Shattered Dreams: House Prices and New Zealand Monetary Policy

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Abstract

New Zealanders all once aspired to home ownership, for many that dream has now been shattered. This paper looks at house price inflation in New Zealand, examining the relationship between the Official Cash Rate (OCR) and bank mortgage interest rates. The OCR is the Reserve Bank of NZ's (RBNZ) main monetary policy tool, which they apply to honour the Governor's contract with the Minister of Finance, of maintaining price stability. We examine the degree of pass through, from the OCR to retail mortgage rates, in the period July 2001 until November 2012. A period of interest not only of interest because of the 2008 Global Financial Crisis, but because pre crisis the RBNZ was increasing the OCR to dampen a booming economy while post crisis they dramatically slashed the OCR in response to a worsening global economic outlook. We find there is little pass through from the OCR to retail mortgage rates and conclude that if government wants to manage housing affordability the RBNZ would require a different tool set.

Keywords: House Price Inflation, Monetary Policy, Inflation Targeting, OCR, Interest Rate Pass-through

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Introduction

Provision of shelter is a basic need of all mankind (Maslow, 1943) and in New Zealand, most people aspire to owning their own home (Morrison, 2007). However, recently, this dream has become distant for New Zealanders living in Auckland, This is significant given that the population of Auckland equates to 34% of the total population. In addition Auckland is the largest growing region in New Zealand as a result of high net domestic immigration (Statistics New Zealand, 2009). There is some need to pay attention to how and where the growing population, especially of Auckland will be accommodated. Figures dealing with housing and house affordability are fraught with political meaning. For example the level of owner occupier housing has been falling from a high of 73% in 1991 to 63% by 2006 (Morrison, 2007) while a report released by the New Zealand Treasury in 2013 suggested that house ownership was constant outside of Auckland (Law & Meehan, 2013). The more universal outlook is presented by the Deputy Prime Minister Bill English (2013) who reports data as showing a substantial decrease in housing affordability. In the thirty years since 1980 it has gone from twice the median income to 5.3 times the median income. While English (2013) says "*housing affordability is an important focus for the New Zealand Government*" an IMF report on New Zealand (2013) and the RBNZ's current Governor Graeme Wheeler (2013) believe house prices will continue rising for some time.

This period also coincides with a fundamental change in the political and financial management of the New Zealand economy. From the mid-1980s New Zealand followed, and to certain extent still follows a radical neo-liberal, managerialist and monetarist ideology in relation to government management, (Saul, 2009, pp. 210-214). By the turn of the century a great deal of the negative factors associated with the reforms had been accepted and the New Zealand economy was growing. This in turn provided a degree of security to those in employment and encouraged citizens to enter into mortgage agreements to buy housing.

However, not all of this activity in the housing market was from owner occupiers as property investing was increasingly seen as an attractive alternative, to bank deposits or equities, for retail investors. Some investors built substantial portfolios as price rose, initially borrowing against their existing home and subsequently their investment properties. New Zealand banks facilitated this activity as they aggressively competed for mortgage business and by the time of the Global Financial Crisis (GFC) in 2007 it was not uncommon for New Zealand Banks to be lending 95 to 100% of a property value to property buyers. It was obvious that by January 2007 housing was in a boom.

After the GFC housing took a little time to recover, however by the time of writing in December 2013 New Zealand and Auckland in particular finds itself caught in another real estate boom. An apparent housing bubble is a significant concern of both Graeme Wheeler and Bill English as the inevitable bursting of the bubble could have a devastating impact on the New Zealand economy and individual households through falling asset prices and unpaid loans (Fallow, 2013; Small & Harris, 2013). This is because for New Zealand households their house is their only significant investment. As of March 2013 New Zealand households had a collective net wealth of $710 billion with a net equity in housing of $490 billion (RBNZ Staff, 2013a).

In many ways the answer to house price affordability is simple, house prices, like any other asset is a function of supply and demand. Anything which reduces the supply, such as limited land for development and or building regulation will increase prices. Just as an increase in demand from population growth will also increase prices. In New Zealand, particularly in areas such as Auckland, and to a lesser extent Wellington and post-earthquake Christchurch there has been a reduced supply and increased demand, consequently house prices have increased relative to the national average. The aim of this paper is to examine the impact of monetary policy on housing in New Zealand. The remainder of this paper provides an overview of monetary policy in New Zealand, with its emphasis on inflation. This is followed by a review of selected literature related to inflation targeting. From this literature a number of hypothesises are developed which are then tested. Results are discussed before being brought together in the conclusion which will hopefully guide future economic policy in New Zealand.

Background

New Zealand has operated under four monetary policy systems, the gold standard, a managed float, direct economic management and an open access deregulated economy

(Quigley, 1992). Prior to the First World War New Zealand, in common with most other countries employed the gold standard. Following the war, when the gold standard had been suspended, rather than returning to the gold standard New Zealand employed a managed floating exchange rate with a fiduciary monetary system. However this was unable to cope with the Great Depression (1929 to the outbreak of the European war 1939). From the 1930s the government had a hands on approach to monetary policy; controlling monetary instruments, setting interest rates at a low level and closely managing the balance of payments as well as regulating the asset portfolios of financial institutions. Such direct control of the financial system became so complicated and unwieldy the operations of New Zealand's financial markets were in danger of imploding by the early 1980s. These factors along with, and largely as a result of, its poor economic management the government of Robert Muldoon, the main instigator of such regulation, was ousted in 1984.

Immediately after the 1984 election Prime Minister elect, David Lange, the leader of the incoming government, was faced with an economic crisis when the RBNZ, still acting under the instructions of the previous government announced that it was ceasing to convert New Zealand dollars to foreign currency causing a rapid outflow of funds (Evans, Grimes, Wilkinson, & Teece, 1996). After a minor constitutional crisis the incoming government, which had not yet been signed in, was able to persuade the outgoing government to float the New Zealand dollar. This action, resulted in an immediate devaluation of the currency, reversed the flow of currency back into the country. The newly elected government, with little economic policy of their own[1], appeared to unquestionably follow economic advice from the Treasury. As result New Zealand converted rapidly to a free market economy, of which one plank, was for monetary policy to focus on price stability.

The New Zealand focus on inflation targeting was formalised in the Reserve Bank of New Zealand Act 1989 in which the RBNZ was charged[2] with operating monetary policy to achieve and maintain price stability. Price stability is measured by changes in the Consumer Price Index (CPI) [3] and the Governor of the RBNZ is required to maintain it in a pre-determined band. This target band, currently 1% to 3%, is determined by the Finance

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[1] 1984 was a *snap* election thus the opposition political party had little time to develop policy.

[2] The RBNZ is also required to promote the maintenance of a sound and efficient financial system and carry out other functions, and exercising powers, specified in the Act

[3] The Consumer Price Index (CPI) measures the inflation in the country which is evaluated by the weighted average price changes of goods and services that are purchased by New Zealand households. The CPI is evaluated quarterly by Statistics New Zealand.

Minister of New Zealand in consultation with the Governor of RBNZ and formalised in the Policy Target Agreement (PTA).The Governor then has operational independence to apply monetary policy to achieve the policy target. Since 1999 the main monetary policy tool has been the Official Cash Rate (OCR). The OCR is the base interest rate applying to registered bank settlement accounts. All registered banks hold settlement accounts with the RBNZ and are used to reconcile the bank payment system at the end of day. Registered banks are allowed to borrow from (lend to) their account at 25 Basis Points over (under) the OCR as needed. Changes in the OCR are expected to be reflected in all other interest rates in the New Zealand economy, thus influencing economic activity and hence the rate of inflation. The principle underlying the system is if inflation is expected to increase (decrease) outside the PTA band increasing (reducing) the OCR will increase (reduce) market interest rates thereby reducing (increasing) economic activity and thus containing inflation within the PTA band. The OCR is reviewed eight times a year to ensure the OCR is at a sufficient level to control inflation.

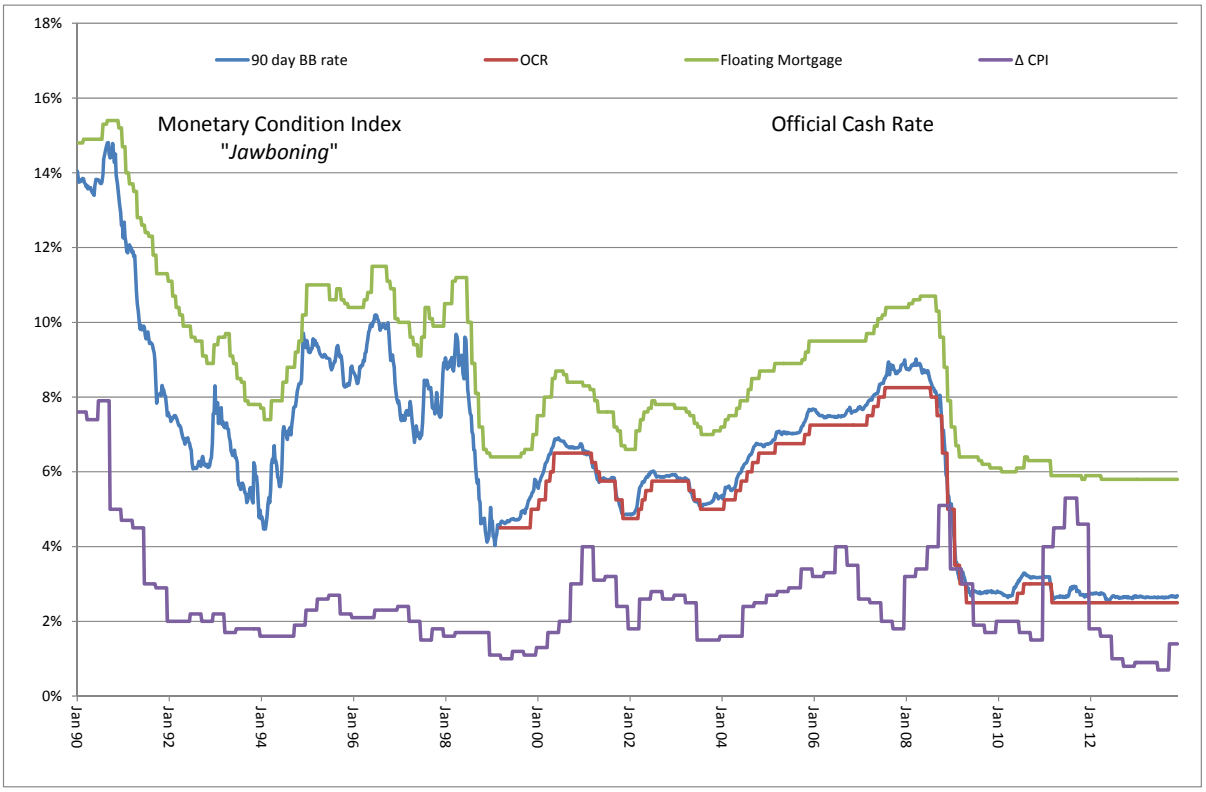
Monetary policy has been successful in maintaining New Zealand's goal of price stability. Inflation in New Zealand the 1970s and 80s averaged over 11%, whilst in the 1990s when inflation targeting was first introduced[4], inflation fell to an average of 2.4%. and since 1999 inflation has averaged around 2.5%. While there can be little argument that the Governor of the RBNZ has been successful in moderating inflation as measured by the CPI, the CPI is based on a *basket* of goods so reports an average inflation rate for the *basket*. One area which has been problematic is house price inflation, which since 2000 has averaged around 6.7% (Law and Meehan, 2013).The aim of this paper is to examine the relationship between the OCR and bank mortgage interest rates by measuring its pass through to bank mortgage interest rates.

Inflation targeting is now not unique as countries such as Australia, Canada, Chile, Norway, Poland, South Africa, the United Kingdom and the Euro Zone all subsequently adopted similar policy (Reserve Bank of New Zealand, 2007). There are now more than 20 countries using inflation targeting as their monetary policy. The adoption of inflation targeting monetary policy has successfully lowered inflation with evidence of its success apparent in New Zealand, Canada, UK and Germany without negative effects on the

[4] Inflation targeting in the 1990's was based on a Monetary Conditions Index which looked at a number of factors in addition to interest rates. The system was not transparent and required the Governor of the RBNZ to *jawbone* market participants in order to achieve the inflation target.

economy (Mishkin & Posen, 1997). Inflation targeting was also shown to be beneficial during the Global Financial Crisis (GFC) controlling inflation, and limiting volatility hence containing the adverse effects of the GFC (Roger, 2010). A cursory examination of Figure 1 shows a substantial drop in the CPI since 1990 and since the introduction of the OCR in 1999 there has been an apparent drop in the volatility of interest rates. Although since the introduction of the OCR the CPI has broken out of the PTA band of 1% to 3% on four occasions, this has only been for short periods of time, and the average CPI over the OCR has been 2.5%.

Figure 1: 90 Day Bank Bill Rate, OCR, Floating Mortgage and Δ CPI

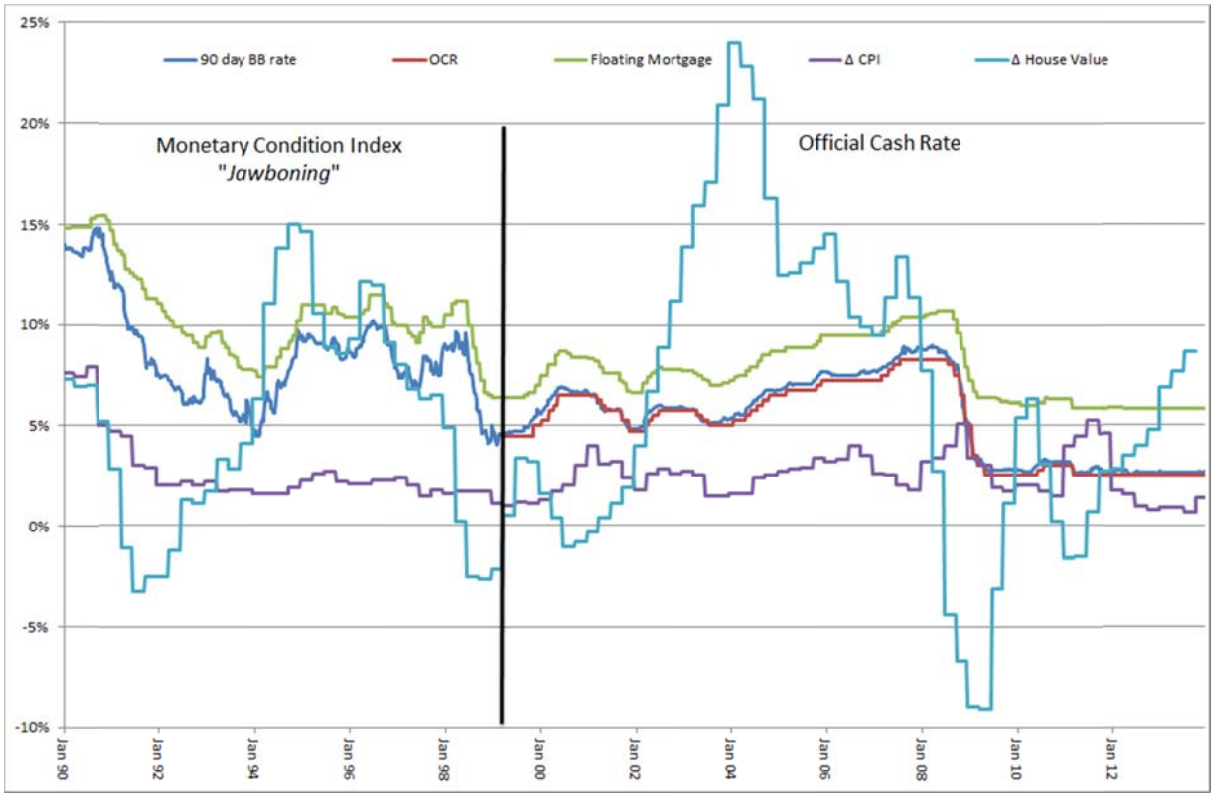


Source:(RBNZ Staff, 2013b)

Despite the overall success of inflation targeting in New Zealand one area of concern is its lack of impact on housing price inflation. Figure 2 which includes the annual change in house price suggests the RBNZ's inflation targeting has had little impact on house price inflation. During the MCI era house price inflation which in the 1990s started at over 7% fell to below -3% before rising steadily to 15% in 1995 and then fell to -2.6% just before the introduction of the OCR. The range for house price inflation in the OCR period is even more extreme, as after a minor spike in 2000 it increased dramatically to 24% at the end of 2004 after which it fell to 13% by 2007 before plummeting to under 9% in mid-2009. Since the low in 2009 it has climbed again and in Quarter 3 2013 it was up to 8.7%. New Zealand

house price inflation appears to be very sensitive to economic growth as four of the five low points in Figure 2 coincide with recognised low points in the economy. In 1990-91 the New Zealand economy went through considerable upheaval due to government policy changes. For example in 1998-99 the New Zealand economy felt the impact of the Asian currency crisis and in 2001-02 New Zealand received some fallout from the collapse of the *Dot Com* bubble. Although the largest drop in house price inflation coincided with the GFC, from the end of 2007 New Zealand appears to have done comparatively well in terms of house prices with the drop in house prices less and the recovery quicker than in other developed economies.

Figure 2: 90 Day Bank Bill Rate, OCR, Floating Mortgage, Δ CPI and Δ Housing Value



Source:(RBNZ Staff, 2013b)

While the Minister of Finance and the Governor of the RBNZ can take comfort, from Figure 2, of inflation being largely under control for the last twenty years the same cannot be said for house price inflation and despite some corrections house price inflation in New Zealand over the period has average 5.9%. However statistics from Quotable Value show inflation to be uneven across the country, whereas overall house price inflation from September 2009 to September 2013 for 5 years has been 17.4%, house price inflation in the Auckland region has been 30.6%, with a peak of 41.6% in South Auckland (Statistics NZ Staff, 2013). The Reserve Bank of New Zealand Act 1989 details two main purposes for the

RBNZ; firstly the formulation and implementation of monetary policy to achieve price stability; and secondly the promoting the maintenance of a sound and efficient financial system (NZ Parliament, 2013A (1) (a) (b)). Rampant house price inflation impacts directly on CPI as the new housing category comprises 4.66% and actual rentals for housing[5] comprises 7.85% of the CPI Basket (Statistics NZ Staff, 2008). However the RBNZ must be concerned about house price inflation and the maintenance of a sound and efficient financial system as the bursting of a housing bubble would devastate New Zealand banks who have the bulk of their loans portfolios in residential property mortgages. The RBNZ's move to limit lending with Loan to Value Ratios (LVR) greater than 80% is intended to reduce systemic risk derived from imbalances in the housing market (Wheeler, 2013 November). The LVR rules are an attempt by the RBNZ to address the dilemma they have faced since the GFC, that is how to restrict house price inflation without damaging the economy.

The remainder of this paper addresses the pass-through of changes in the OCR to mortgage rates to determine the impact of changes on mortgage interest rates and ultimately house price inflation. Initially, it was assumed that a change in the OCR would completely and immediately pass-through to retail rates thus controlling demand and inflation. Mortgage interest rates, especially floating rates, are an effective mechanism to assess the impact of regulation on economic activity as they have a direct effect on household disposable income and subsequently the level of discretionary spending.

Literature Review

Investigations in the early 2000s mostly find high or complete long-run retail interest rate pass-through of changes in the OCR. For instance, (Bondt, 2002) among other findings in his study for the Euro area found that market interest rate changes pass-through to long-term bank deposit and lending rates was higher than that of short-term rates and the pass-through for bank long-term lending rates was close to 100%. In addition Hofman and Mizen (2004) found that the pass-through to mortgage interest rates was complete in the UK. While later studies by Sorensen and Werner (2006); and Rocha (2012) show incomplete pass-through of market interest rates to bank interest rates, especially towards long-term lending rates. These assessments indicated an increasing incomplete pass-through of the changes in market interest rates.

[5] Actual rents charged tenants is a function of house value.

The pass-through of the policy rate change to the retail interest rate in Thailand has also been found to be weakening over time (Charoenseang and Manakit, 2007). The same has been the case in Ghana (Kovanen, 2011) where the degree of pass-through of a change in the policy rate has fallen.

In relation to the inflation targeting monetary policy in New Zealand, Svensson (2001) in his independent review of the operation of monetary policy in New Zealand stated that New Zealand's monetary policy was really good at controlling medium-term inflation targets and also avoiding unnecessary variability in interest rates and exchange rates. In his review, he suggested that the use of an alternate method to predict inflation for the medium and long-term would increase the long-term credibility of the monetary policy.

Tripe, McDermott, and Petro (2005) found monetary policy was more effective after the introduction of inflation targeting in New Zealand. This did not imply that the degree of pass-through was better for all interest rates. They found a significant increase in the degree of pass-through for floating rates but a small fall in the degree of pass-through for fixed mortgage rates with one, two and three-year maturity.

Liu, Margaritis, and Tourani-Rad (2008) looked at the transparency of monetary policy examining the degree of pass-through and the adjustment speed of retail rates as a result of changes in the OCR. They also, like Tripe et al. (2005), found that the introduction of the OCR increased pass-through of floating rates and deposit rates but not fixed mortgage rates; also, the immediate pass-through of market rates was incomplete to bank retail rates. They also showed that OCR changes control short-term rates more than long-term ones.

The difference between the studies by Tripe et al. (2005)and Liu et al. (2008) is the former were checking whether or not the introduction of OCR was more efficient that before the introduction of the OCR, while Liu et al. (2008) took it a little further to check the extent to which the introduction of the OCR would affect the degree and the adjustment speed of the pass-through of changes in market rates.

Sethi (2008), writing at the beginning of the GFC, in an assessment for the RBNZ, concluded inflation targeting policy in New Zealand was very effective. This conclusion was derived as the transmission of changes in the OCR was observed to have significantly passed through to the retail interest rates. The only change in the transmission through interest rates was the lag was longer in the 2000s than in the 1990s. More recently Santiago and Coble (2011), conclude that the interest rate channel is still effective in New Zealand. In their paper,

the pass-through of the money market instead of the policy rate (OCR) to real interest rates was observed.

While the above literature shows the effectiveness of the OCR as a monetary policy tool, Chetwin and Reddell (2012), in their research for the RBNZ, state that since the GFC and the following recession, the OCR does not act as a proxy for a bank's cost of funds. This is due to increased external costs that banks in New Zealand have to bear due to a lack of available domestic funding. This directly affects the pass-through of changes in market interest rates to retail rates indicating that the OCR may not be as effective.

Since the end of the GFC in early 2009, Figure 1 shows the spread between the OCR and the retail interest rates has widened, which the International Monetary Fund (2011) putd down to increased competition for deposits states. Here increased deposit competition is the competition faced by banks in New Zealand to raise deposits (increased costs). This competition is due to the low availability of deposits in the local market and increased difficulty in attracting overseas funds. Recently Shi, Jou, and Tripe (2013) infer the presence of fixed and floating mortgage rates makes it difficult for the RBNZ to be able to control housing prices. Shi et al. (2013), also find that an increase in the OCR does not lower the real housing prices and they also point out the presence of a housing bubble in the current housing market. Adding to this possibility of the OCR being ineffective, ASB Economist Leung (2013) writing in the ASB Business Economic Weekly stated that the absence of the overall inflationary pressure, the RBNZ is not increasing the OCR and hence not reacting to the rising house prices in New Zealand. She also reports that the continuation of the combination of rising housing prices and weak broad inflation pressure could lead to RBNZ needing to use macro-prudential tools to subdue rising housing prices.

Other macro-prudential tools available to the RBNZ[6] are the countercyclical capital buffer (CCB), minimum core funding ratio (CFR), sector capital requirements (SCR) and restrictions on high loan-to-value ratio (LVR). These are primarily designed to prevent and make use of in the case of a banking crisis. However in 2013 the RBNZ attempted to dampen house price inflation when it required banks to limit high LVR lending to less than 10% of their mortgage books. LVR restrictions took effect from October 1 and the RBNZ reported an almost immediate drop in high LVR lending with a fall from over 25% in September to

[6] The RBNZ also has an exchange rate intervention power to prevent a currency crisis, if any (Hunter, 2008).

11.7% in October (Spencer, 2013a). Although it has been too early to judge if this action has impacted on house price inflation, there has been a reduction in enquiries for new house construction. As a result the RBNZ moved in December to exempt new construction from bank LVR restrictions with Deputy Governor Grant Spencer (2013b) saying "*this exemption will help to support the supply of new housing and, in doing so, reduce some of the pressure arising from excess demand in the New Zealand housing market*".

Quantitative Analysis

The only tool the RBNZ appears to be left with to address house price inflation is the OCR. It is therefore an opportune time to determine the effectiveness of the OCR as a monetary policy tool by evaluating the pass-through of a change in the OCR to the mortgage rates. To determine the efficiency of the monetary policy tool (OCR) to control house price inflation in New Zealand, the following hypotheses are tested.

Hypothesis 1: The OCR alone completely explains the retail mortgage interest rates charged by the banks.

If the above stated hypothesis is true, then the OCR is completely efficient as a change in the OCR would be completely passed on to the mortgage interest rates. If the above hypothesis is not true, then it means that the OCR alone does not explain the mortgage interest rates and that the degree of pass-through of a change in the OCR to the interest rates would need to be examined to determine the effectiveness of the OCR to control house price inflation.

Hypothesis 2: The data is non-stationary.

Data is non-stationary when there is presence of a unit root and hence the OCR is cointegrated with each of the different mortgage rates. If this hypothesis is true, then the estimates determined from hypothesis 1 (using the OLS regression) will have an overestimated parameter which leads to spurious regression and other correction techniques needing to be used to find the actual relationship parameter of the OCR and each of the mortgage rates. If the stated hypothesis is rejected, then the data is stationary and the model determining the parameters in hypothesis 1 (using the OLS) is accepted as the model to determine the degree of pass-through of a change in the OCR to the mortgage rates.

Hypothesis 3: The OCR is an efficient monetary policy tool to control house price inflation in New Zealand.

The above stated hypothesis will be true if a change in the OCR is completely passed over to the mortgage interest rate. Since OCR is the main determinant of retail interest rates in New Zealand, the parameter determining the relationship between the OCR and each of the mortgage rates is the parameter that determines the long-run estimate of the pass-through of the OCR to the mortgage rates. This parameter needs to be significantly (at 5% confidence level) equal to 1 if the pass-through is complete and the monetary policy is completely efficient. If the pass-through is estimated to be significantly (at 5% confidence level) equal to 0, then the OCR can be assumed to be completely inefficient as a monetary policy tool.

Methodology

Hypothesis 1: To test the first hypothesis, the relationship between each of the mortgage rates and the OCR is determined. This relationship can be stated as the following:

$$y_t = \alpha_0 + \alpha_1 x_t + \varepsilon_t , \qquad (1)$$

where y_t is the mortgage rate and x_t is the OCR, α_0 and α_1 measure the bank's margin and the degree of long-run pass-through respectively, and ε_t is the error term.

To find a quantitative value of this relationship, the above equation is regressed using the Ordinary Least Squares (OLS) method. The OCR theoretically should completely explain the interest rates that banks charge their customers, here, the mortgage rates. If this is true, then the OLS regression should result in α_1 equalling 1, indicating a complete pass-through (Liu et al., 2008).

Hypothesis 2: The long-run parameter of the mortgage rate explained by the OCR found using the OLS is not necessarily true. This is because the OCR and the different mortgage rates could be cointegrated. Non-stationary cointegration between variables typically results in the overestimation of the correlation coefficient of the two variables, hence sometimes resulting in false positives. To prevent overestimation of the explanatory long-run parameter, the presence of a unit root is checked for. The Augmented Dickey-Fuller (ADF) test is conducted to check for a unit root. The test is expected to result in the hypothesis not being rejected because the two rates keep changing continuously, making their mean and variance change continuously, and hence resulting in non-stationary data and a spurious regression.

Hypothesis 3: After determining the presence of a unit root (which is expected as the OCR and retail interest rates are expected to move together), the long-run parameter is estimated again after correcting for autocorrelation and non-stationary cointegration

problems. The non-stationary problem is addressed by adding leads and lags (or two-sided lags) of the first difference of the OCR (x_t variable), while the autocorrelation problem is addressed by adding the lags of the error correction term.

Traditionally, to eliminate this problem, Moshin (2011), Sorensen and Werner (2006), and Tripe, McDermott et al. (2005) used lag transformations to control for the existence of cointegration and used these transformed cointegrated time series data to generate an Error Corrected Model (ECM) by using any one of the cointegrated regression estimation methods – a fully modified pass-through estimator, a canonical cointegration regression estimator, a dynamic OLS by Phillips and Hansen (1990), Park (1992) and Stock and Watson (1993) respectively – to estimate the long-run pass-through of changes in the OCR to the retail bank mortgage interest rates.

The traditionally used method was concluded by (Liu et al., 2008) to have some limitations and they adopted a new and improved model built to overcome these limitations. This model was derived by Phillips and Loretan (1991) to estimate long-run economic stability. To estimate the long-run parameters, (P. Phillips & Loretan, 1991) used Nonlinear Least Squares (NLS) regression. The model has the following long-run relationship estimation equation:

$$y_t = \alpha + \alpha_1 x_t + \sum_{k=1}^{K} d_{1k}(y_{t-k} - \alpha_0 - \alpha_1 x_{t-k}) + \sum_{i=-l}^{L} d_{2i}\Delta x_{t-i} + \nu_{1t} \qquad (2)$$

where K and L represent the lag order *between the OCR and the respective mortgage rate,* and Δx_t is the first difference in x_t.

This estimation model includes two-sided lag differences to eliminate the endogeneity problem. It accounts for the changes occurring over time in the OCR and their effect on real interest rates making this a more suitable model than the previous used methods (Liu, Margaritis et al., 2008). This model also takes into account the effect of the OCR changes in the past and in the future, thus making this model more accurate than previously used models in the other previously mentioned studies.

Data

To analyse the degree of pass-through and assess the effectiveness of the OCR as a monetary policy tool in controlling house prices, the dependent data used is that of the different types of Mortgage Interest Rates offered by each of the top five New Zealand banks, namely ANZ, ASB, BNZ, National Bank and Westpac. The different types of mortgage interest rates include floating, 6 months, 1, 2, 3, 4 and 5 years fixed interest rates. The

independent variable in the analysis is the OCR. The data for all variables are weekly based with a sampling period from the 20 July 2001 to 2 November 2012. The last date of the sampling period is selected to match the closing date of the National Bank to keep the analysis of all the banks consistent. The above mentioned five banks are selected as these banks together account for more than 75% of the whole financial market share in New Zealand. Kiwibank, another current major bank in New Zealand, has not been selected as the bank commenced trading in the first week of February 2002 and the bank did not offer all the mortgage interest rate options that are being assessed below. For consistency purposes, this bank has been ignored. Additionally, Kiwibank, though a popular bank, does not hold as much market share as do the other banks.

The data in the analysis is split into three distinct parts: pre GFC, GFC and post GFC from the beginning of the sampling period to the week ending 9 August 2007, from the week ending 16 August 2007 to 2 April 2009 and from the week ending 9 April 2009 to the end of the sampling period. The weekly data was obtained from a New Zealand based finance company, interest.co.nz, specializing in topics relating to interest rtes.

A robustness check has also been performed, for which the data has been obtained from the RBNZ website. The data used for the robustness check is the average monthly mortgage interest rate data of all the registered banks in New Zealand. This data only includes floating and 2-year mortgage interest rates offered by the banks.

Results

Hypothesis 1 Result:

The results from the OLS regression of the different types of mortgage interest rates of the five banks against the OCR are exhibited in Table 1. The results clearly show that none of the slopes, α_1, are equal to 1, indicating incomplete pass-through of a change in the OCR through to the mortgage interest rates. The result of the slope being highly significant at a 5% confidence level could imply that the mortgage rates are not explained by the OCR alone. Hence, the first hypothesis is rejected.

Results from the OLS regression also show the slopes of the mortgage rates to decrease with an increase in the maturity of the mortgage, indicating that changes in the OCR are passed through at a higher rate to mortgage rates with shorter maturities than to ones with longer maturities. The slopes of the mortgage rates not equalling 1 could also mean that there

is a possibility of missing variables in the equation used and that the OCR is not the only variable that explains the cost of funds for banks to create mortgages.

The t-values from the regression are very high at over 100 for floating mortgage interest rates. From previous statistical knowledge, such high t-statistics usually suggest the presence of high serial correlation, also known as autocorrelation.

Hypothesis 2 Result:

The results from the ADF test performed on each variable, summarized Table 2, show the presence of a unit root in them. The results indicate that the variables are non-stationary and hence hypothesis 2 is not rejected.

Accepting hypothesis 2 means that any analysis done using these variables without correcting for their non-stationary property would result in spurious results. This also implies that the results from the OLS regression earlier are unreliable. The variables have unit root of the order I(1). To correct for spurious results resulting from non-stationary variables in the OLS regression, the first difference of the variables can be used. Table 3 contains the OLS regression outputs of the first difference of the OCR with each of the mortgage interest rates. The results show that a change in the OCR significantly helps predict a change in the mortgage interest rates. The estimator, though significant at a 5% confidence level, it is very low in terms of R-squared. R-squared for the regression is lower than 20% for almost all the results, indicating that the OLS regression does not closely explain the relationship between the OCR and each individual mortgage interest rate for each individual bank. A better fitting model, taking into consideration the autocorrelation problem from the first hypothesis testing and the cointegration of non-stationary variables resulting from the second hypothesis testing, needs to be used to analyse the pass-through of a change in the OCR through to mortgage interest rates.

Hypothesis 3 Result:

The long-run relationship between the OCR and the mortgage interest rates is estimated using the equation stated earlier in the methodology. The results from the NLS regressions for the whole sampling data and for the three different periods are recorded in Table 3 and Table 5 respectively. The results in a nutshell show incomplete pass-through of a change in the OCR through to the mortgage interest rates, and hence OCR is an inefficient monetary policy tool. And so hypothesis 3 is rejected. The OCR is proved to be an inefficient

monetary policy tool with respect to mortgage rates and the justification leading to this conclusion is explained in detail below.

The slope (α_1) in the results represents the degree of pass-through of a change in the OCR to the retail mortgage rates. This slope as mentioned earlier and as specified by (Liu et al., 2008) in their study, needs to equal 1 and needs to be significant to indicate a complete pass-through. The results in Table 3 show significant pass-through at a 5% confidence level but the pass-through degree is at a maximum of 86.46% for Westpac's floating mortgage rates and all the other mortgage rates for all the banks are lower, implying that there is incomplete pass-through for all mortgage rates.

The degree of pass-through of change in the OCR decreases with increasing maturity of the mortgages. For example, the degree of pass-through of a change in the OCR through to a 5-year mortgage is much less than it is through to a 3-year mortgage. This is probably due to other factors – like the probability of the interest rates rising, the uncertainty of the future resulting in higher default risk with an increase in time – affecting the cost and risk factors included in longer-term mortgages issued by the banks. The pass-through of a change in the OCR through to the five banks' 4- and 5-year fixed rate mortgages is insignificant at a 5% confidence interval. If the mortgages issued by the banks are long-term at fixed rates and if the pass-through to long-term mortgages is insignificant, this makes it very difficult for the monetary policy to be efficient and control the savings and expenses of people in the economy through tightening and loosening the OCR and thus, it makes this monetary policy inefficient as a monetary policy.

Floating rate mortgages are the most common type of mortgages. They have the highest degree of pass-through from a change in the OCR. Though it is not complete, the pass-through is significant for the overall data and is around 80%. This figure though high, is lower than the pass-through that (Liu et al., 2008) estimated in their study. The pass-through for floating rate mortgages was around 93% with a 5% confidence level, a whole 13% more than the degree of pass-through as observed in Table 3. As mentioned earlier in the Literature Review section, the degree of pass-through has been seen to be reducing through the years and the results in Table 3 compared to the results from the research done by (Liu et al., 2008) show the same, lower degree of pass-through than in previous years.

The period of study in this report includes the pre and post GFC and during the GFC, where the banks' and the markets' activities were different. Keeping this fact in mind, the

period of the GFC (period 2) is analyzed separately along with before GFC (period 1) and after peak GFC period (period 3). The three distinct sections are specified earlier in the Data section of the report. NLS regressions of the long-run estimator equation for each of the three different periods were performed and the results are produced in Table 5. The NLS regression of the long run estimator shows the pass-through in the first period, the period before the beginning of the GFC, to be higher than the pass-through obtained from analyzing the whole data for floating, 6 months, 1-year, 2-year and 3-year mortgages, while the pass-through for 4 and 5-year mortgages are quite similar at around 30% and 25% respectively. The difference in the pass-through for mortgage rates from floating to 3 years differed from around 30% to around 10% respectively.

The results for period 1 are also similar to the results that (Liu et al., 2008) have estimated in their research with only the pass-through to the floating rates being higher in the research now than before.

By looking at Table 5 it can be noticed that almost all the estimates of the pass-through obtained from the NLS regression are the highest in the three periods but not significant. Floating and 6-month mortgage interest rates of BNZ and 6-month mortgage interest rates of ASB and Westpac are the only significant estimates at a 5% confidence level. This result could be indicative of the type of funding of the three banks, that the three banks – ASB, ANZ and Westpac – are funded excessively by liabilities other than interbank borrowings – like attracting increased retail deposits – for the short-term mortgages issued by these banks while the other two banks extensively use interbank or wholesale funding to fund their short-term mortgages.

Another important result seen in Table 5 is that the pass-through estimates for period 2 are all significant with the exception of three estimates – 3 and 4-year pass-through estimates of ASB and the 5-year pass-through estimate for BNZ. The extremely significant high pass-through in this period could be pinned on the aspect that the banks were on high alert at that time due to failure of banks in the USA and due to non-availability of funds from foreign markets. So, the banks had to rely heavily on raising funds locally either through interbank wholesale borrowings or retail deposit funding rather than overseas funding to fund their loans.

The pass-through in period 3, in Table 5, is completely insignificant implying no efficient pass-through. This could be a result of increased competition among the banks and

decreased reliance on wholesale funding. Mainly increased competition in the banking sector has pushed the banks to go for cheap available funds to fund their assets to try and win over the competition while not losing customers. This attitude of the banks has caused changes in the OCR to not pass-through to retail mortgage interest rates, thus making the OCR inefficient and causing it difficulty in containing inflation.

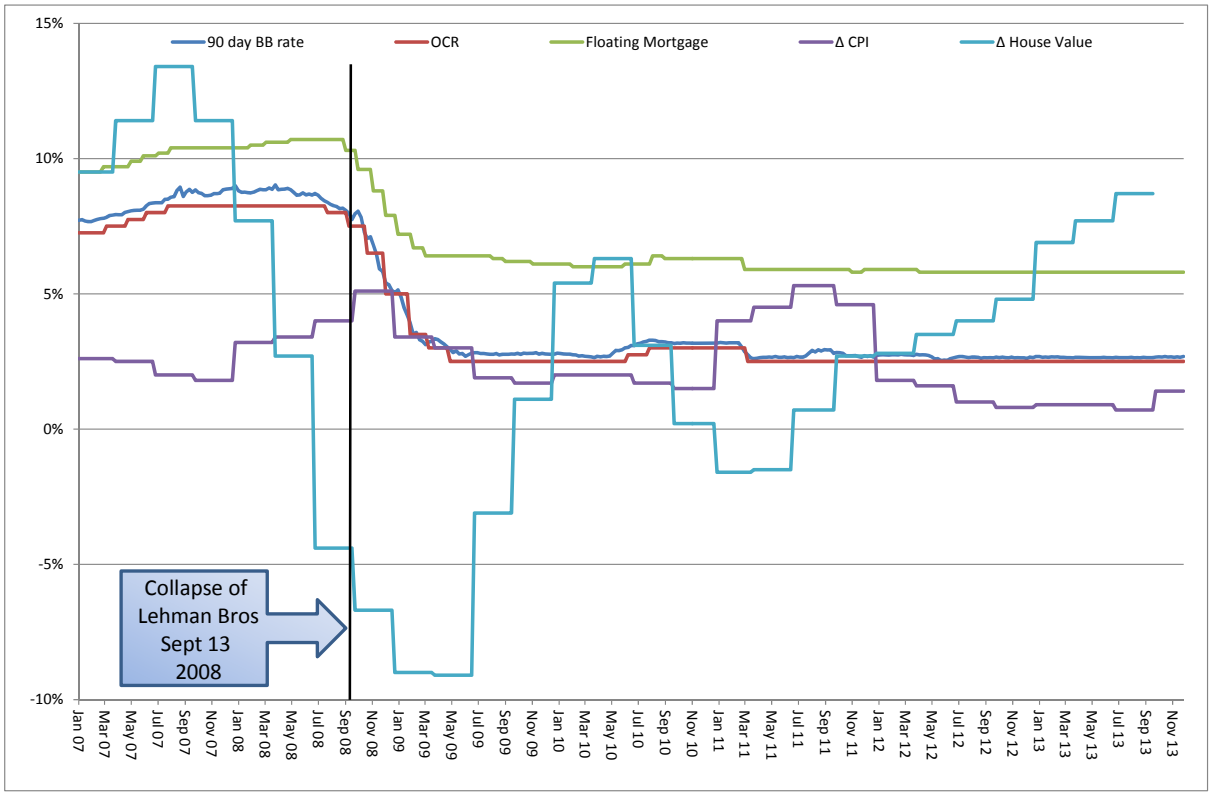
Another reason for the reduced pass-through in period 3, Table 5, could be due to very low OCR rates, 3% and below in this period, since the introduction of inflation targeting in New Zealand in 1999. A robustness check has been performed to support the results that have been concluded from regressing the long-run cointegration equation to estimate the pass-through of a change in the OCR through to the mortgage interest rates. To test this, the average monthly data of floating and 2-year fixed mortgage interest rates has been analyzed. The whole data and periods 1 and 3 have been tested and the results are posted in Table 6. Period 2 has not been tested for in the robustness check as the total number of sample data in this period too small (17 data points) to be able to get a correct estimate. The results in Table 6 complement the conclusions drawn so far. The degree of pass-through is not significant for period 3, which is similar to the Table 5 results, and the degree of pass-through for the whole data and for period 1 are similar to the results Table 3 and Table 5 both with 5% confidence level.

The robustness check confirms that the estimates obtained in Table 4 and Table 5; and the conclusions made from them are indeed correct. The degree of pass-through of a change in the OCR through to mortgage interest rates means the OCR is no longer an efficient monetary policy tool. From this it is therefore hardly surprising, that since the GFC, house price inflation is out of control.

Examination of house price inflation in Figure 3 shows house price inflation was falling prior to the GFC and was in fact negative when Lehman Bros collapsed in September 2008; house price inflation remained negative until the third quarter of 2009. In comparison the RBNZ reduced the OCR by 25bps from its high of 8.25% (July 24, 2008), then on the collapse of Lehman Bros a further 50bps (September 11), this was followed with further cuts of 100bps (October 23), 150bps (December 4), 150bps (January 29, 2009), 50bps (March 12) and a final cut of 50bps to finish at 2.5% (30April). In all the OCR fell 5.75% in less than a year, the CPI which had been outside the target band at 5% in the third quarter of 2008 fell to 1.9% over the same period. CPI remained at this level until the last quarter of 2010 when it

rose to 4%, before hitting 5.3% in the second quarter of 2011 before falling again to 1.8% in the last quarter of 2011.

Figure 3: 90 Day Bank Bill Rate, OCR, Floating Mortgage, Δ CPI and Δ Housing Value



The RBNZ since April 2009 has kept the OCR at 2.5%, apart from a brief period when it increased to 2.75% on June 10, 2010, then 3% on July 29 before reversing it to 2.5% on March 10, 2011. The banks to some degree are doing the work of the RBNZ in keeping a check on inflation as the margin between the OCR and floating rate mortgages has increased from 250bps pre GFC to 450bps post GFC. This combined with a visual examination of the period suggests the OCR had little impact on the CPI and even less on house price inflation.

Conclusion

New Zealand monetary policy is very simple and straightforward. Its sole target is inflation as measured by the CPI. The RBNZ's tool of choice for inflation targeting is the OCR with changes in the OCR passing through to all other interest rates in the economy. Changes in interest rates directly impact on the disposable income of both households and businesses, thereby stimulating or restricting economic activity to maintain the CPI in the mandated band. The results of this and other investigations to date would suggest the RBNZ has been reasonably effective in controlling inflation. However, this research indicates that

post GFC, the OCR has had little impact on mortgage interest rates. Although inflation as measured by the CPI appears under control house price inflation has continued unabated.

House price inflation appears largely independent of the OCR, the only time there appears to have been a direct impact was in 2001 when the RBNZ moved the OCR above 5% and house price inflation responded by dipping into negative territory (Figure 2). If there was a significant pass-through of a change in the OCR through to housing price, then the housing bubble which occurred from 2002 to 2007 should not have occurred. The OCR in this period ranged from 4.75% at the beginning of the 2002 year to 8.25% by the end of 2007, house price inflation in this period rose rapidly to peak at 24% in 2004 before dropping to a more manageable 13% in 2007. From the beginning of 2008 house price inflation fell rapidly into negative territory. The fall in 2008 predates both the GFC (which many date as the collapse of Lehman Bros) and the RBNZ's slashing of the OCR in last quarter of 2008. Since the beginning of 2009 although the OCR has been set at 2.5% (apart from a brief move to 3%) house price inflation has again moved well above the CPI. Clearly there must be forces other than the RBNZ's OCR which is driving house price inflation.

A problem facing the RBNZ could be, it is simply not possible to control both CPI and house price inflation with one tool. By keeping the OCR at 2.5% they are stopping the New Zealand economy from slipping into recession, but a low OCR is also stimulating house price inflation. Anytime house price inflation is above mortgage interest rates it is entirely rational to borrow in order to invest in property further driving house price inflation. If the RBNZ was to address house price inflation by increasing the OCR it would need to increase it to a very high level which would severely damage the rest of the economy. It has recently attempted to address house price inflation by introducing a limit[7] on high loan to value ratio mortgages written by registered banks. While it is too early to judge the impact on house price inflation, of this restriction, there was immediate criticism of it unfairly targeting first home buyers. This was then followed by a reported downturn in sales enquiries to new home building firms. The RBNZ in December moved to exempt new residential construction loans from the restriction to reduce some of pressure from excess demand in the New Zealand housing market.

[7] Banks will are required to restrict new residential mortgage lending at LVRs of over 80 percent to no more than 10 percent of the dollar value of their new housing lending flows.

It is looking more likely that house price inflation is beyond the control of the RBNZ. The solution to house price inflation and housing affordability in general lies in the economics of supply and demand for housing. If the price of housing is to be brought down either the supply of affordable housing needs to be substantially increased or demand needs to be reduced. For the supply to be increased there would need to be a proactive building programme which would likely need to be led by the government. Alternatively the government could more actively manage immigration, with the least affordable housing being in the Auckland region a solution to housing affordability maybe to require immigrants to live outside Auckland.

If the government is unwilling or unable to enter the housing market to affect change then best option may be to do nothing. Eventually the housing market must self-correct, how bad the correction is depends on what the government does beforehand. Government regulation of the housing market may simply postpone the inevitable and result in a larger correction. If house price inflation and housing affordability are Auckland problems then as prices increase in Auckland, demand will fall as Auckland residents and potential immigrants look elsewhere in the country to make their homes. Such action will be gradual and have little impact on other New Zealand regions. It is not possible to describe New Zealand real-estate as a bubble; at least not until it bursts.

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Appendix

Table 1: OLS Regression

	Floating			6-Months			1-Year			2-Years		
Bank	**Constant**	**Slope**	**R-squared**	**Constant**	**Slope**	**R-squared**	**Constant**	**Slope**	**R-squared**	**Constant**	**Slope**	**R-squared**
ANZ	0.0367 (85.5)*	0.7993 (103.5)*	0.9472	0.0395 (69.27)*	0.6152 (59.98)*	0.8577	0.0409 (79.29)*	0.5962 (64.32)*	0.8739	0.0506 (86.76)*	0.4443 (42.36)*	0.7503
ASB	0.0366 (93.76)*	0.7972 (113.42)*	0.9556	0.0397 (74.5)*	0.6114 (63.81)*	0.8721	0.0420 (81.97)*	0.5746 (62.29)*	0.8666	0.0505 (85.25)*	0.4455 (41.83)*	0.7455
BNZ	0.0360 (114.5)*	0.7879 (139.1)*	0.9701	0.0391 (65.89)*	0.6108 (57.28)*	0.846	0.0420 (80.91)*	0.5730 (61.39)*	0.8632	0.0510 (84.61)*	0.4231 (39.01)*	0.7181
National	0.0367 (82.24)*	0.7971 (99.77)*	0.9441	0.0393 (73.4)*	0.6196 (64.62)*	0.8764	0.0410 (77.15)*	0.5923 (62.3)*	0.8682	0.0508 (88.56)*	0.4409 (42.91)*	0.7576
Westpac	0.0357 (86.45)*	0.8158 (109.83)*	0.9528	0.0376 (77.47)*	0.6491 (74.37)*	0.9026	0.0406 (81.73)*	0.6006 (67.16)*	0.8831	0.0499 (89.87)*	0.4556 (45.58)*	0.7767
	3-Years			4-Years			5-Years					
Bank	**Constant**	**Slope**	**R-squared**	**Constant**	**Slope**	**R-squared**	**Constant**	**Slope**	**R-squared**			
ANZ	0.0589 (95.07)*	0.3255 (29.22)*	0.5882	0.0654 (100.6)*	0.2332 (19.93)*	0.3989	0.0705 (109.94)*	0.1567 (13.58)*	0.2349			
ASB	0.0583 (92.69)*	0.3345 (29.55)*	0.5936	0.0644 (95.24)*	0.2477 (20.36)*	0.4092	0.0700 (102.28)*	0.1603 (13.02)*	0.2202			
BNZ	0.0589 (90.28)*	0.3187 (27.16)*	0.5524	0.0651 (92.93)*	0.2329 (18.47)*	0.3629	0.0705 (98.94)*	0.1490 (11.63)*	0.1835			
National	0.0592 (95.00)*	0.3199 (28.66)*	0.5821	0.0659 (100.78)*	0.2249 (19.22)*	0.3847	0.0709 (109.3)*	0.1485 (12.8)*	0.2165			
Westpac	0.0579 (95.03)*	0.3416 (31.18)*	0.6193	0.0650 (99.26)*	0.2391 (20.28)*	0.4074	0.0699 (103.83)*	0.1644 (13.59)*	0.2352			

Notes: The results of the degree of pass-through of a change in the OCR through to each of the different mortgage interest rates, for the 5 largest banks, measured by OLS is displayed above. The slope represents the pass-through rate. The values in the brackets are the t-statistics. * indicates significance at a 5% confidence level.

Table 2: ADF Test Results

ADF test								
rate	**t-stat**	**p-value**	**rate**	**t-stat**	**p-value**	**rate**	**t-stat**	**p-value**
ANZ			ASB			BNZ		
floating	-1.5927	0.7507	floating	-1.6656	0.7198	floating	-1.5875	0.7529
6months	-1.4778	0.7993	6months	-1.7518	0.6833	6months	-1.4745	0.8007
1 year	-1.3711	0.8445	1 year	-1.4761	0.8001	1 year	-1.7522	0.6832
2 years	-1.4919	0.7934	2 years	-1.7011	0.7048	2 years	-1.8835	0.6276
3 years	-1.7052	0.7031	3 years	-2.0038	0.5767	3 years	-1.7297	0.6927
4 years	-1.8437	0.6445	4 years	-2.1234	0.5261	4 years	-1.8197	0.6546
5 years	-2.1691	0.5067	5 years	-2.5275	0.355	5 years	-2.0557	0.5547
National Bank			Westpac			OCR		
floating	-1.561	0.7641	floating	-1.8037	0.6614	OCR	-2.0344	0.5638
6months	-1.4644	0.805	6months	-1.4284	0.8203			
1 year	-1.3991	0.8327	1 year	-1.6606	0.722			
2 years	-1.5073	0.7869	2 years	-1.5909	0.7515			
3 years	-1.7269	0.6939	3 years	-1.6752	0.7158			
4 years	-1.8138	0.6571	4 years	-1.9637	0.5937			
5 years	-2.1924	0.4969	5 years	-2.0274	0.5667			

Notes: The above table contains the results of the Augmented Dickey-Fuller (ADF) test. The t-stat and p-value of the results are presented. The ADF tests for "*Null Hypothesis: Non-stationary"* that is it test for the data for presence unit roots assuming non-stationary data. All the p-values in the results are >0.5 resulting in the null hypothesis being accepted.

Table 3: Regression of the First Difference

	Floating			6-Months			1-Year			2-Years		
Bank	**Constant**	**Slope**	**R-squared**	**Constant**	**Slope**	**R-squared**	**Constant**	**Slope**	**R-squared**	**Constant**	**Slope**	**R-squared**
ANZ	-1.251e-05 (-0.33)	0.3764 (11.9)*	0.1929	0.0000 (-0.187)	0.4427 (12.657)*	0.2131	-1.062e-05 (-0.255)	4.230e-01 (12.182)*	0.2004	-1.770e-05 (-0.430)	3.131e-01 (9.098)*	0.1221
ASB	-1.057e-05 (-0.298)	4.085e-01 (13.807)*	0.2438	-1.423e-05 (-0.327)	2.036e-01 (5.604)*	0.04917	-1.016e-05 (-0.233)	3.389e-01 (9.295)*	0.1268	-2.612e-05 (-0.601)	2.805e-01 (7.729)*	0.09081
BNZ	-1.536e-05 (-0.378)	3.247e-01 (9.564)*	0.1333	-5.393e-06 (-0.093)	2.715e-01 (5.577)*	0.0487	-2.187e-05 (-0.519)	1.882e-01 (5.347)*	0.04482	-3.574e-05 (-0.515)	5.996e-02 (1.034)*	0.0001173
National	-1.442e-05 (-0.375)	3.417e-01 (10.643)*	0.1603	-1.434e-05 (-0.383)	4.323e-01 (13.825)*	0.2443	-1.590e-05 (-0.362)	3.887e-01 (10.592)*	0.159	-2.054e-05 (-0.502)	3.385e-01 (9.907)*	0.1418
Westpac	-1.156e-05 (-0.324)	4.366e-01 (14.641)*	0.2662	-9.886e-06 (-0.257)	3.439e-01 (10.684)*	0.1614	-1.299e-05 (-0.334)	3.645e-01 (11.208)*	0.1749	-2.159e-05 (-0.547)	3.165e-01 (9.608)*	0.1344

	3-Years			4-Years			5-Years		
Bank	**Constant**	**Slope**	**R-squared**	**Constant**	**Slope**	**R-squared**	**Constant**	**Slope**	**R-squared**
ANZ	-0.0000193 (-0.453)	0.2348121 (6.597)*	0.06743	-2.291e-05 (-0.544)	1.233e-01 (3.505)*	0.01883	-1.838e-05 (-0.419)	1.285e-01 (3.505)*	0.01883
ASB	-1.949e-05 (-0.463)	3.237e-01 (9.195)*	0.1244	-1.798e-05 (-0.424)	3.356e-01 (9.469)*	0.131	-1.173e-05 (-0.257)	3.566e-01 (9.366)*	0.1285
BNZ	-2.758e-05 (-0.612)	2.078e-01 (5.522)*	0.04776	-3.145e-05 (-0.718)	1.069e-01 (2.921)*	0.01265	-2.758e-05 (-0.578)	8.486e-02 (2.128)*	0.005967
National	-1.954e-05 (-0.459)	3.074e-01 (8.648)*	0.1115	-2.151e-05 (-0.532)	1.947e-01 (5.765)*	0.05197	-1.594e-05 (-0.365)	1.727e-01 (4.741)*	0.03524
Westpac	-2.267e-05 (-0.527)	2.969e-01 (8.267)*	0.1028	-2.394e-05 (-0.550)	2.462e-01 (6.776)*	0.07097	-2.868e-05 (-0.634)	2.063e-01 (5.456)*	0.04665

Notes: The results of the degree of pass-through of a change in the OCR through to each of the different mortgage interest rates, for the 5 largest banks, using the first differenced data measured by OLS is displayed above. The slope represents the pass-through rate. The values in the brackets are the t-statistics. * indicates significance at a 5% confidence level.

Table 4: PL Long Run Pass Through Estimator

Dependent Variable	ANZ		ASB		BNZ		National		Westpac	
	A	*A1*	*A*	*A1*	*A*	*A1*	*A*	*A1*	*A*	*A1*
Floating	0.8288 (0.000027)	0.8612 (10.891)*	0.6765 (0.0000247)	0.8466 (12.824)*	0.0674 (0.0000131)	0.8005 (21.596)*	0.5765 (0.0000252)	0.8582 (12.727)*	0.7444 (0.0000246)	0.8646 (14.556)*
6-months	-0.0059 (-0.00000619)	0.6448 (4.900)*	0.1431 (0.0000318)	0.6063 (5.858)*	0.5746 (0.0000166)	0.5896 (6.966)*	0.4288 (0.0000224)	0.6749 (5.452)*	0.0024 (0.0000135)	0.6489 (7.485)*
1-year	0.0042 (0.00000634)	0.5860 (6.129)*	0.1417 (0.000045)	0.5554 (6.088)*	0.1695 (0.0000274)	0.5546 (4.713)*	0.8080 (0.0000214)	0.5860 (6.063)*	0.0207 (0.0000156)	0.5675 (5.432)*
2-years	0.0319 (0.0000131)	0.4202 (3.053)*	0.3805 (0.0000262)	0.4325 (3.243)*	-0.0220 (-0.00000549)	0.4161 (4.285)*	0.0340 (0.0000129)	0.4223 (2.988)*	0.1162 (0.00007)	0.4044 (3.317)*
3-years	0.0113 (0.00000988)	0.3065 (2.050)*	0.3304 (0.0000252)	0.3010 (2.190)*	0.1248 (0.0000471)	0.2976 (1.819)	0.5750 (0.0000227)	0.2925 (2.338)*	0.0041 (0.00000861)	0.3048 (2.448)*
4-years	-0.0095 (-0.0000102)	0.2405 (1.559)	0.7462 (0.0000195)	0.2239 (1.480)	0.4898 (0.0000217)	0.2679 (1.312)	0.2825 (0.0000321)	0.2187 (1.454)	0.0266 (0.0000111)	0.2267 (1.630)
5-years	0.6713 (0.0000217)	0.1477 (1.135)	0.6675 (0.0000201)	0.1298 (1.008)	0.9492 (0.0000227)	0.1682 (0.996)	0.0591 (0.0000207)	0.1369 (1.124)	0.5519 (0.0000166)	0.1564 (1.120)

Notes: The table shows the results of the Phillip-Loretan long-run pass-through estimate (Eq. (2) in the Methodology Section) for overall data, the period from 20th of July 2001 to the 2nd November 2012. The results show the summary of the coefficients of the constant *(A)* and the slope *(A1)* from the regression, where the slope represents the pass-through of a change in the OCR through to the mortgage interest rates. The values in the brackets are the t-statistics. * indicates significance at 5% confidence level. The results with a 5% confidence level indicate a significant pass through.

Table 5: PL Long Run estimator for Before, During and After the GFC

	Period 1					Period 2					Period 3				
Dependent	**ANZ**	**ASB**	**BNZ**	**National**	**Westpac**	**ANZ**	**ASB**	**BNZ**	**National**	**Westpac**	**ANZ**	**ASB**	**BNZ**	**National**	**Westpac**
Variable	*A1*	*A1*	*A1*	*A1*	*A1*	*A1*	*A1*	*A1*	*A1*	*A1*	*A1*	*A1*	*A1*	*A1*	*A1*
Floating	1.0894 (72.861)*	1.0775 (52.804)*	1.0492 (33.582)*	1.0936 (65.345)*	1.0518 32.351	0.8786 (12.328)*	0.8636 (17.528)*	0.8334 (7.65)*	0.8786 (12.328)*	0.9148 (12.216)*	1.2154 (1.666)	1.1531 (1.492)	0.9950 (4.224)*	1.2227 (1.842)	1.5206 (1.397)
6-months	0.9157 (10.08)*	0.9052 (9.42)*	0.9209 (12.129)*	0.9317 (13.69)*	0.8939 9.14	0.8172 (19.343)*	0.8106 (14.332)*	0.9062 (18.123)*	0.8187 (19.672)*	0.8313 (15.507)*	2.2922 (1.047)	1.2976 (3.551)*	1.2114 (7.227)*	2.0597 (1.862)	1.2556 (3.306)*
1-year	0.7437 (5.035)*	0.7995 (6.341)*	0.7562 (2.887)*	0.7856 (6.308)*	0.7362 6.705	0.7845 (12.451)*	0.7802 (14.13)*	0.7560 (11.021)*	0.7844 (12.59)*	0.8469 (5.207)*	1.0586 (0.556)	0.9370 (0.755)	0.8931 (0.595)	1.1366 (0.775)	1.4021 (1.087)
2-years	0.5067 (2.703)*	0.5244 (2.958)*	0.4897 (3.601)*	0.5241 (3.511)*	0.4679 2.955	0.6342 (5.839)*	0.7237 (11.305)*	0.6822 (19.598)*	0.6450 (6.566)*	0.5316 (0.896)	8.3091 (0.41)	6.1623 (0.39)	6.1165 (0.62)	7.2115 (0.409)	7.5046 (0.555)
3-years	0.3159 (1.98)*	0.3511 (1.846)	0.3095 (1.969)*	0.3319 (2.261)*	0.3004 2.243	0.5737 (9.702)*	0.6203 (7.818)*	0.5603 (6.597)*	0.5478 (6.284)*	0.6282 (9.781)*	32.7924 (0.071)	-41.7040 (-0.050)	10.4767 (0.197)	45.9813 (0.051)	4.9691 (0.438)
4-years	0.2501 (1.332)	0.2665 (1.589)	0.2485 (1.214)	0.2552 (1.62)	0.2079 1.615	0.4969 (8.368)*	0.2331 (0.374)	0.4180 (2.87)*	0.4545 (4.074)*	0.5501 (7.654)*	286.4990 (0.007)	37.5277 (0.052)	3.7902 (0.259)	110.3533 (0.016)	6.0322 (0.199)
5-years	0.1751 (0.946)	0.1560 (0.958)	0.1588 (0.834)	0.1735 (1.176)	0.1116 0.971	0.4217 (4.298)*	-0.3715 (-0.179)	0.3511 (1.779)	0.3826 (3.161)*	0.4732 (4.737)*	-23.3513 (-0.074)	-8.1480 (-0.170)	2.6017 (0.214)	107.6657 (1.124)	1.4428 (0.278)

Notes: The table shows the results of the Phillip-Loretan (PL) long-run pass-through estimate (Eq. (2) in the Methodology Section) for three different periods in the overall data. Period 1 is the period before the Global Financial Crisis (GFC), data ranging from weekending 20 July 2001 to weekending 9 August 2007.Period 2 is the period during the GFC, data ranging from weekending 16 August 2007 to 2 April 2009. Period 3 is the after the GFC, data ranging from weekending 9 April 2009 to weekending 2 November 2012.
The results shown are the summary of the coefficient of the slope *(A1)* from the PL regression, which represents the pass-through of a change in the OCR through to the mortgage interest rates. The values in the brackets are the t-statistics. * indicates significance at 5% confidence level. The results with a 5% confidence level indicate a significant pass through.

Table 6: Robustness Check

	Overall *(A1)*	**Period 1 *(A1)***	**Period 3 *(A1)***
floating	1.0393 (2.014)*	1.0433 (24.375)*	0.8422 (1.020)
2-years	0.4890 (4.259)*	0.4965 (6.296)*	2.7458 (0.285)

Notes: The table contains the slope *(A1)* of the Phillips-Loretan (PL) long-run estimate (Eq. (2) in Methodology Section). 'Overall' includes the whole data while Periods 1 and 3 represent pre-Global Financial Crisis (GFC) and post-GFC respectively. The data for during GFC is not used as the number of data samples was insufficient to get an accurate result.
The slope measures the pass-through of a change in the OCR through to the mortgage interest rates. The values in the brackets are the t-statistics. * indicates significance at a 5% confidence level. results with a 5% confidence level indicate a significant pass through.