21% and 19.88% respectively. The minimum RPI for Sydney, Melbourne and national over the modelling period are -7.42%, -9.39% and -10.30% respectively, showing some negative outcomes in the house prices performance in the cities. The mean, median, maximum, minimum and standard deviation of population for Sydney, Melbourne and national, over the modelling period indicates 1.55%, 1.57%, 2.19%, 0.14%, and 0.34% respectively. Percentage change wise, this shows modest growths. Housing finance, a significant indicator of household borrowings for property purchases shows a standard deviation of 16.57% suggesting high fluctuations in the volume of money offered to households by financial institutions. Such volume of money can be an important indicator of house prices because mortgage availability has implications for household borrowings for homeownership that drive house prices.

Evidence of individual housing market performance of Sydney and Melbourne, and the national performance are shown in Figure 1. Whereas the blue line represents the national performance, the red and green lines denote Sydney and Melbourne respectively. Overall, the performance has followed a similar pattern, albeit with some variations in the direction and magnitude of the performance. Between 2004 and 2007, house prices for Sydney, Melbourne and the two cities combined experienced a steady price growth. However, the GFC in 2008 affected the market leading to a decline in performance as demonstrated by Figure 1. This was followed by the resource boom in Australia leading to a rebound in economic activities, and house price increases thereof due to demand. After the resource boom was a slowdown in house price growth in 2013, but the rebound in economic activities coupled with increased foreigners' participation in the Australian residential property market led to an exponential house price growth from 2014 until 2019. Sydney house prices shows a significant increase compared to Melbourne due to various reasons including the preference of foreign real estate investors focus in the Sydney market. In 2018, the entire housing market in Australia entered a correction

period due partly to the changes in Foreign investment laws and the Royal banking Commission's enquiry into poor lending practices of some financial institutions. A rise and fall are seen towards the end of 2019 and 2020 due to Covid-19 pandemic and its negative impact on the housing market, which was later resolved through some RBA, Federal and State Government initiatives leading to a rebound in the house prices of Sydney and Melbourne.

4.0 Methodology

In principle, residential property prices are determined through the interaction between supply and demand. An increase in demand in excess over supply will place upward pressure on prices while the opposite will occur for an increase in excess supply. While demand and to a lesser extent, supply are unobservable, the factors that contribute to these forces are less so.

The fundamental driver of demand for owner occupied premises is population growth. As new households are formed, more residential space is required thereby increasing demand. However, the cost and availability of finance acts as a moderating factor. Housing finance / lending activity contains information regarding planned purchases while the lending rate represents the cost of obtaining finance. The value of residential work commenced is also an important indicator of construction activity. Unsurprisingly, these variables are highly correlated. For example, a reduction in lending rates leads to cheaper finance increasing borrower-accepted commitments which may have flow on effects to construction activity. The high degree of correlation between these variables is measured by the correlation matrix depicted in Table 4. Therefore, it is not appropriate to include these variables as individual regressors in a single equation due to the problems stemming from collinearity. As a result, these variables will be modelled as a suite of indicators.

4.1 Correlation matrix

Correlation	Log_e(RPI)	Log_e(RPI:SYD)	Log_e(RPI:MEL)	Log_e(FIN.)	Log_e(RESI)	LEND
Log_e(RPI)	1.00					
Log_e(RPI:SYD)	0.96***	1.00				
Log_e(RPI:MEL)	0.99***	0.94***	1.00			
Log_e(FINANCE)	0.85***	0.84***	0.83***	1.00		
Log_e(RESI)	0.81***	0.88***	0.76***	0.65***	1.00	
LEND	-0.77***	-0.84***	-0.74***	-0.79***	-0.61***	1.00

Table 4: Correlation matrix between residential property prices and housing finance, the value of residential work and lending rates.

Source: Authors, 2021

Regression analysis is commonly used to estimate the long run relationships between explanatory variables and dependent variables. Estimation by least squares (OLS) is commonly used. However, in time series data, care must be taken to avoid spurious results which can occur if variables are non-stationary. OLS may still be employed if variables are not cointegrated and stationary. Differencing is often employed to achieved stationarity, however interpretation may become problematic if excessive differencing is required. To overcome these issues, error correction models (ECMs) such as those employed by Engle and Granger

(1987) may be used. These approaches are valid when time series are non-stationary and cointegrated however they require all variables to be integrated of the same order and cointegrated.

While theoretically valid, these conditions are rarely met in applied work. In cases where variables contain a mixed order of integration, i.e. some are stationary while others are not; and there is the possibility of cointegration among *some* of the I(1) variables, the error correction model is no longer valid. In such cases, the autoregressive distributed lag (ARDL) cointegration approach may be used as this is one of the least 'restrictive' among the class of equivalent time series estimation techniques requiring fewer assumptions (Pesaran and Shin, 1995, Pesaran et al., 2001).

Generally, the approach involves estimating differences in the dependent variable on lags of itself which represent the *autoregressive* components; and lags of the independent variable which represent the *distributed lag* components. The first step involves the estimation of an unrestricted error correction model. From this, the appropriate lag structure is determined. Common lag order selection criteria include the Akaike information criterion (AIC), the Schwarz/Bayes criteria (SC) and the Hannan-Quinn information criteria (HQ).

The next step is to estimate a separate long run model in 'levels' with (lagged) residuals included as an error correction term in the 'restricted' error correction model. Long run coefficients may also be recovered from the unrestricted ECM while the coefficient of the error correction term is commonly interpreted as the speed of adjustment – that is, the speed with which the system returns to its long run equilibrium following a short-term shock. Accordingly, the unrestricted ECM may be expressed as follows:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta y_{t-i} + \sum_{i=0}^{q} \sum_{k=1}^{K} \beta_{ki} \Delta X_{kt-i} + \theta_{11} y_{t-1} + \sum_{k=1}^{K} \theta_k X_{kt-i} + \varepsilon_t$$

The restricted ECM may be expressed as:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta y_{t-i} + \sum_{i=0}^{q} \sum_{k=1}^{K} \beta_{ki} \Delta X_{kt-i} + \emptyset z_{t-1}$$

where:

$$y_t = \beta_0 + \sum_{k=1}^{K} \alpha_k X_{kt} + v_t$$

$$z_{t-1} = y_{t-1} - \alpha_0 - \sum_{k=1}^{K} \alpha_k X_{kt-1}$$

The β -parameters are of no interest and usually ignored while the θ parameters are used to construct the long run coefficients and $\emptyset$ may be interpreted as the 'speed of adjustment'. This estimation procedure was applied to the data and results are reproduced in the following section.

5.0 Results

Estimation results are summarised in Table 5, Table 6 and Table 7.

Population changes is one of the most consistent drivers of residential property prices. A 1% growth in population lead to an estimated 1.9 - 2.3% increase in RPI at the national level. In Sydney markets, this effect was estimated to be 2.0 – 2.5%; while in Melbourne markets, it was 1.9 – 2.7%. As population grows through either natural increases or immigration, which is an important policy of Australian Government, there is demand for accommodation. This inevitably leads to demand for housing in various cities and aggregated at the national level, with supply lagging, house prices rise in response to the excess demand. This positive relationship between population growth and house prices is consistent with earlier research including Miles (2012) and Yang et al. (2018).

Another consistent driver of residential property prices is housing finance. A 1% growth in housing finance lead to an estimated increase of 0.45% in RPI at the national level. In Sydney markets, this effect was estimated to be 0.60% while in Melbourne markets, it was 0.45%. As explained earlier, housing finance measures borrower-accepted commitments made for the purposes of owner occupied housing. This indirectly captures the demand for housing and as the housing finance commitments rise, it means home purchases are increasing. Thus, these commitments demonstrate the capacity of home buyers to afford homes. The availability and granting of housing finance lead to increase in demand for housing relative to supply, thereby causing house price increase.

The value of residential work started also had a significant impact on house prices. A 1% increase in the value of residential work commenced lead to an estimated increase of approximately 0.28% in RPI at the national level. In Sydney markets, this effect was estimated to be 0.78% while in Melbourne markets, it was approximately 0.40%. While in practice, the value of residential work commenced may represent supply of housing, it is possible that the effect of this factor is changing, and the market is reacting to it as a demand driver because the value is measured in monetary terms. This positive relationship between house prices and value of residential work started has also been found by Wong et al. (2020) and is consistent with a priori expectations and market commentary.

The cost of finance as measured by the lending rate was also expected to have an impact on residential property prices. A 1% increase in the lending rate lead to an estimated decrease of 5.23% at the national level. In Sydney markets, this effect was estimated to be 7.97% while in Melbourne markets, it was approximately 4.33%. This is consistent with the literature (see for example Wong et al. (2020), Hailemariam et al. (2021)) and practice because lending rate measures the cost of borrowing (mortgage). The lending rate is also used to assess the borrowing capacity of homeowners. As the rate increases, it increases the cost of borrowing and affects the borrowing capacity of potential homeowners negatively. Consequently, many potential homeowners are unable to meet the credit requirements, leading to a decrease in housing demand. A decrease in housing demand with supply relatively steady affects house prices negatively.

All states and territories

	Y = Log_e(RPI)			Y = LEND
	(1)	(2)	(3)	(3.1)
Explanatory variable	Coefficient (SE)	Coefficient (SE)	Coefficient (SE)	Coefficient (SE)
Constant	-31.90*** (5.41)	-39.50*** (3.90)	-28.66* (16.33)	0.1498*** (0.049)
Log_e(Population)	1.9109*** (.396)	2.3364** (0.325)	1.9910** (0.9425)	
Log_e(Finance)	0.4494*** (.15)			
Log_e(Residential)		0.2773** (0.138)		
Lending rate			-5.2287 (5.4352)	
Unemployment				-1.6577* (0.9381)
'Speed' of adjustment	12.99%	13.27%	7.22%	8.64%
Adjusted R^2	0.9974	0.9969	0.9968	0.9205
SE of regression	0.01209	0.01327	0.01338	0.00363
ARDL bounds test[1]				
F-stat	8.4716***	2.1533	2.9172	0.6347
	I0 bound	I1 bound		
10%	3.17	4.14		
5%	3.79	4.85		
2.5%	4.41	5.52		
1%	5.15	6.36		
Residual analysis (p-values)				
Jarque-Bera[2]	0.0286	0.1687	0.0036	0.0000
Breush-Godfrey[3]	0.4107	0.1188	0.1768	0.7373
BPG[4]	0.1652	0.0113	0.0774	0.1596

Table 5: ARDL 'Long run' coefficients, associated tests and residual analysis for all states and territories

Sydney

	Y = Log_e(RPI - Sydney)		
	(4)	(5)	(6)
Explanatory variable	Coefficient (SE)	Coefficient (SE)	Coefficient (SE)
Constant	-39.46*** (7.94)	-42.83*** (2.14)	-37.76*** (9.36)
Log_e(Population)	2.2912*** (0.5773)	2.0571*** (0.1902)	2.5502*** (0.5411)
Log_e(Finance)	0.5970** (0.2479)		
Log_e(Residential)		0.7763*** (0.0915)	
Lending rate			-7.9726** (3.7878)
'Speed' of adjustment	9.57%	29.31%	9.98%

[1] Null hypothesis: No long-run relationship exist

[2] Null hypothesis: Residuals are normally distributed

[3] Serial correlation test (lags = 4). Null hypothesis: Residuals are not serially correlated

[4] Breusch-Pagan-Godfrey Heteroskedasticity test. Null hypothesis: Residuals are homoskedastic

Adjusted R^2	0.9959	0.9958	0.9957
SE of regression	0.0183	0.0184	0.0188
ARDL bounds test			
F-stat	4.8365*	6.3107**	5.5663**
	I0 bound	I1 bound	
10%	3.17	4.14	
5%	3.79	4.85	
2.5%	4.41	5.52	
1%	5.15	6.36	
Residual analysis (p-values)			
Jarque-Bera	0.0221	0.5354	0.0931
Breush-Godfrey	0.7643	0.3692	0.2635
BPG	0.2852	0.2605	0.1113

Table 6: ARDL 'Long run' coefficients, associated tests and residual analysis for Sydney model

Melbourne

	Y = Log_e(RPI - Melbourne)		
	(7)	(8)	(9)
Explanatory variable	Coefficient (SE)	Coefficient (SE)	Coefficient (SE)
Constant	-31.90*** (5.41)	-44.14*** (11.40)	-41.63** (15.75)
Log_e(Population)	1.9109*** (0.3961)	2.4942** (0.9990)	2.7411*** (0.9120)
Log_e(Finance)	0.4494*** (0.1561)		
Log_e(Residential)		0.3869 (0.3875)	
Lending rate			-4.3286 (5.4392)
'Speed' of adjustment	12.99%	7.64%	8.33%
Adjusted R^2	0.9980	0.9971	0.9970
SE of regression	0.0140	0.0158	0.0159
ARDL bounds test			
F-stat	4.8378*	2.2855	3.2195
	I0 bound	I1 bound	
10%	3.17	4.14	
5%	3.79	4.85	
2.5%	4.41	5.52	
1%	5.15	6.36	
Residual analysis (p-values)			
Jarque-Bera	0.0796	0.2468	0.0094
Breush-Godfrey	0.5115	0.7939	0.5939
BPG	0.7416	0.2809	0.4825

Table 7: ARDL 'Long run' coefficients, associated tests and residual analysis for Melbourne model

Unemployment: While it may be reasonable to assume that levels of unemployment would exert a significant and negative impact on the residential property market, econometrically it is not a reliable indicator. As depicted by Figure 5, residential property prices rose between 2003 – 2007 as the unemployment rate declined over the same period. However, after a brief downturn in 2008, residential property prices continued to rise from 2009 to 2017 during which

unemployment experienced a turbulent but gradual increase. The market correction of 2018 occurred during a period of elevated unemployment. Lastly, the COVID-19 pandemic resulted in a peak unemployment rate of 7.4% which also coincided with a rallying property market. *Prima facie*, it would appear that periods of high unemployment actually aided the property market. However, this finding may not be altogether surprising when one considers the accommodative measures undertaken by the central bank in response to unemployment. In executing its duties to ensure the *continued economic prosperity of the Australian people*, the RBA implements monetary policy countercyclical to unemployment in order to maintain the inflation target range. As depicted in Figure 6, long term interest rates as measured by the 10-year treasury bond rate are lowered (raised) in response to heighted (lowered) levels of unemployment. Given that lending rates closely follow bond rates, periods of high unemployment are met with low lending rates which in turn fuel demand for residential property placing upward pressure on prices. This explains the apparent pro-cyclicality of unemployment with the property market. As indicated by equation 3.1, a 1% increase in unemployment results in an estimated decrease of approximately 1.4% in the lending rate.

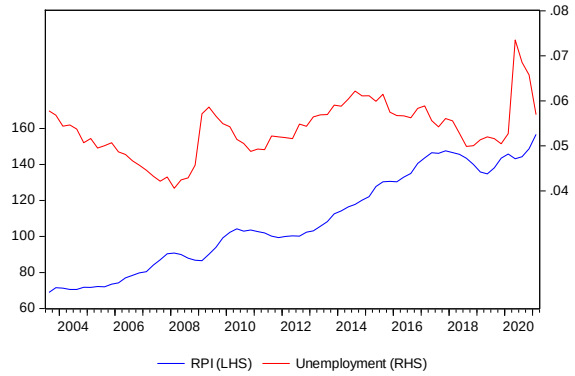


Figure 5: Residential Property Prices (RPI) and Unemployment rates between 2003-Q3 and 2021-Q1

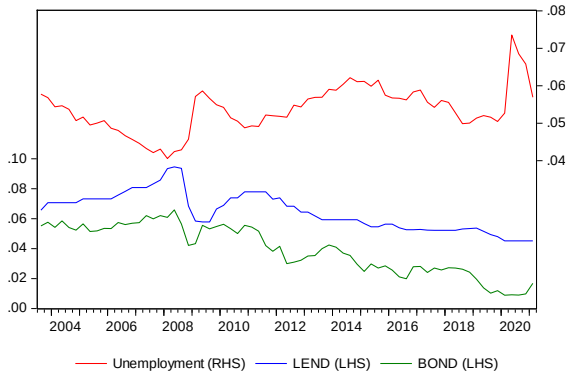


Figure 6: Lending rates (LEND), 10-year treasury bond rates (BOND) and Unemployment rates over the modelling period

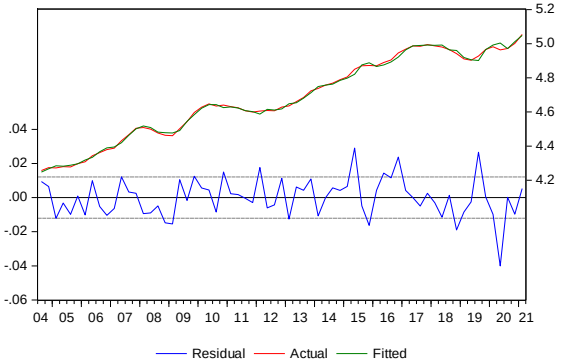
Source: Authors, 2021

ASX200: The equity market was tested for significance and while it exhibited a significant impact on residential property prices in a parsimonious specification, it became insignificant when other variables such as housing finance and the value of residential work were included. Therefore, even though movements in the equity market have explanatory power in determining residential property prices, it was ultimately not included in the final modelling in favour of superior variables such as housing finance and the value of residential work.

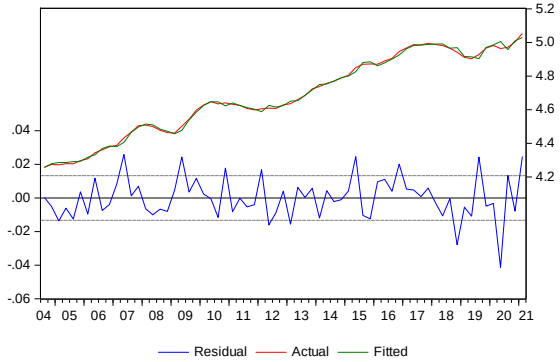
Regarding model diagnostics, residuals are mostly normal however the assumption is violated in some models. This was due largely to the volatility surrounding the COVID-19 period. When this period is omitted, the null hypothesis was not rejected indicating normality in errors. Given this was not a serious violation to normality assumption, the outlier(s) were retained in the dataset. The null hypothesis for the serial correlation tests were not rejected indicating that the residuals were free from serial correlation. Lastly, the heteroskedasticity test was not rejected indicating equal variance across the residuals and no violation of the assumption.

The following line charts depict the actual, fitted and residual values for models (1) to (9):
As the line charts indicate, there is a good fit between actual and predicted values. Furthermore, the residual plots appear homoskedastic and randomly distributed with no serial correlation or discernible trend, i.e. 'white noise'. This is consistent with the residual tests. A significant period of volatility evolved over the COVID-19 period resulting in non-normality of the errors, but this is resolved when the period is removed.

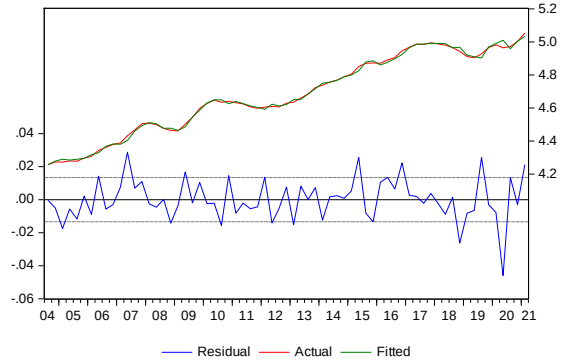
Model (1)



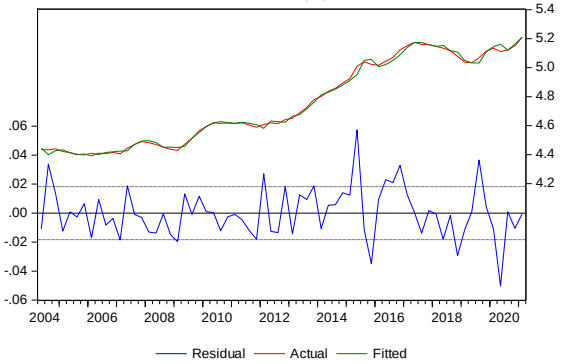
Model (2)



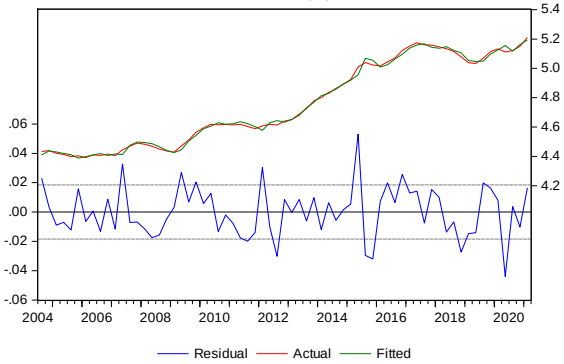
Model (3)



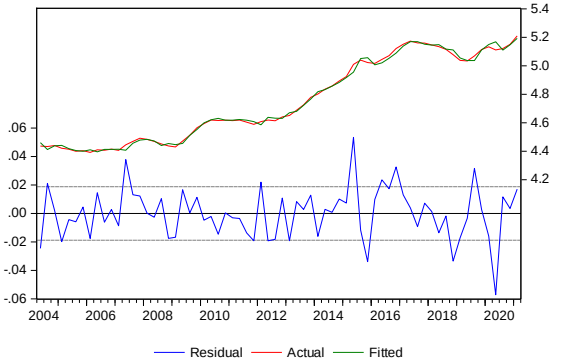
Model (4)



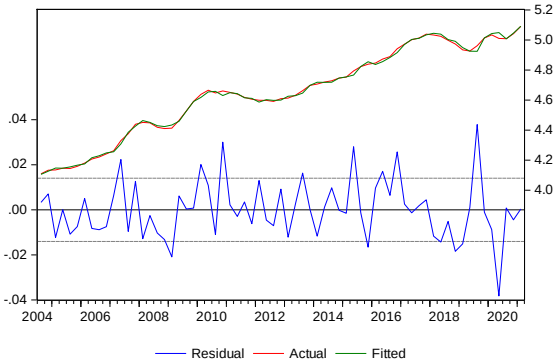
Model (5)



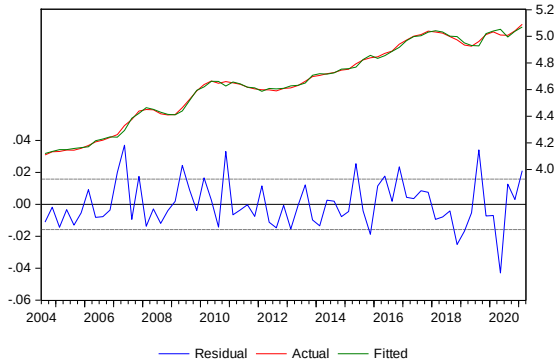
Model (6)



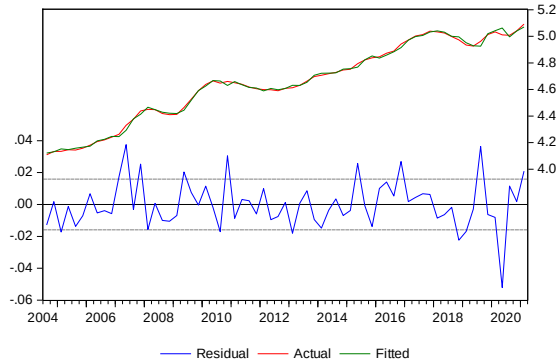
Model (7)



Model (8)



Model (9)



5.0 Conclusion

The Australian Residential Property Market exhibited significant volatility since 2018. As noted in (Wong et al., 2020), the short span of housing market downturn between 2017 and 2019 was unique and significance witnessing the traditional key macroeconomic determinants such as unemployment rate, GDP and interest rate inadequately arrested the latest Australian residential property market development. It was uncovered in the research that some new market drivers such as depreciating capital liquidity, excess housing supply and diminishing foreign investors have emerged as the new housing market drivers after the infamous Royal Banking Commission enquiry in 2018.

The market recovered as credit liquidity improved in 2019, only to be plunged into negative territory again due to the COVD-19 pandemic 2020. The anticipated impact of COVID-19 on the housing market was that demand for housing would tumble with many experts predicting in excess of 10% reduction in the Australian house prices. Instead, the contrary occurred. The weighted average index of the eight cities' house prices jumped 24.04% from 2019 to the June quarter 2021. The same house price accelerations observed in both Sydney and Melbourne subsequent to a slew of fiscal and monetary expansionary measures implemented by the Commonwealth and the RBA. With the absence of foreign investors due to the border closures since the beginning of the pandemic, this study uncovered that the population growth has exerted its positive influence on the housing market whilst the increase in housing supply did not result in the expected reduction in price indicating that the housing demand far exceeded housing supply in Australia. Among the expansionary measures, RBA undertook the historical first QE measure in Australia to probe up the much-needed market financing liquidity. As a follow up study on the Australian housing market drivers and consistent with the findings in (Wong et al., 2020), the housing market performance was unfazed by the traditional drivers such as the nation's unemployment rate whilst the emerging determinants such as capital liquidity continue to uplift the Australian housing market since 2020.

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