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A Natural Quasi-Experiment of the Monetary Policy Shocks on the Housing Markets of New Zealand during COVID-19

Chung Yim Yiu

Department of Property, The University of Auckland Business School, Auckland 1010, New Zealand; edward.yiu@auckland.ac.nz

Abstract: It is hard to experimentally test the impacts of monetary policy shocks on housing markets as it is very unlikely for a central bank to change monetary policies swiftly twice within a short period of time for exogenous reasons. However, during the pandemic, the central bank of New Zealand changed its policies 180 degree in 2 years, from an unprecedented low interest rate and a relaxed mortgage policy in 2020 to a 13-year record high interest rate and a tightened mortgage policy in 2022. Among the OECD members, New Zealand is the country that increased the interest rate the earliest and also the country that had its house prices fall the earliest. It provides natural quasi-experiments to test the monetary policy hypothesis empirically by the two policy changes as treatments on house prices. This study conducts a time series regression analysis on the housing markets of New Zealand to test the hypothesis in the pre-COVID and the COVID periods, ranging from 2016 Q2 to 2022 Q3. The results confirm that mortgage rates have a negative and significant effect on house price changes after controlling for the economic growth factor and the housing supply factor, no matter whether the monetary policy switches to expansionary or contractionary mode. The robustness test results of the housing markets show that a 1% fall/rise in the mortgage rate caused a 5.6% increase/decrease in house prices, ceteris paribus, in the COVID period. The results also do not support the housing supply hypothesis in New Zealand.

Keywords: monetary policy; mortgage rate; COVID-19; house prices; natural quasi-experiment; New Zealand

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1. Introduction

It is well-known in economics studies that it is difficult to keep other things being equal, i.e., ceteris paribus, conditions in studying a cause-effect hypothesis (Hirschauer et al. 2019). Natural quasi-experiments are therefore increasingly exploited by economists to study interventions, such as a policy shock, instead of relying on observational studies, to ex ante ensure ceteris paribus conditions rather than relying on an expost control of confounders through statistical modeling (Athey and Imbens 2017). This study adopts a natural quasi-experimental approach to consider the recent monetary policy shocks during the pandemic as exogenous interventions and to compare the before-and-after-treatment outcomes in the housing markets of New Zealand (Charness et al. 2012). The policy shocks of New Zealand are chosen because they switched swiftly between expansionary and contractionary policies twice within two years for exogenous reasons. The rapid changes between the expansionary and contractionary policies provide two opposite shocks (treatment and treatment reversal) in a short period to test the monetary policy effects on housing markets, while controlling other factors being equal. For example, housing supply and population size are often argued to be two of the major determinants of house prices, but it is implausible for them to change directions twice within such a short timeframe in the COVID period.

In early 2020, the COVID-19 shock led to a global recessionary period with serious disruptions in business operations, especially in tourism. Unemployment rates of many developed economies rose to record highs. In response to the catastrophic event, a global

synchronized counter-cyclical measure was taken by central banks. In the first quarter of 2020, there were 73 interest rate cuts, and in the whole year of 2020, there were 207 interest rate cuts; some of them were even cut to historic lows (Sahin and Girgin 2021). The coordinated expansionary monetary policy had huge impacts on housing markets globally. House prices in these countries went up substantially even at the peaks of the pandemic when their GDP growth rates were deeply negative, and their unemployment rates were unprecedentedly high. For example, Knight Frank's (Knight Frank Research 2021) Global House Price Index showed that 93% of the 56 sampled countries recorded annual growth in house prices in Q2 2021. New Zealand ranked the second highest in the growth rates. Besides interest rate cuts, the Reserve Bank of New Zealand (RBNZ) also relaxed mortgage policy, such as relaxing the loan-to-value ratio caps for investors, etc., in April 2020. The impacts of the expansionary monetary policy on global house prices were evidenced by a panel study of five countries (Yiu 2021). However, there is another common alternative hypothesis in explaining the global house price increases after the outbreak of COVID-19: the sharp increase in construction and material costs largely due to the disruptions in the global supply chains. For example, the construction cost index increased by 4.0% when the inflation rate was just 1.5% in Q2 2020. It is hard to control the supply-side effects by econometric means as the data of construction and material costs are not reported as frequently as house prices and other macroeconomics factors.

It is a better approach to disentangle the two hypotheses (monetary policy versus housing supply) with an experiment which treats (intervenes) only one factor but keeps the other factor almost unchanged. Interestingly, the RBNZ started switching monetary policy from expansionary to contractionary by increasing interest rates and reinstating and then tightening the loan-to-value ratio caps for investors in March and May 2021. The interest rate hike continued and accelerated throughout 2022 in response to the serious inflation and the plummeting of the New Zealand dollar exchange rate to the US dollar. The annual growth rate of the house price index turned negative since July 2022 (REINZ 2022), but the construction costs index still climbed very fast in that period, the annual growth rate of construction costs even hit an all-time high of 9.6% in Q3 2022 (CoreLogic 2022). In other words, it provides a critical test of the two hypotheses. The contractionary monetary policy hypothesis predicts a housing price fall, but the increasing construction costs hypothesis predicts a housing price rise. The swift change of monetary policy twice within a two-year window can also control many other factors, such as population size and land supply, as these factors are not likely to change directions twice within a short period of time. In fact, the population size of New Zealand kept increasing steadily but at a much slower rate after the outbreak of COVID-19, due to the slightly negative number of net migrants after March 2021 (StatsNZ 2022e). In other words, the population hypothesis should predict a housing price fall in the whole COVID period.

This paper conducts a time series analysis on the monetary policy hypothesis on house price changes, using both total mortgage loans and interest rate as proxies. The paper is organised as follows. Section 2 critically reviews the literature on the monetary policy hypothesis and on using quasi-experiments in economic studies. Section 3 addresses the research design, data, and methodology. Section 4 reports the empirical results and the robustness tests results. Section 5 discusses the interpretations and implications. Section 6 concludes the study.

2. Literature Review

2.1. Monetary Policy and House Prices

Previous studies on the association between monetary policy and house prices have found different results. Griffin et al. (2021), for example, found a consistently positive association between credit supply variables and housing price changes during the boom and bust in the US subprime crisis. Chadwick and Nahavandi (2022) confirmed that a contractionary monetary policy shock reduced real housing prices in New Zealand. Theoretically, Mayer and Sinai (2009, p. 8) explained the causal link by the argument

that "when the real interest rate is low, homeownership is relatively attractive because mortgage payments are low and alternative investments do not yield much". Empirically, the negative association between interest rates and housing prices was found as early as in Harris (1989). More recently, the association was commonly found in cross-country studies (Otrok and Terrones 2005; Arestis and González 2014, 2016; Geng 2018; Shida 2021).

However, some studies, such as Dokko et al. (2011), Favilukis et al. (2013); Glaeser et al. (2013), Shi et al. (2014), and Tripathi (2019), did not find a negative association between interest rates and housing prices. One contended that the housing boom was caused by a decline in risk premia rather than low interest rates, which is an endogeneity issue in the empirical studies as Favilukis et al. (2017) argued that both the interest rate fall and the house price rise are driven by the influx of foreign capital when the risk premium is low. The second strand of endogeneity concern is on other confounding factors, such as insufficient housing supply and planning restrictions (Glaeser et al. 2013) or economic growth. The third strand of studies also raised a concern of reversal causality bias, as they found a bi-directional relationship between lending and property prices (Gerlach and Peng 2005; Greiber and Setzer 2007; Goodhart and Hoffman 2008).

This study, therefore, exploits the exogenous shocks of interest rate changes in the pandemic period as they were contrarian measures of the RBNZ in response to the recessionary crisis in 2020 and the inflationary situation in 2022. Both are exogenous global shocks, as the former was caused by the unexpected outbreak of the pandemic and the latter was mainly triggered by the Russia–Ukraine war. Using the exogenous shocks of interest rate change is one of the best ways to eliminate reverse causality bias, as the temporal precedence is guaranteed by the exogenous event (Kenny 1979). Moreover, the foreign investment amounts in New Zealand during the first two quarters of the COVID-19 outbreak (2020Q1 and 2020Q2) plunged by NZD 4.9 billion and 6.1 billion, respectively (StatsNZ 2021). In other words, foreign capital flows could not explain the house price surge in this time. In addition, foreigners have been banned from buying houses in New Zealand since October 2018. The chosen period and country to be studied in this paper can be pre-empted from any arguments of low-risk premium or influx of foreign capital. More importantly, this study tests the monetary policy hypothesis by imposing both a treatment (expansionary policy) and a treatment reversal (contractionary policy) within a short period of time, which is suggested by Meyer (1995) as a robustness test (to be discussed in the ensuing section). In addition, the potential confounding factors, such as housing supply or construction costs, could only be valid in either the treatment or the treatment reversal experiment, but not both.

One of the major reasons why there has been no consensus on the monetary policy hypothesis is because most of the previous studies are subject to endogeneity biases as they were not based on randomized controlled trials. It is also hard to establish a causal relationship (temporal precedence) because the studies do not use an intervention approach. Favara and Imbs (2015) supplied one attempt to use a natural quasi-experiment to examine the causal chain from credit policy to housing prices. They considered the changes of mortgage credit after the lifting of branching restrictions in the United States in 1994 as a treatment and found a causal chain between credit expansion and house prices increase. Yet, they admitted that the deregulation itself is not exogenous. Yiu (2021) is another attempt to use a natural quasi-experiment to test the causal link between real interest rates and housing prices by considering the global interest rate cuts after the COVID-19 shock as an exogenous intervention. However, it can still be subject to an endogeneity issue that the pandemic caused a serious disruption to the supply chains and could make housing prices rise. To mitigate the endogeneity issues, this study considers the two swift changes of the monetary policy in New Zealand in 2020 after the outbreak of COVID-19 as a treatment and a reversal in 2022.

2.2. Natural Quasi-Experiments

Endogeneity has become a serious concern in empirical studies of economics and finance as "it limits the validity of empirical testing of models". A natural quasi-experiment can help mitigate the problem of endogeneity because it provides "a plausibly exogenous source of variation in the independent variables of interest" (Gippel et al. 2015, p. 144). In natural sciences, such as medical research, experiments of randomized controlled trials can be conducted to compare the differences between treatment groups and control groups. However, such experiments are usually difficult, if not impossible, in economics and finance studies (Kaplan et al. 2013). It can result in endogeneity bias due to the non-random treatment problem.

Natural quasi-experiment is a recognized approach to deal with endogeneity issues (Reeb et al. 2012). Dunning (2007) suggested using public policy changes and crises as the naturally occurring treatments or interventions in quasi-experimental studies. Since the interventions are exogenously imposed, a natural quasi-experiment can make a strong case for a causal interpretation of the results by ruling out reverse causality (Antonakis et al. 2014).

Endogeneity issues also exist in housing studies. For example, GDP growth is commonly found to boost house prices, but it can have a reverse causality issue because house price increases can impose a house wealth effect which boosts economic growth (Miller et al. 2009). The quasi-experimental approach has become more common in housing studies. Yet, most of these natural quasi-experiments are based on a one-off policy change (Deng et al. 2022). Meyer (1995) suggested adding a treatment reversal as a robustness test. Heider and Ljungqvist (2015), for example, applied both a treatment and a reversal of the treatment (tax policy) to investigate its effects on capital structure. However, a reversal of treatment in natural quasi-experiments is easier said than done as policy implementation is unlikely to be retreated within a short time, let alone being changed in opposite directions twice rapidly. This study is therefore important and novel because it provides both a treatment and a reversal on the monetary policy hypothesis tests.

3. Materials and Methods

3.1. Data

This study makes use of public data in New Zealand to conduct the tests, including the data series of total mortgage lending (TML) and 2-year fixed mortgage rates, MR2y from RBNZ (2022a, 2022b), gross domestic product (GDP), consumer price index (CPI), building consents issued (BCI), and number of property transfers (NPT) from StatsNZ (2022a, 2022b, 2022c, 2022d) and the house price index (HPI) from REINZ (2022).

Table 1 shows the descriptive statistics of the variables, and Table 2 shows their stationarities by using the ADF unit root tests. They show that mortgage rates are stationary in the level terms, while real house prices, building consents issued, and total mortgage lending are stationary in the first differences.

Table 1. Descriptive statistics of variables, 2016Q2–2022Q3.

Variable	Mean	Standard Deviation	Minimum	Maximum
dlog(TML)	0.0002	0.188	−0.336	0.510
dlog(HPI/CPI)	0.011	0.034	−0.066	0.078
dlog(BCI)	0.028	0.095	−0.114	0.208
dlog(GDP)	0.008	0.037	−0.102	0.138
MR2y	4.689	0.664	3.467	5.970
No. of Periods	26 (2016Q2–2022Q3)			

Sources: RBNZ (2022a, 2022b), StatsNZ (2022a, 2022b, 2022c, 2022d), REINZ (2022).

Table 2. Unit root tests of variables, 2016Q2–2022Q3. Notes: figures are statistics, ***, ** and * represent p-value $\leq$ 0.01, 0.05 and 0.10, respectively.

Variable	Level	First-Difference
	ADF—t-Statistic	ADF—t-Statistic
HPI/CPI, Real House Price Index and dlog (HPI/CPI), Real House Price Quarter-on-Quarter Change (%)	−2.87 *	−4.19 ***
MR2y, 2-year Fixed Mortgage Rate (%)	−3.16 **	
dlog (GDP), Gross Domestic Product Quarter-on-Quarter Change (%)	−1.54	−8.11 ***
BCI, Building Consents Issued (nos.) and dlog (BCI), Building Consents Issued Quarter-on-Quarter Change (%)	−0.88	−5.90 ***
TML, Total Mortgage Lending (NZD m) and dlog (TML), Total Mortgage Lending Quarter-on-Quarter Change (%)	−2.30	−6.05 ***

3.2. Research Design

This study considers the changes of the RBNZ's monetary policies in 2020 and 2022 as the treatment and the reversal treatment of the natural quasi-experiments for studying the causal chain from monetary policy to house prices. The causal link from the central bank's policy rates to the market mortgage rates is well recognized (Shi et al. 2014), and the links from the mortgage rates to mortgage lending and further to house prices are to be studied with three models. The first model studies the causal link from mortgage rate to total mortgage lending changes, and the second model studies the causal link from total mortgage lending changes to real house price changes. The third model then tests the causal link from mortgage rate changes to real house price changes. The models also control other factors, including explicitly (1) housing supply and (2) GDP growth; and implicitly (3) migrants' housing demand by means of the ban on foreigners from purchasing homes in New Zealand since 2018.

Before the outbreak of COVID-19, the RBNZ had reduced the official cash rate (OCR) from 3.5% in 2015 to 1% in 2019 (i.e., a modest expansionary monetary policy in the pre-COVID period). The period coincided with the long growing trend of house prices in New Zealand. In this period, the dominant alleged cause of house price growth was the demand of migrants (Hyslop et al. 2019). The enactment of the Overseas Investment Amendment Act to ban foreigners from buying residential properties in New Zealand in 2018 resulted in a slight reduction in the number of transactions and house prices in 2019. However, in the wake of the pandemic, the RBNZ further cut the OCR to an unprecedented low from 1% to 0.25% in March 2020, with a forward guidance that it would remain at this level for at least one year. Besides cutting the interest rate, the RBNZ also imposed other expansionary monetary measures such as the removal of the loan-to-value ratio (LVR) restrictions on housing purchases in April 2020 (RBNZ 2021).

After a one-year freeze, the RBNZ started reversing from the expansionary monetary policy to a more contractionary one. First, the LVR restrictions were reinstated in March 2021 and were further tightened twice in May and November 2021[1]. In particular, the definition of high LVR for investors was lowered from 70% to 60% in May and then lowered to 40% in November (RBNZ 2021).

Then, the RBNZ raised the OCR by 0.25% in early October 2021, which was one of the earliest post-COVID interest rate hikes in the world. There were continuously 9 straight hikes in interest rate from 0.25% to 4.25% in about 13 months, which was the most aggressive tightening of the policy rate by the RBNZ since 1999. This level of OCR was the highest since 2009. Retail mortgage rates also followed the OCR trends closely. The average 2-year fixed mortgage rate rose to 4.45% in February 2020 and plunged to 3.46% in April 2021, then surged swiftly to 6.06% in September 2022 as reported by the RBNZ.

The responses of the mortgage markets were highly sensitive to the changes of the monetary policies. The total mortgage lending amount was abruptly increased by 208.7% in April 2021 when the mortgage rate was at the lowest point, but it plummeted by 38.7% in July 2022 when the mortgage rate was climbing. The changes in mortgage lending reflected the changes in housing demand, which could be revealed in the changes of house prices and the number of property transfers. For example, the annual change of the number of home transfers in New Zealand reversed from a sudden fall of 30% in Q2 2020 after the outbreak of the pandemic to a sharp increase of 69% in Q2 2021 immediately after the expansionary monetary policy, then to a continuous decline to the lowest of −28% in Q3 2021 when the policy was tightened (StatsNZ 2022d).

Facing the pandemic shock, house price change was less sensitive than that of the number of property transfers, as predicted by the prospect theory. Even during the pandemic, the annual rate of increase of the national house price index of New Zealand declined slightly from 8.6% in April 2020 to 6.9% May 2020. Further fueled by the expansionary monetary policies, the growing trend of housing prices accelerated until reaching the peak in Q3 2021 with an annual growth rate of 30.6% (or 24.6% of real house prices in Q2 2021). Then, after tightening the monetary policy, house prices fell by −6.0% in Q3 2022 (or −12.3% of real house prices) (REINZ 2022).

The impact of the monetary policies on the mortgage and housing markets can be vividly depicted in time series charts. Figure 1 shows the time series of the 2-year fixed mortgage rates (MR2y), the year-on-year change of total mortgage lending amount (TMLyoy), and the year-on-year change of the house price index (HPIyoy). First, it shows a sudden plummet (−49.6%) of the TMLyoy in April 2020 in the wake of the pandemic. Then, with the sharp cut in interest rate, together with other expansionary policies, a sharp rebound of mortgage lending with a peak of 208.7% annual growth was triggered in April 2021. However, when the Reserve Bank started increasing interest rate, mortgage lending plummeted again. The strong and negative association between the MR2y and TMLyoy supports the first hypothesis that the change in mortgage loans is associated with monetary policy.

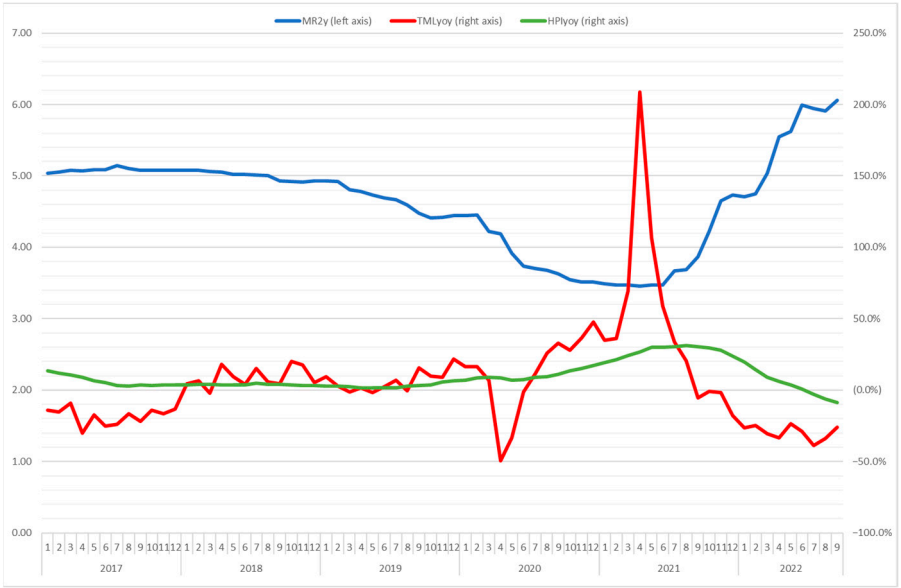


Figure 1. Two-year fixed mortgage rates (MR2y, left axis), year-on-year change of total mortgage lending (TMLyoy, right axis), and year-on-year change of the house price index (HPIyoy, right axis) of New Zealand, January 2017–September 2022. Sources: RBNZ (2022a, 2022b), REINZ (2022).

The shock of the monetary policies on housing prices can also be shown clearly in the time series chart. First, it shows a slight reduction in the growth rate (from 8.6% in April to 6.9% in May 2020) of house prices when the pandemic broke out. It indicates

that the pandemic shock on the housing markets is trivial, at least in the initial period of the outbreak, in comparison with that on the mortgage markets. However, when the expansionary monetary policies were launched, housing (investment) demand exploded, and the HPIyoy climbed gradually to a peak of 30.6% in Q3 2021, which ranked the second highest in the world in the period and also broke the 30-year record of New Zealand. Besides the effect of the expansionary monetary policy, the price rise might have been fueled by the disruptions in housing supply during the pandemic (Chadwick et al. 2022). However, when the Reserve Bank of New Zealand started increasing interest rates, the house price index turned south, and its year-on-year change fell after July 2022. The casual observation of the positive association between the TMLyoy and HPIyoy supports the second hypothesis that house price change is associated with the availability and affordability of mortgage loans which are shaped by monetary policy.

3.3. Alternative Hypothesis of the Quasi-Experiment

The following prima facie evidence can help refute the alternative hypothesis of insufficient housing supply. Figure 2 shows the time series of the year-on-year change of building consents issued of all dwellings (BCIyoy), the year-on-year change of total mortgage lending amount (TMLyoy), and the year-on-year change of the house price index (HPIyoy). In contrast with the contention of the alternative hypothesis that the disruption in the supply chains during the pandemic caused an abrupt increase in construction material costs, which was a potential reason of the house price hikes, however, the number of building consents issued for all dwellings indeed sharply increased by 83.8% in the same month of the peak of TMLyoy. More importantly, contradictory to the prediction of the alternative hypothesis on the negative relationship between housing supply and house prices, the BCIyoy is found to be positively associated with HPIyoy in Figure 2. In fact, contrary to the hypothesis, it is more plausible to explain the positive association by referring to the DW model (DiPasquale and Wheaton 1992) that housing supply is largely determined by house prices.

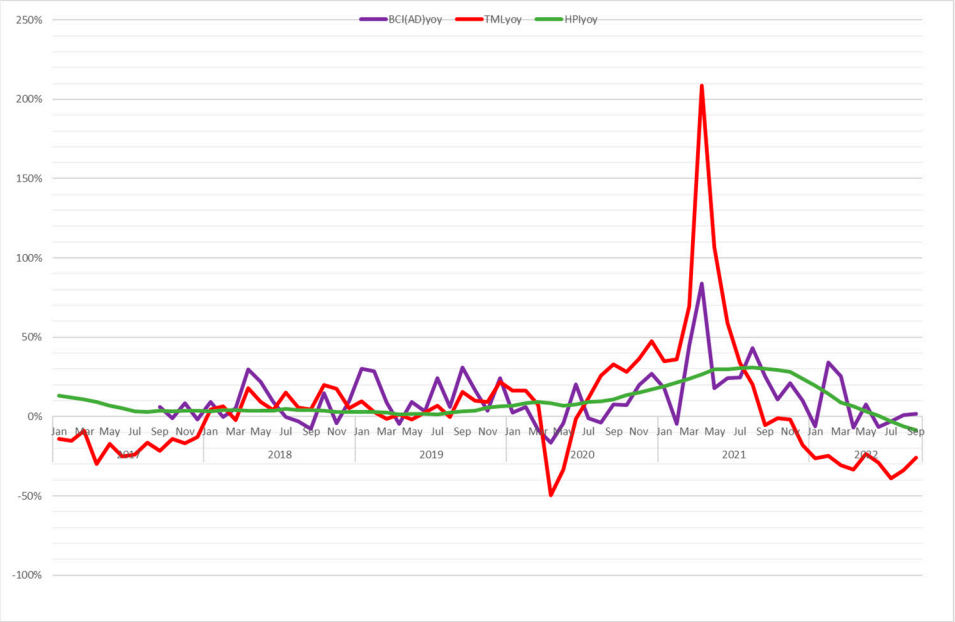


Figure 2. Year-on-year change of building consents issued for all dwellings (BCIyoy), year-on-year change of total mortgage lending (TMLyoy), and year-on-year change of the house price index (HPIyoy) of New Zealand, January 2017–September 2022. Sources: RBNZ (2022b), REINZ (2022), StatsNZ (2022a).

In fact, with the continuous effort of the New Zealand government to increase housing supply in the past decade, the number of building consents issued for all dwellings has almost doubled from about 25,000 units per year in 2013 to about 50,000 units per year in 2021. It could also retain strong positive growth in the number of building consents issued during the pandemic.

Besides the housing supply hypothesis, there are two other common alternative hypotheses. The first one is the migrant's hypothesis, and the second one is the economic growth hypothesis. The migrant's hypothesis argues that house price increases are caused by the increase in housing demand due to the growth in the number of net migrants. This narrative is easy to be believed in countries which welcome migrants. However, this alternative hypothesis has also been controlled in this study as non-residents have been banned from buying homes since October 2018. Lastly, the economic growth hypothesis posits that GDP growth determines house price growth. This alternative hypothesis is tested in this study by including a GDP growth variable in the models. Intuitively, however, it can also be eliminated as the periods of house price increases and decreases in the testing periods were coincided with an economic recession (intermittent negative GDP growth rates in 2020 and 2021) and an expansion (positive GDP growth rates in Q2 and Q3 2022).

3.4. Empirical Models of the Quasi-Experiment

In this study, two time series regressions are examined, the first model tests the first hypothesis of the effect of mortgage rates, $MR2y_t$, on total mortgage lending, TML_t (Equation (1)), and the second model tests the second hypothesis of the effect of total mortgage lending, TML_t, on real house prices, HPI_t/CPI_t (Equation (2)).

$$dlog(TML_t) = c_1 + \beta_1 MR2y_t + \beta_2 dlog(GDP_t) + \beta_3 dlog(CPI_t) + \gamma_1 dlog(TML_{t-1}) + \varepsilon_{1,t} \ldots\ldots \quad (1)$$

$$dlog(HPI_t/CPI_t) = c_2 + \beta_4 dlog(TML_t) + \beta_5 dlog(GDP_t) + \beta_6 dlog(BCI_t) + \gamma_2 dlog(HPI_{t-1}/CPI_{t-1}) + \varepsilon_{2,t} \ldots\ldots \quad (2)$$

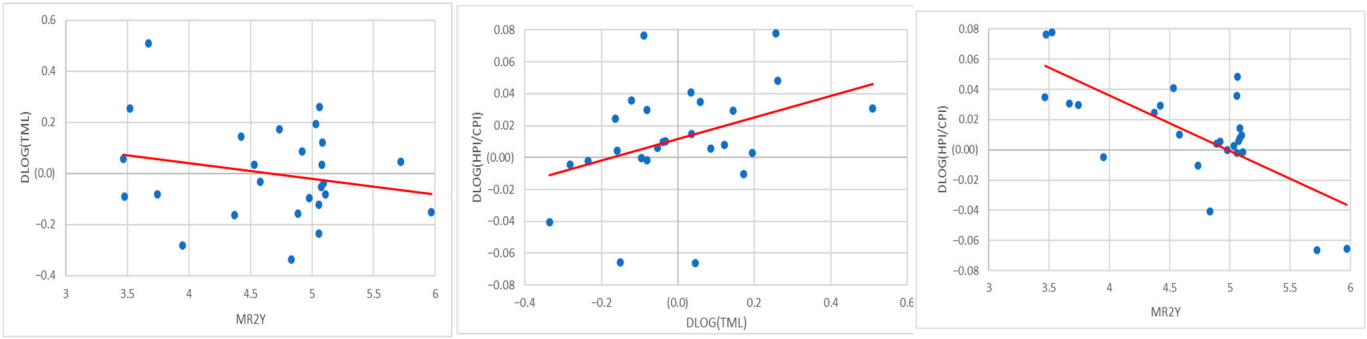
where TML_t, $MR2y_t$, GDP_t, BCI_t, CPI_t, and HPI_t are total mortgage lending, mortgage rate, gross domestic products, building consents issued, consumer price index and house price index of New Zealand at time t. The last two variables $dlog(TML_{t-1})$ and $dlog(HPI_{t-1}/CPI_{t-1})$ in the equations are to control for the autoregressive effects of total mortgage lending changes and real house price changes in a one-quarter lag; c_i, β_i, γ_i are coefficients to be estimated, and $\varepsilon_{i,t}$ are the error terms.

The study period is from 2016Q1 to 2022Q3 to provide a balanced time series with four-year control period before the first shock and three-year testing period after the first shock. The two shocks are the recessionary period after the outbreak of COVID in 2020 and the inflationary period since 2022. They act as natural quasi-experiments to test the monetary policy hypotheses in the mortgage rate effect on total mortgage lending and real house prices. The systematic risk of direct real estate is not considered in the models as it has been found to be relatively small in the New Zealand housing markets (Yiu et al. 2022).

4. Results

Before presenting the regression results, some casual observations based on scatterplots of total mortgage lending changes, real house price changes, and mortgage rates are examined first. Figure 3 shows the correlation scatterplots of total mortgage lending changes and mortgage rates of New Zealand in the period. The correlation plots confirm a negative association between mortgage rates and total mortgage lending changes and a positive association between total mortgage lending changes and real house price changes as shown in the left and the middle panels of Figure 3. The negative association between real house price changes and mortgage rates is also very strong with a correlation coefficient of -0.72 as shown in the right panel of Figure 3. Since there are other uncontrolled factors,

such as economic growth and housing supply, that can impose crucial effects on mortgage lending and real housing prices, more robust time series regression models are exploited to test the hypotheses in the ensuing paragraphs.



A negative (correlation coefficient = −0.22) association between dlog(TML) and MR2y

A positive (correlation coefficient = 0.37) association between dlog(HPI/CPI) and dlog(TML)

A strongly negative (correlation coefficient = −0.72) association between dlog(HPI/CPI) and MR2y

Figure 3. Scatterplots of total mortgage lending quarter-on-quarter changes, real house prices quarter-on-quarter changes and mortgage rates of New Zealand, 2016Q2–2022Q3.

Table 3 shows the empirical results of the time series regression models on the total mortgage lending and real house prices. In the TML model (Model 1), most of the coefficients are statistically significant, and the sign and magnitude of the MR2y coefficient is negative at about −8.6%. It confirms the first hypothesis of the negative impact of mortgage rates on the changes of total mortgage lending, ceteris paribus. The strong positive association of the changes of GDP and total mortgage lending reflects the importance of market confidence on economic growth and on mortgage lending decisions.

Table 3. Results of the regression models.

Dependent Variables	Model 1—Total Mortgage Lending $dlog(TML_t)$	Model 2—Real House Prices $dlog(HPI_t/CPI_t)$	Model 3—Combined Full Period $dlog(HPI_t/CPI_t)$
Constant	0.417 (2.17) *	0.001 (0.27)	0.128 (2.78) **
$MR2y_t$	−0.086 (−2.12) *		−0.027 (−2.88) ***
$dlog(GDP_t)$	3.171 (4.26) ***	−0.129 (−0.87)	0.150 (1.24)
$dlog(CPI_t)$	−6.736 (−1.67)		
$dlog(BCI_t)$		−0.054 (−1.09)	−0.024 (−0.48)
$dlog(TML_t)$		0.110 (3.46) ***	
$dlog(TML_{t-1})$	−0.167 (−1.12)		
$dlog(HPI_{t-1}/CPI_{t-1})$		0.825 (6.07) ***	0.400 (1.95) *
No. of Observations		25 (2016Q3–2022Q3)	
Adj. R-sq	0.495	0.650	0.605

Figures in parenthesis are t-statistics, ***, ** and * represent p-value $\leq$ 0.01, 0.05 and 0.10, respectively.

In the RHP model (Model 2), the sign and magnitude of the TML coefficient are positive at about 11.0%. It shows the strongly positive impact of mortgage lending on house prices. The significance of the results of Models 1 and 2 provide rigorous evidence

by means of the natural quasi-experiments on the monetary policy hypothesis. In contrast, the alternative hypotheses of economic growth and housing supply cannot be confirmed by Model 2, as the effect of economic growth (GDP) is found to be negative and statistically insignificant on real house price changes. Housing supply effect (BCI) is also found to be statistically insignificant.

The above results establish the causal links from mortgage rate to total mortgage lending and from total mortgage lending to real house prices. Model 3 further combines Models 1 and 2 to directly test the mortgage rate effect on real house prices. The result confirms the negative impact of mortgage rates on real house prices, ceteris paribus. The result is also much stronger in statistical significance than Model 1. The coefficients of the change of building consents issued and economic growth are still insignificant. The empirical result can be interpreted as a 1% change in mortgage interest rate caused a 2.7% change in house prices in the opposite direction, ceteris paribus, in this six-year period, with an expansionary and then an contractionary monetary policy being implemented.

Robustness Tests

The inclusion of the pre-COVID period serves as a temporal control, when a modest expansionary monetary policy was implemented. In order to ascertain that the associations between mortgage lending, mortgage rate, and real house prices are valid after the outbreak of COVID-19, the following four robustness tests confining the data to specific periods were conducted with the results being shown in Table 4.

Table 4. Results of the robustness tests.

Dependent Variables	**Model 1a—Total Mortgage Lending (COVID Period)** $dlog(TML_t)$	**Model 2a—Real House Prices (COVID Period)** $dlog(HPI_t/CPI_t)$	**Model 3a—Combined (COVID Period)** $dlog(HPI_t/CPI_t)$	**Model 3b—Combined (Pre-COVID Period)** $dlog(HPI_t/CPI_t)$	**Model 3c—Combined (Expansionary Period)** $dlog(HPI_t/CPI_t)$
Constant	0.328 (1.11)	0.001 (0.56)	0.257 (2.71) **	0.170 (2.08) *	0.098 (2.80) **
$MR2y_t$	−0.072 (−0.94)		−0.056 (−2.83) **	−0.036 (−2.05) *	−0.019 (−2.70) **
$dlog(GDP_t)$	3.315 (3.25) **	−0.382 (−1.70)	0.101 (0.63)	1.082 (1.19)	0.145 (1.59)
$dlog(CPI_t)$	−5.158 (−0.62)				
$dlog(BCI_t)$		−0.152 (−1.38)	−0.123 (−1.04)	−0.022 (−0.64)	−0.030 (−0.79)
$dlog(TML_t)$		0.196 (3.34) **			
$dlog(TML_{t-1})$	0.009 (0.04)				
$dlog(HPI_{t-1}/CPI_{t-1})$		0.830 (4.46) ***	−0.062 (−0.15)	0.678 (2.76) **	0.393 (2.19) **
No. of Observations		11 (2020Q1–2022Q3)		14 (2016Q3–2019Q4)	21 (2016Q3–2021Q3)
Adj. R-sq	0.497	0.759	0.705	0.270	0.561

Figures in parenthesis are t-statistics, ***, ** and * represent p-value $\leq$ 0.01, 0.05 and 0.10, respectively.

Models 1a, 2a and 3a repeat the tests of Model 1, 2 and 3 by restricting the data to the COVID period (Q1 2020–Q3 2022). Basically, the signs of the major coefficients are the same as in their corresponding models on the full period. Yet, as the number of observations is reduced to 11 quarters, the statistical significances of the coefficients are mostly weakened. However, Model 3a still found a stronger negative (−5.6%) and significant effect of mortgage rate on real house prices in the COVID period.

In contrast, Models 3b and 3c confine the data to the pre-COVID period (Q3 2016–Q4 2019) and the whole expansionary period (Q3 2016–Q3 2021), respectively. The results both confirm the negative effects of mortgage rate on real house prices in the two periods, but the magnitude is even stronger in the pre-COVID period (−3.6%) than the whole expansionary period (−1.9%). The three models' results imply that the contractionary policy imposes a much stronger impact on housing markets than the expansionary one, but in opposite directions. In addition, the negative effect of mortgage rate on real house prices is valid in both the pre-COVID period and the COVID period. The magnitude of the association is also similar to the result found by Chadwick and Nahavandi (2022) of the Reserve Bank of New Zealand. Intuitively, the magnitude of the effect seems to be underestimated in comparison with the casual observations, as the house price index fell by 53.7% when the mortgage rate was cut from about 4.89% to 3.52% from 2019Q1 to 2020Q4 and rose by 11.0% when the mortgage rate was up from 3.52% to 5.97% from 2020Q4 to 2022Q3. It is probably because the casual observations have not taken into account other factors' effects and the compounding effect.

5. Discussion

This is a novel attempt to apply natural quasi-experiments with both treatment and reversal treatment to study the monetary policy hypothesis on housing markets. There are two major contributions of this study. First, it is different from many previous studies relying on econometric methods to deal with confounding and endogeneity biases. This study takes the monetary policy changes in the COVID period as a treatment and a reversal treatment of the quasi-experiments. Second, unlike other previous studies that just consider one policy change as the treatment, this study is unique in harnessing pandemic shock and global inflation shock as two exogenous shocks to study the monetary policy hypothesis. Specifically, the RBNZ responded to the shocks by two completely opposite monetary policies. After the outbreak of the pandemic, the RBNZ encompassed an expansionary monetary policy by reducing the interest rate to unprecedented lows and removed the loan-to-value ratio in mortgages to investors. However, in response to the global inflation, especially after the outbreak of the Russia–Ukraine war in February 2022, the RBNZ switched swiftly to a contractionary monetary policy by increasing the interest rate to record highs and tightening the loan-to-value ratio of mortgages to investors. These swift changes in monetary policy provided interventions to the mortgage markets and the housing markets for examining the causal links of the public policy changes on mortgage loans and house prices.

Applying a quasi-experimental approach to the pandemic shock and the global inflation shock in this period can first exclude the possibility of one-sided evidence that may be caused by other confounding biases such as a housing supply issue. For example, Yiu (2021) found a global house price increase after imposing an expansionary monetary policy in 2020. Yet, as an alternative hypothesis, the house price rise could also be caused by the shortage of housing supply due to the disruptions of the supply chains after the outbreak of the pandemic. This study, however, provides the stylized facts and empirically tests the impacts of both the expansionary and the contractionary policy changes within a short period of time in one country, and the proxies of housing supply and economic growth are also incorporated in the empirical models to test the hypotheses. Since the disruptions of the supply chain still existed in 2022, construction and material costs were still increasing, and the swift change of the monetary policy from an expansionary to a contractionary approach since May 2021 was a second treatment (reversal treatment) of the quasi-experiments with the construction disruption factor unchanged. The plummet of house prices when the central bank increased the policy rate provided a critical test on the alternative hypotheses. The empirical results confirm the impacts of monetary policy change on total mortgage lending and house price changes. In contrast, the results do not support the housing supply hypothesis and the economic growth hypothesis.

Better still, the analysis of the New Zealand housing markets can also exclude the migrants' effects, as this is one of the most common conjectures in the alleged causes of high housing prices, especially in New Zealand. This is because since the Overseas Investment Amendment Act came into effect in late October 2018 in New Zealand, non-citizens and non-residents are restricted from buying residential land and existing properties. The housing boom and bust after the outbreak of the pandemic was unlikely to be driven by the demand changes of migrants.

The empirical results confirmed a slight deceleration in house price growth in the wake of the COVID-19 shock but a strong surge in house prices when the central bank launched the expansionary monetary policy, including a deep cut in the interest rate to an unprecedented low and a removal of all the LVR restrictions. More importantly, the house price index fell when the central bank switched from the expansionary policy to a contractionary one, including a series of swift and continuous increases of the interest rate and tightening of the LVR restrictions. As the shock and the two policy changes happened within a short period, we can exclude the demographic change effects, such as population size and cultural shift in the preference of home ownership, etc.

Since the 1990s, the effects of most of the financial crises in developed countries lasted for a long period. For example, the Asian Financial Crisis in 1998 caused a long-lasting recessionary period in many countries in Southeast Asia, and the Global Financial Crisis in 2008 also triggered a long period of low to ultra-low interest rates in many developed countries. It is hard to find appropriate sample periods to test the switching effects of both an expansionary and a contractionary monetary policy on housing markets in the past three decades. Specifically, due to the long period of low interest rates coexisting with continuous economic growth, population growth and housing supply shortages, it is hard to disentangle the impacts of monetary policy from GDP growth, home demand growth, or insufficient supply. These coexistences create difficulties in using policy changes as quasi-experiments. This is probably the first time that we experienced two swift changes of monetary policy caused by two exogenous global shocks. It provides the first opportunity for considering the two monetary policy changes as a treatment and a reversal treatment in quasi-experiments to mitigate endogeneity biases in the empirical tests.

The method and the findings of this study provide a solution to the challenge of reversal causality bias in the previous studies of macroeconomic determinants of house prices (Gerlach and Peng 2005; Goodhart and Hoffman 2008). The causality relationship between interest rates and house prices has been found with both decreasing and increasing interest rates in the wake of the global recession after the outbreak of the pandemic and the global inflation after the outbreak of the Russia–Ukraine war. It confirms Arestis and González's (2014, p. 487) proposition that "changes in the mortgage rate negatively affect the demand for credit because this means a significant change in the user cost of dwelling, which provokes a change in the demand for housing".

6. Conclusions

This paper aims to test the two hypotheses of the causal links from monetary policy to mortgage loans and from mortgage loans to house prices through natural quasi-experiments considering the COVID-19 pandemic and global inflation as two exogenous shocks. The Reserve Bank of New Zealand swiftly switched its monetary policy in response to the global shocks, which are considered as two interventions (treatment and reversal treatment) in the housing markets, with the economic condition and the housing supply condition being controlled. The study considers a period of 26 quarters from 2016Q2 to 2022Q3 to cover a balance of data points shortly before and after the outbreak of COVID-19 in 2019Q4. The period before the pandemic is included as the control group. Time series regression models are used to test the hypotheses. The results confirmed (i) the negative effect of mortgage rate on total mortgage lending change, (ii) the positive effect of total mortgage lending change on real house price change, and (iii) the negative effect of mortgage rate on real house price change. The robustness tests confining the data to the COVID period also

confirm the monetary policy hypothesis. In addition, the alternative hypotheses of housing supply and economic growth effects on house price change are statistically insignificant.

The major contributions of this paper are the exploitation of the two swift changes in monetary policies in opposite directions within two years. It provides a unique opportunity to test the monetary policy hypotheses in both expansionary and contractionary policy periods. It is a basic requirement in experimental studies that both a treatment group and a control group are provided for comparing the differences. However, it is hard to have a control group in macroeconomic studies, such as the monetary policy hypothesis, because of the contagious nature of financial crisis and the highly intertwined globalized financial markets. For example, in the wake of the pandemic, an almost synchronized expansionary monetary policy was implemented by almost all the central banks of developed countries. This study, however, investigates the impacts of both expansionary and contractionary monetary policies in the housing markets of New Zealand. The change in the policy provides a reversal in the treatment for comparing the treatment effects as suggested by Meyer (1995) and Gippel et al. (2015). First, the pre-COVID period data provide a baseline result before receiving any policy treatments. Second, the substantial interest rate cuts and the removal of LVR restrictions impose a positive treatment on the housing markets for comparing the expansionary policy effect with the pre-COVID control group. Third, the swift change of the policy from an expansionary to a contractionary one, including several interest rate hikes and tightening of the LVR restrictions, can be considered as a reversal treatment for comparing the contractionary policy effect with the expansionary group and the control group. It is a strong test to mitigate endogeneity biases as the confounding factors are mostly one-sided. For example, the claim of a disruption in the supply chains causing insufficient housing supply could only result in higher house prices, which could only be a plausible alternative explanation for the positive effects of an expansionary monetary policy on house prices but not for any negative effects of a contractionary monetary policy on house prices.

However, the study is limited by taking only the mortgage rate change as a proxy of the monetary policy change without explicitly considering the changes of the loan-to-value ratio and the restrictions on various types of borrowers, etc. Yet, since the changes on all these monetary policies are in the same direction, either an expansionary or a contractionary one, their effects can be reflected by the mortgage rate changes. The study may also be limited by some unobservable idiosyncratic disruptions caused by COVID-19, which may render the period an outlier, but the large number of previous studies as well as the robustness test on the pre-COVID period finding the negative association between interest rate and house prices in the world before the pandemic (Otrok and Terrones 2005; Arestis and González 2014, 2016; Geng 2018) can ease our minds on the outlier concern. The major contention in the previous findings is on the endogeneity bias, which can partly be addressed by means of this study using a quasi-experimental approach. Lastly, the findings are also limited by assuming a linear relationship between mortgage rate and house prices. It deserves a further study to explore the non-linearity effect of mortgage rate on house prices.

The findings of this study are applicable to other countries, as the exogenous shocks are global phenomena. The study has been extended to a cross-ten-OECD-country panel analysis and found a similar result, which is to be separately reported in another paper (Yiu forthcoming). An important research implication of this study is in further developing quasi-experimental methods for housing studies to deal with endogeneity bias issues. The practical implication of this study is also crucial in the spillover effects of monetary policy on the housing markets. Since central banks have a pivotal role in ensuring economic and financial stability, they switched from an expansionary monetary policy to a contractionary one in response to the change from a global recession to a global inflation. Gnan (2021) raised the concern of the 'potential side effects' of monetary policy in disrupting house prices, as housing markets can be one of the biggest risks to the economies and the financial systems as evidenced in the Global Financial Crisis in 2008. The findings of this study on

the New Zealand housing markets shed light on the importance of the macroprudential policies, such as the loan-to-value ratios and loan service-to-income ratios, in preventing asset booms and busts.

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Note

[1] In March 2021, the restrictions were reinstated to: (a) a maximum of 20% of new lending at LVRs above 80% for owner-occupiers; and (b) a maximum of 5% of new lending at LVRs above 70% for investors. In May 2021, the restrictions were tightened to a maximum of 5% of new lending at LVRs above 60% for investors. In November 2021, the restrictions were further tightened to a maximum of 5% of new lending at LVRs above 40% for investors.

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