Forward guidance and interest rate pass-through: Evidence from New Zealand

Abstract

This paper examines the impact of forward guidance in monetary policy on the short- and long-term pass-through of interest rates in New Zealand, the first country to implement explicit inflation targeting. The results show that forward guidance enhances the long-term pass-through, particularly for term deposit interest rates and long-term fixed mortgage rates. Additionally, we observe a reduction in the markup on various lending rates and a modest increase in the short-term pass-through following the implementation of forward guidance.

1. Introduction

Following the onset of the Global Financial Crisis in 2008, the economies of many developed countries faced significant challenges. To help their economies recover, central banks adopted accommodative monetary policies, initially by successively lowering policy rates. Once these rates approached their lower limits, central banks turned into unconventional measures, expanding their balance sheets significantly through large-scale asset purchases. Similar strategies were employed by many central banks during the more recent COVID-19 pandemic crisis.

A common theme of these policies, better known as quantitative easing, was to lower interest rates other than policy rates across a range of government and agency bonds of different maturities, as well as wholesale and retail interest rates. The effectiveness of these policies was greatly enhanced by central banks publicly announcing their commitment to keep policy rates low over the forecast horizon, a strategy known as forward-guidance (Bernanke, 2020).[1]

In monetary policy, forward guidance refers to the practice of central banks communicating clearly to the public its outlook for the future course of monetary policy. This communication plays a crucial role in shaping market participants' expectations, enhancing interest-rate pass-through by reducing uncertainty and anchoring long-term interest rate expectations. The effectiveness of forward guidance depends on its clarity, credibility, and consistency, making it particularly valuable during periods of low or near-zero interest rates. However, its influence can diminish if communication lacks transparency or if the central bank's credibility is in question.

The Reserve Bank of New Zealand (RBNZ) was the first central bank to adopt explicit inflation targeting within an innovative monetary policy framework built on three key pillars: operational independence, transparency, and accountability. Together, these pillars create a robust framework for the RBNZ, enabling it to effectively manage monetary policy and maintain price stability while fostering confidence among market participants and the public.

New Zealand provides a unique and interesting case for studying forward guidance in monetary policy due to its relatively small and open economy, strong institutional framework, history of policy innovation, and the central role of the housing market and financial stability in economic management. The RBNZ's approach to forward guidance, particularly in the

[1] With limited scope for further interest rate cuts, the central bank can use forward guidance to influence longer-term rates by convincing markets that rates will remain low for an extended period. This can help encourage borrowing and investment, enhancing pass-through even when conventional policy tools are constrained.

context of inflation-targeting and unconventional monetary policy, offers valuable insights into the effectiveness and challenges of this policy tool. A study on the New Zealand experience provides other researchers and policymakers useful insights to explore how forward guidance influences market expectations, economic behavior, and financial stability in general, and for small and highly interconnected economies more specifically.

The use of forward guidance initially evolved from central banks' recognition of the importance of transparent communication with markets about how interest rates are likely to respond to changing economic conditions. By clearly outlining the anticipated response of interest rates to evolving economic developments, forward guidance aims to reduce uncertainty about the economic outlook, thereby enhancing the effectiveness of monetary policy.[2]

More specifically, forward guidance can improve monetary policy transmission and interest rate pass-through by reducing policy uncertainty and increasing transparency in countries with a credible central bank. This is particularly the case in countries like New Zealand where the central bank enjoys a high degree of operational independence that allows it to implement monetary policy without political interference, thereby providing a relatively stable backdrop for analyzing the effects of forward guidance. In addition, the RBNZ has a strong commitment to transparency, publishing detailed statements about its policy decisions and the reasoning behind them. This is crucial for the effectiveness of forward guidance, as it helps guide market expectations and fosters public understanding of future policy moves.

[2] Inflation targeting and forward guidance are viewed as complementary tools in modern monetary policy. While inflation targeting anchors long-term expectations around price stability, forward guidance strengthens policy effectiveness by providing clearer insights into the future path of interest rates.

The concept of forward guidance at work has been around for a long time. For instance, in the early 1980s, Federal Reserve Chairman Paul Volcker explicitly communicated his goal of reducing inflation and outlined the steps the Federal Reserve would take to achieve it.[3] However, the theoretical framework for forward guidance within the context of the monetary policy reaction function was formally developed later by Woodford (1999) and Eggertsson and Woodford (2003). Their work emphasized that central bank communication is a powerful tool for shaping public expectations and enhancing policy effectiveness.

The adoption of forward guidance by the European Central Bank (ECB) and the Bank of England in 2013, at a time when both central banks had already reached the effective lower bound on interest rates, marked a turning point in the prominence of this policy tool. Since then, forward guidance has become a key focus in policymaking, serving as a crucial tool for central banks to influence inflation expectations and guide financial markets through their monetary policy strategies.[4]

Forward guidance generally falls into two categories: Delphic and Odyssean. Under the Delphic approach, the central bank forecasts the future path of interest rates without making any binding commitments to take specific actions in the future to reach those rates. In contrast, the Odyssean approach involves the central bank committing to achieve the target rates in the future. The guidance may be time-based, in which case the central back commits to a stance of

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[3] See Federal Reserve Bank of St Louis (2015), "The Origins of Unconventional Monetary Policy in the U.S." Annual Report.

[4] Forward guidance also has its drawbacks. As reported by the Financial Times (23 July 2022), the ECB was unable to react to soaring inflation by raising rates as early as many policymakers deemed desirable because of a commitment to forward guidance that eventually had to ditch after nine years of keeping rates low, according to people involved in the decision.

monetary policy over a specific period or state-based in which case the commitment horizon is conditioned on the state of the economy.[5]

Odyssean forward guidance is generally considered more effective in strengthening the transmission of monetary policy and improving interest rate pass-through (Campbell et al., 2012). As for the effectiveness of Delphic forward guidance, opinions are divided. Some scholars and policymakers argue that forward guidance can influence interest rates and affect macroeconomic outcomes (Melosi, 2017; Campbell et al., 2019; Bernanke, 2020; Goy et al., 2022). However, others contend that its impact may be limited in certain countries due to variations in policy transparency (Bianchi and Melosi, 2018) or as a result of an imperfect market (McKay et al., 2016; Hagedorn et al., 2019).

The Reserve Bank of New Zealand (RBNZ) commenced the practice of announcing a forward path for the policy interest rate into its regular procedures in 1997, becoming the first central bank to use published interest rate forecasts as a monetary policy tool. Explicit forward guidance was introduced in 2009 (Detmers et al., 2021).[6] RBNZ's approach to forward guidance is primarily predictive rather than commitment-based, and current research typically classifies it as Delphic in nature (Sutherland, 2023).

The Reserve Bank of New Zealand (RBNZ) issues a written statement on the state of the economy and policy outlook with every monetary policy decision. However, an interest rate forecast is published only with every second decision. Researchers have utilized this distinction

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[5] See Reserve Bank of Australia "Unconventional Monetary Policy": https://www.rba.gov.au/education/resources/explainers/unconventional-monetary-policy.html.

[6] On 29 October 2009, the RBNZ's monetary policy statement mentioned that "we expect to keep the OCR at the current level until the second half of 2010".

to analyze the relative impact of qualitative versus quantitative forward guidance. Their findings align with market participants' recognition of the conditional nature of the RBNZ's interest rate forecasts, reflecting an understanding that these forecasts are dependent on evolving economic conditions.

As former Fed Chairman Ben Bernanke pointed out, monetary policy is 2% action and 98% talk. By providing forward guidance on the future path of monetary policy, individuals and companies can make better financing and investment decisions. In theory, clear guidance on short-term policy rates is expected to affect long-term interest rates which are determined by the bond market and not by the central bank. However, in practice, the impact of forward guidance on long-term rates is an empirical issue as it depends on factors such as the credibility of the central bank, the type of forward guidance used, the competitiveness of the banking system, and other variables. For example, when the central bank promises to keep future short-term policy rates low, money market and bond traders can borrow short term and lend longer term when the yield curve is upward sloping. When the central bank is credible and reputable, trading strategies like gapping, carry trade, or riding the yield curve, can generate profits while also contributing to lower longer-term interest rates.

In this study, we examine whether the central bank improved the degree of interest rate pass-through by using Delphic-type forward guidance. We analyze the long-term relationship and the short-term dynamics to assess whether and how the adoption of forward guidance influences interest rate pass-through.

While commercial bank interest rates are widely recognized as being influenced by the RBNZ's predicted path for the official cash rate (OCR) in New Zealand (Liu et al., 2008), no comprehensive study has yet examined the precise impact of forward guidance on the transmission of interest rates. Our results show that forward guidance significantly enhanced the interest rate pass-through. In particular, the long-term pass-through of interest rates increased significantly, with the transmission of the OCR to retail interest rates, bar the floating rate, being almost complete.

Our study contributes to the interest rate pass-through literature. The existing literature on monetary policy forward guidance predominantly focuses on equity and bond markets in the United States and the Eurozone in particular. Few, if any, have examined how forward guidance affects the various interest rates set by banks. In almost every country, bank credit is the most important source of funds and the engine oil that keeps the economy running. Therefore, an in-depth examination of the transmission effects of forward guidance, especially its varying impact on different segments of the yield curve (including both short-term and long-term interest rates), is of significant practical importance for enhancing the country's monetary policy toolkit and improving policy effectiveness.

Our study also contributes to the existing literature on the impact of economic policy uncertainty. Previous studies have shown that higher policy uncertainty can lead to lower firm-level investment (Kang et al, 2014, Gulen and Ion, 2016), less technological innovations (Bhattacharya et al, 2017), greater financial instability (Phan et al, 2021), and declines in stock prices (Pastor and Veronesi, 2012). In this study, we examine empirically whether reduced economic policy uncertainty enhances the monetary policy transmission.

The rest of this paper is organized as follows: Section 2 reviews the literature. Section 3 outlines the methodology and data. The empirical results are reported and analyzed in Section 4. Section 5 presents our conclusion.

2. Literature Review

Forward guidance is a tool used by central banks to communicate future monetary policy to the public. The theoretical foundations of forward guidance were first introduced into central bank monetary policy by Woodford (1999) and Eggertson and Woodford (2003). Bilbiie (2019) advanced the concept of optimal forward guidance, which refers to the policy of maintaining low interest rates for an optimally preset interim period after the liquidity trap ends until the economy returns to normal conditions. Plosser (2013) argued that forward guidance is not an external policy action but rather a statement from the central bank about its future monetary policy actions, typically involving the likely future path of the policy rate or the future stance of monetary policy.

Traditionally, central banks have used forward guidance by releasing forecasts of key economic variables, such as inflation and real GDP growth, and communicating these to the public through press conferences, announcements, and speeches. Carney (2012) described forward guidance as a method of managing expectations -- essentially communication from the central bank about the future stance of monetary policy. This approach is particularly relevant when the policy rate reaches its lower bound, at which point forward guidance serves as a non-traditional monetary policy tool alongside quantitative easing and credit easing policies.

The impact of forward guidance on financial markets has been extensively investigated, with studies examining its effects on various markets, including the debt market (Detmers et al., 2021), the stock market (Gürkaynak et al., 2004), the futures market (Kuttner, 2001; Nakamura and Steinsson, 2018), and the currency market (Gali, 2020). Most studies confirm the significance of forward guidance. For example, Moessner (2015) analyzed the impact of the forward guidance provided by the Federal Open Market Committee (FOMC) on US Treasury yields and deemed it to be effective. Moessner (2013) examined the 3-month forward interest rates implied by Eurodollar futures at horizons of one to five years and showed that guidance announcements had the greatest impact on intermediate 3-year horizons. Additionally, a study on implied interest rates of US Treasuries at horizons of one to seven years found that guidance announcements had the most significant influence on intermediate horizons of four and five years. Swanson (2021) provided further supporting evidence by analyzing the impact of forward guidance on various financial indicators, including four currencies, equities, exchange rates, corporate bonds, and interest rate options, from 2009 to 2015. The study highlighted that forward guidance had a notably significant effect on short-term Treasury yields, particularly when the zero lower bound (ZLB) was in effect in the United States.

Sinha (2015) examined the impact of forward guidance by the FOMC on 2- and 10-year US Treasuries and the corresponding option contracts, finding a more pronounced effect on long-term asset yields. Ferreira (2022) confirmed that forward guidance is at least as effective, if not more than conventional financial tools in stimulating industrial activity in the United States. Similar conclusions were drawn by Natvik et al. (2020) in their studies of Norway and Sweden.

Bianchi and Melosi (2018) analyzed the effects of forward guidance in the United States from the mid-1950s to just before the Great Recession. Their findings indicated that the transparency of forward guidance directly correlates with the overall welfare it provides. Christiano et al. (2005) observed a sluggish response in inflation and a persistent, hump-shaped response in output following a policy shock.

However, some researchers have questioned the effectiveness of forward guidance. Swanson and Williams (2014) argued that forward guidance has little effect, especially when interest rates are at ZLB. Their results showed that from 2008 to 2010, 1- and 2-year treasury rates were unexpectedly unaffected by forward guidance. Filardo and Hofmann (2014) further contended that forward guidance is rendered ineffective when markets have more accurate information about the anticipated future path of interest rates. This skepticism extends to the practice of forward guidance by the Bank of England, the ECB, and the Bank of Japan.

Gabaix (2020) and Cole (2021) argued that the effectiveness of forward guidance is influenced by how agents form their expectations, noting that in practice, agents do not fully understand the world, especially for events that are far in the future. Eusepi and Preston (2010) argued that the more systematic and accurate the details of the central bank communications are, the more effective they are in anchoring expectations.

Regarding the impact of Delphic versus Odyssean forward guidance, Delis et al. (2022) studied US syndicated loans from 1999 to 2017 and concluded that Odyssey forward guidance is more effective. Campbell et al. (2017) quantified the macroeconomic impact of forward guidance after the onset of the Great Recession and found that Odyssean is more effective. Goy et al. (2022) argued that both types of forward guidance are effective, depending on the context.[7]

[7] Bassetto (2019), on the other hand, argues that the distinction between Delphic and Odyssean is meaningless

The existing literature has two key limitations. First, previous studies have primarily focused on examining the impact of forward guidance on financial markets or risk-free interest rates, with little attention given to its effect on interest rate pass-through. Second, the current literature predominantly employs dynamic stochastic general equilibrium (DSGE) models to examine the effects of forward guidance, with an emphasis on short-term fluctuations while overlooking its long-term consequences.

While there is extensive literature on interest rate pass-through, few studies have examined the impact of forward guidance. The existing research on the pass-through tends to focus on three main areas: 1) the relationship between bank lending rates, deposit rates, and official policy rates (Heffernan, 1997; Sander and Kleimeier, 2004; Kleimeier and Sander, 2006, Payne, 2007; Liu et al., 2008; Chong, 2010), 2) the relationship between bank retail rates and wholesale market rates (e.g., Hannan and Berger, 1991; Newmark and Sharpe, 1992; De Bondt, 2005; Chong et al., 2006; van Leuvensteijn et al, 2013), and 3) the relationship between lending rates and the cost of funds (e.g., Scholnick, 1996; Sorensen and Werner, 2006; Liu et al., 2011). The findings generally show that the degree of pass-through is usually neither complete nor immediate, meaning that monetary policy typically has a delayed effect.

Several factors have contributed to the rigidity in the responses of bank interest rates to policy rate changes, including fixed menu costs, significant switching costs for bank customers, asymmetric information, and limited competition within the banking industry (see de Bondt, 2005, Chong et al, 2006, Hannan and Berger, 1991, Heffernan, 1997). In markets with limited

and suggests that forward guidance is valuable under two conditions: first, the central bank must have some private information; and second, that this private information relates to the central bank's preferences or beliefs.

competition or high market concentration, banks may have more pricing power, which allows them to adjust retail rates more slowly in response to changes in the policy rate. The lack of competitive pressure can lead to less pass-through of policy rate changes to retail rates. The presence of a large number of fixed-rate loans, especially for mortgages, can create rigidity in bank interest rates. When policy rates change, the impact is felt only when borrowers refinance or take out new loans, leading to a delayed effect in the overall interest rate environment.

At the individual bank level, the degree of pass-through can be affected by bank characteristics such as bank size, bank liquidity, asset structure, and funding policy. Large banks typically have better access to wholesale funding and may be less reliant on retail deposits. This access allows them to adjust interest rates in response to central bank policy changes more quickly, since they can adjust their cost of funding more flexibly.

Banks with strong liquidity positions are less likely to be directly impacted by fluctuations in short-term market interest rates or sudden funding shocks. As a result, these banks may be more willing to adjust their retail interest rates in line with policy rate changes since they can manage their liquidity needs without much difficulty.

Banks that rely heavily on short-term wholesale funding markets or money market instruments are more likely to respond quickly to changes in central bank policy rates. These banks' funding costs are more directly influenced by changes in policy rates, and therefore, they often pass these changes on more rapidly to retail interest rates to maintain profitability. In contrast, banks with a larger proportion of stable, long-term funding (e.g., deposits, long-term bonds) are typically less affected by short-term fluctuations in interest rates. This can lead to more gradual adjustments in their retail rates since the cost of funding remains more stable over time.

Banks with a higher proportion of longer-term assets (e.g., fixed-rate mortgages) may experience slower pass-through of policy rate changes, since the rates on these products are not immediately adjustable. Understanding these bank-specific factors is essential for policymakers and analysts when assessing the effectiveness of monetary policy transmission, as they help explain why different banks may exhibit varying degrees of interest rate pass-through in response to central bank actions.

Kleimeier and Sander (2006) examined the impact of expected and unexpected monetary policy changes on interest rates passthrough in the Eurozone's retail banking. They found that lending rates adjusted more quickly when policy rate changes were correctly anticipated. Their findings underscore the importance of well-communicated monetary policy in achieving faster and more uniform interest rate pass-through.

In New Zealand, Liu et al (2008) studies the impact of monetary policy transparency on interest rate pass-through. They found that the introduction of the Official Cash Rate (OCR) in 1999 enhanced monetary policy transparency, which in turn reduced the volatility of policy rates and improved interest rate pass-through for floating mortgage rates, base lending rates, and deposit rates. However, fixed mortgage rates were not similarly affected, as they were found to be priced based on longer-term bond yields, making them less sensitive to changes in overnight policy rates.

To influence long-term interest rates, central banks have adopted unconventional monetary policy tools, such as quantitative easing and large-scale asset purchases. The Bank of Japan, for example, implemented yield curve control. As an alternative, forward guidance in monetary policy aims to influence long-term interest rates by reducing uncertainty surrounding future policy rates, thereby shaping market expectations more effectively.

Our study investigates the impact of forward guidance on both long- and short-term pass-through. The testable hypotheses are as follows:

a) Long-term pass-through hypothesis: Forward guidance is expected to positively influence the degree of long-term pass-through for various interest rates set by commercial banks, especially for rates set for longer maturities.

b) Short-term pass-through hypothesis: Forward guidance may also positively affect the degree of short-term pass-through for various interest rates set by commercial banks, especially for those with longer maturities.

3. Methodology and Data

The Official Cash Rate, introduced in March 1999 in New Zealand, is the overnight policy rate set by the Reserve Bank of New Zealand. The bank's monetary policy committee reviews the rate seven times a year, aiming to maintain medium-term inflation within the target range of 1% to 3%, as specified in the current Policy Targets Agreement. The OCR directly influences short-term interest rates in the wholesale market, which in turn affect the deposit rates offered by banks and the lending rates charged by banks on various loans, including mortgages, car loans, credit card balances, and corporate loans.[8] Through these channels, the OCR serves as a crucial tool for the transmission of monetary policy to the broader economy.

[8] According to Bernhard et al. (2021), residential mortgages accounts for about 43% of commercial bank balance sheets in New Zealand.

To investigate the existence of a long-term relationship between the OCR and bank interest rates, we begin by conducting unit root and cointegration tests. These tests ensure that the interest rate series are integrated of the same order and are influenced by a common stochastic trend. This step is essential for validating the suitability of analysing their long-term relationship.

Following the methodology outlined by Liu et al. (2008), we utilize the Dynamic Ordinary Least Squares (DOLS) method to assess the degree of long-term pass-through. The DOLS approach addresses potential biases arising from endogeneity and serial correlation by including leads and lags of the differenced explanatory variable. The model specification is as follows:

$$Y_t = \alpha_0 + \alpha_1 OCR_t + \alpha_2 D_t + \alpha_3 D_t OCR_t + \varepsilon_t \quad (1)$$

where Y_t denotes the retail interest rates at time *t*, which include the 6-month time-deposit rate (Deposit), floating first mortgage new-customer housing rate (Floating), new standard residential fixed mortgage interest rates for one year (Fixed1y), fixed mortgage interest rates for two years (Fixed2y), fixed mortgage interest rates for three years (Fixed3y), fixed mortgage interest rates for four years (Fixed4y), fixed mortgage interest rates for five years (Fixed5y), and small and medium enterprise new overdraft rate (Lending). D_t is a dummy variable which equal to zero before forward guidance was implemented in October 2009, and 1 otherwise. α_0 denotes the intercept, α_1 is the slope coefficient, α_2 measures the change in the intercept after forward guidance, and α_3 refers to the change in the slope coefficient after forward guidance was put in place. ε_t is the error term at time *t*.

As stated above, DOLS is employed due to its robustness in addressing issues of endogeneity and serial correlation in time series data, making it a more reliable method for parameter estimation in time-series econometric models (see Phillips and Loretan, 1991, Saikkonen, 1992; Stock and Watson, 1993). Unlike ordinary least squares, DOLS explicitly accounts for the presence of unit roots in variables, which is crucial in ensuring valid inference when analyzing non-stationary time series data.

By incorporating leads and lags of the differenced independent variables, DOLS mitigates biases arising from simultaneity and autocorrelation. This feature enhances the model's ability to accurately capture the long-term relationship between variables, providing a more precise and consistent estimation of the parameters in cointegrated systems. In the context of this study, DOLS captures the interactive dynamics between the central bank's policy rates and the interest rates set by commercial banks. Commercial banks do not merely respond to current or past changes in policy rates; they also anticipate future policy rate adjustments when setting their deposit and lending rates. This anticipatory behavior becomes particularly pronounced when the central bank provides forward guidance, as it shapes expectations regarding the future trajectory of policy rates. Consequently, DOLS is well-suited to analyze the nuanced influence of forward guidance on interest rate pass-through.

To analyze the short-term dynamics, we estimate an error correction model (ECM) for the first differences of the data series. The ECM framework is grounded in the Granger representation theorem (1987) which states that if non-stationary variables are cointegrated, their relationship can be represented in a dynamic model that integrates the long-run equilibrium relationship, short-run dynamics, and the error correction mechanism. The error correction term reflects deviations from the long-run equilibrium and facilitates adjustments back to this equilibrium.

The ECM is specified as follows:

$$\Delta Y_t^X = \beta\Delta Y_{t-1}^X + a_1\Delta OCR_t + a_2\Delta OCR_{t-1} + a_3\Delta OCR_{t-2} + a_4\Delta OCR_{t-3} + b_1\Delta OCR_t * D_t + b_2\Delta OCR_{t-1} * D_{t-1} + b_3\Delta OCR_{t-2} * D_{t-2} + \gamma ECM^X{}_{t-1} + \varepsilon_t \quad (2)$$

where Δ is the first-difference operator and *X* represents the various retail interest rates. D_t is the forward guidance regime dummy variable, as described above. $ECM^X{}_{t-1}$ is the lagged residual of Equation (1) estimated by DOLS, and the lag order of (2) is determined using standard lag length information criteria. β, a_i, b_i denote the short-term interest rate adjustment coefficients, γ is the error correction adjustment coefficient, and ε_t denotes the error term at time *t*.

This study uses monthly series of interest rate data downloaded from the website of the Reserve Bank of New Zealand. The series are deposit rates, floating mortgage rates, 1- to 5-year fixed mortgage rates, small and medium-sized enterprise new overdraft rates, and OCR. The sampling period spans December 2004 to March 2023, with a temporal horizon of almost 20 years.

Table 1 provides a summary of the descriptive statistics for the OCR and various retail interest rates, with the data presented in levels (Panel A) and first differences (Panel B). The mean of the floating mortgage rate is 6.69% per annum, higher than the averages of the 1-year fixed mortgage rate (5.93%), the 2-year fixed rate (6.12%), the 3-year fixed rate (6.31%), and 4-year rate (6.55%). However, the average floating rate is slightly lower than the average 5-

year fixed rate of 6.72%. These findings suggest that for shorter fixed-term mortgages (1-4 years), the market anticipates monetary policy to effectively control inflation expectations. The mean interest rate for small and medium-sized enterprise loans is significantly higher, averaging 9.96%, as expected, due to higher perceived credit risks and funding costs. The monthly average changes in interest rates are small but negative across most categories, indicating a general downward trend during the sample period. The data plot is shown in Figure 1.

[INSERT TABLE 1 HERE]

[INSERT FIGURE 1 HERE]

The correlation coefficients between OCR and retail interest rates are shown in Table 2. Panel A shows the results for the level data. Most coefficients range from 0.79 to 0.99. The strongest correlation is 0.99 between OCR and floating rates, suggesting that floating rates adjust closely in line with changes in OCR. The OCR and 5-year fixed mortgage rates show the lowest correlation at 0.79, reflecting the reduced influence of OCR on longer-term rates. Overall, we note the correlation coefficients decrease as the mortgage term lengthens, consistent with the expectation that longer-term fixed rates are less responsive to short-term policy changes.

Panel B shows the coefficients for the first-differenced data with the correlation values ranging from 0.28 to 0.96, indicative of modest to strong correlations. The highest correlation of the change in the OCR is with floating interest rates changes at 0.78, aligning with their strong linkage observed in the level data. The weakest correlation of the change in the OCR is with the differenced fixed 5-year mortgage rate at 0.28, suggesting limited immediate responsiveness of long-term rates to OCR changes.

[INSERT TABLE 2 HERE]

4. Empirical Results

4.1 Unit root test results

The results of the unit root Philips-Perron (PP) and Augmented Dickey-Fuller (ADF) tests, for both level and first-differenced data series are presented in Table 3. These tests help determine whether the time series data are stationary, which is essential for analyzing the long-term relationships and conducting cointegration analysis. None of the level series (OCR and the various retail interest rates) is stationary at the 1% significance level. This indicates that the series contain at least one unit root and are non-stationary at their levels. All first-differenced series are stationary at the 1% significance level, indicating that they become stationary after differencing once. This confirms that the data series are integrated of order 1, denoted as I(1).

Since all the series are I(1), this suggests that the data are non-stationary in their levels but exhibit a common stochastic trend once differenced. This finding is important for subsequent cointegration analysis, as the unit root test results imply that we can proceed with testing for cointegration among the series (using techniques like the Engle-Granger or Johansen cointegration tests) to explore their long-term relationships.

[INSERT TABLE 3 HERE]

4.2 Granger causality tests

The results of the Granger causality tests are summarized in Table 4, where we tested the hypothesis that changes in the Official Cash Rate influence commercial bank interest rates, and whether changes in those interest rates also Granger cause changes in the OCR. A lag length of one month was used in the Granger causality tests, which is appropriate for capturing short-term dynamics in interest rate movements.

The test results show that the null hypothesis of no Granger causality between OCR and retail interest rates is rejected at the 1% significance level for all pairs of interest rates tested. This means that changes in the OCR are found to significantly influence changes in commercial bank interest rates, and vice versa. The findings suggest bi-directional causality, indicating that not only do fluctuations in the OCR lead to adjustments in bank interest rates, but changes in bank interest rates can also lead to future changes in the OCR. This highlights the dynamic interaction between the central bank's policy rate and the retail rates set by commercial banks. In untabulated regressions, we obtained the same findings on bi-directional causality using the first difference of variables.

The significant bi-directional causality suggests that OCR changes are transmitted through commercial bank interest rates and that changes in the retail market, especially in longer-term rates, may influence central bank policy decisions. Since we are also considering the effect of forward guidance, the presence of bi-directional causality implies that commercial banks not only react to current and past policy rate changes but also adjust their rates in anticipation of future OCR moves, which could be influenced by forward guidance signals.

[INSERT TABLE 4 HERE]

4.3 Cointegration test results

The Johansen cointegration test was employed to investigate the long-term equilibrium relationship between the Official Cash Rate (OCR) and the retail interest rates set by commercial banks. This test is used to determine whether a group of non-stationary time series shares a long-run, stable relationship or trend, despite being individually non-stationary. We determined the lag length by building a VAR and using standard criteria, including the sequential modified likelihood ratio [LR] test statistic, final prediction error (FPE), the Akaike information criterion (AIC), the Schwarz information criterion (SC), and the Hannan-Quinn (HQ) information criterion. After selecting the optimal lag length using these criteria, the Johansen cointegration test was applied. The results, as presented in Table 5, indicate that each of the retail interest rate series is cointegrated with the OCR, indicating the presence of a common stochastic trend in the long-term equilibrium relationship.

Since OCR and retail interest rates are cointegrated, this suggests that monetary policy transmission through the interest rate mechanism is effective in New Zealand. The OCR remains a key driver of retail bank interest rates in the long term. The presence of cointegration underscores the importance of forward guidance. If the market expects the OCR to follow a certain path, commercial banks may adjust their long-term lending and deposit rates in line with these expectations, ensuring that the anticipated monetary policy stance is fully reflected in the retail interest rate setting.

[INSERT TABLE 5 HERE]

4.4 Long-term relationships

We estimate the long-rum pass-through from the OCR to retail interest rates using DOLS. The results reported in Table 6 provide key insights into the long-term pass-through of the OCR to retail interest rates before and after the introduction of forward guidance by the Reserve Bank of New Zealand. We find that prior to the introduction of forward guidance the degree of long-term pass-through varied widely from 16% (5-year fixed mortgage rate) to 67.2% (1-year fixed mortgage rate) to 75.6% (floating mortgage rate). These results align with prior findings (e.g., Liu et al., 2008), showing that shorter-term retail interest rates are more responsive to OCR changes.

However, significant increases in the pass-through were observed across most retail rates after the implementation of forward guidance. The degree of pass-through increased significantly during the second sub-period reaching a near-complete pass-through of 99.1% for deposit rates. Fixed mortgage rates pass-through jumped to over 90% for maturity terms of two years or longer. The negative relationship between maturity and pass-through for fixed mortgage rates disappeared. A small decrease in pass-through was observed for floating mortgages rates, reflecting banks' "wait and see" approach due to the flexibility of these rates. A significant increase in the pass-through of the OCR to small and medium enterprise new overdraft lending rate was also observed.

[INSERT TABLE 6 HERE]

Table 6 also shows that deposit rates have the lowest markup, proxied by the equation constant, estimated at 1.88 prior to forward guidance. Markups prior to forward guidance were notably higher, ranging from 3.70 (1-year fixed mortgage rate) to 7.12 (5-year fixed mortgage rate). Forward guidance led to a statistically significant reduction in markups, ranging from –1.14 (2-year fixed mortgage rate) to –2.90 (5-year fixed mortgage rate), with greater reductions observed for longer maturities.

These reductions in markups were accompanied by increased pass-through rates, underscoring the effectiveness of forward guidance in reducing costs for borrowers. Although the application of forward guidance suggests a decrease in the constant of the equation for deposit rates, we note this change is not statistically significant. Similarly, we do not find statistically significant changes for the constant of the floating and one-year fixed mortgage rates.

Forward guidance improved the transparency and predictability of monetary policy, reducing uncertainty and aligning market expectations more closely with the central bank's policy trajectory. This resulted in more complete pass-through to retail interest rates, especially for fixed rates with longer maturities. The floating rate's relative insensitivity reflects the short-term nature of these loans, which are less influenced by longer-term policy expectations. The reduction in markups, especially for longer-term fixed rates, represents a direct benefit to borrowers, improving affordability and financial stability.

Our findings regarding the long-term pass-through from the OCR to fixed mortgage rates diverge significantly from those of Liu et al. (2009). While their study emphasized the weak relationship between OCR and fixed mortgage rates following the OCR's introduction in 1999, our results demonstrate a strong improvement in pass-through after the adoption of forward guidance. However, our results are consistent with those of Detmers et al (2021). They found similar market reaction across the yield curve to both qualitative and quantitative forward guidance in RBNZ's monetary policy statements. They show that central bank communication is very important regardless of its form. Similar results were found in the United States by Gürkaynak et al. (2005) and Moessner (2013).

Changes in both the markup and the degree of pass-through reflect changes in the competitiveness of the banking industry. The more competitive the lending market, the lower the spread between lending rates and the cost of funds (e.g., a lower net interest margin). Our results show that the New Zealand banking industry appears to have become more competitive after the adoption of forward guidance.

4.5 Short-term interest rate transmission and adjustment speed

To analyze the short-term dynamic relationships between OCR and retail interest rates, we estimated error correction models (ECMs) for retail interest rates as specified in Equation (2). By estimating ECMs for retail interest rates, the study assesses how quickly and effectively retail rates adjust to deviations from their long-run equilibrium relationships with the OCR. The results, presented in Table 7, provide insights into the speed and nature of adjustments for various retail interest rates towards their long-run equilibrium relationships.

The negative and statistically significant coefficients of the error correction term for most retail interest rates (at the 10% level) confirm mean-reverting behavior. This suggests that these rates gradually adjust back toward equilibrium when deviating due to short-term shocks. The fastest adjustment is observed for the floating rate, with approximately 8.4% of the deviation from equilibrium corrected within one period. Longer-term fixed rates exhibit slower speeds of adjustment, implying that their pricing incorporates additional factors, such as expectations of future interest rate movements and risk premiums.

Lending rates for small and medium-sized enterprises (SMEs) stand out as exceptions. Their error correction terms are not statistically significant, indicating weaker or less predictable adjustments to the OCR in the short term. This could be attributed to unique factors affecting SME lending, such as credit risk or structural rigidities in this segment. In conclusion, while retail interest rates generally adjust towards equilibrium following changes in the OCR, the speed of this adjustment varies significantly across different rate types, with floating mortgage rates responding most dynamically and SME lending rates displaying limited short-term responsiveness.

[INSERT TABLE 7 HERE]

The positive and statistically significant impact period coefficients (at the 1% level) confirm that changes in the OCR immediately influence retail interest rates. The floating mortgage rate exhibits the strongest pass-through, reflecting its high sensitivity to OCR changes due to its variable nature. The lending rate, often influenced by longer-term considerations like credit risk and market conditions, demonstrates the weakest immediate response.

In terms of subsequent adjustments, positive and significant coefficients at lag 1 indicate that the OCR's influence on retail rates persists in the short term, supporting the notion of continued adjustment after the initial impact. For lags 2 and 3, signs of reversals in the adjustment process emerge. This suggests potential over-adjustment in earlier periods or counteracting market dynamics, such as expectations or external shocks, that temper the initial response.

Interaction terms highlight changes in pass-through dynamics following the adoption of forward guidance. The positive combined values of the interaction coefficients imply that forward guidance marginally enhances the short-term transmission of OCR changes to retail rates. This likely stems from clearer communication reducing uncertainty and aligning market expectations more effectively with monetary policy intentions.

The findings highlight a strong initial pass-through of OCR changes to retail rates, particularly for floating mortgage rates, with some reversal effects over time. Forward guidance appears to improve the short-term alignment of retail interest rates with OCR adjustments, though its effect is modest. This underscores the importance of both the type of interest rate and the communication strategy in the transmission of monetary policy.

4.6 Impulse response

The impulse response analysis in Figure 2 provides additional confirmation of the dynamics between OCR shocks and retail interest rates, reinforcing findings from Table 7. A unit shock to the OCR leads to an immediate, positive response in retail interest rates across all categories. This initial reaction aligns with expectations, as retail interest rates adjust upward in response to higher borrowing costs influenced by the OCR.

After the initial rise, the responses display reversals, indicating a correction mechanism or an overreaction in the initial periods. These reversals are particularly pronounced for fixed mortgage rates (2- to 5-year terms) and the lending rate, suggesting that these rates are more prone to fluctuations following an OCR shock. The lending rate exhibits a delayed peak response compared to other retail rates, both in terms of maximum positive and negative deviations. This lag may reflect additional frictions in the lending market, such as contractual obligations, risk assessments, or market rigidities.

Overall, the impact of OCR shocks is characterized as short-lived, modest in magnitude, and relatively smooth across retail interest rates. This indicates that while the OCR effectively transmits shocks to the retail market, the adjustments are moderate and contained, limiting volatility. The findings suggest that market mechanisms play a significant role in stabilizing retail interest rates after an OCR shock. This stability is critical for minimizing disruptions in borrowing and lending behavior, supporting overall economic stability. The stronger fluctuations for longer-term rates and lending rates may highlight areas where monetary policy transmission is less direct or faces more resistance, necessitating further investigation.

In conclusion, the impulse response analysis underscores the efficacy of OCR shocks in influencing retail interest rates in the short term but also highlights the inherent stability of retail rates due to market dynamics. The observed reversals and smooth adjustments suggest a well-functioning interest rate market, albeit with some variations across different rate types.

[INSERT FIGURE 2 HERE]

4.7 Robustness Tests

This section provides insights into the robustness of long-term pass-through relationships by adjusting the lengths of the 2nd subperiod in the analysis. In terms of robustness test design, the 1st subperiod (December 2004 to October 2009) remains fixed due to data constraints. Two alternative 2nd subperiods are considered.

Robustness Test 1: November 2009 to February 2020 (pre-pandemic period).

Robustness Test 2: March 2020 to March 2023 (pandemic and post-pandemic period). We find that for fixed mortgage rates (3-, 4-, and 5-year terms), the degree of long-term pass-through increased after the introduction of forward guidance in both robustness tests. This suggests that forward guidance has enhanced the alignment between OCR changes and these mortgage rates over the long term, likely due to clearer signaling about future monetary policy intentions. The 1-year fixed mortgage rate coefficients are positive but not statistically significant at the 10% level in both tests. This implies that while there may be some relationship, it lacks robustness, potentially due to greater sensitivity of short-term rates to factors beyond forward guidance, such as market volatility or short-term funding costs.

For 2-Year fixed mortgage rates, the results of Test 1 (Table 8) show the coefficient is positive and statistically significant at the 10% level, suggesting evidence of long-term pass-through during this period. In Test 2 (Table 9), the coefficient remains positive but is not statistically significant, reflecting weaker evidence of a stable relationship in the more volatile pandemic and post-pandemic period.

The consistent improvement in long-term pass-through for longer-term rates supports the notion that forward guidance helps reduce uncertainty, especially for rates that are more closely tied to expectations about future monetary policy. However, differences in the significance of results for 1- and 2-year rates between the two robustness tests suggest that short- and medium-term rates may be more sensitive to economic conditions or policy uncertainty, particularly during periods like the COVID-19 pandemic.

5. Conclusion

The central bank's forward guidance is envisaged to have the power to shape predictions about future short-term market interest rates. These predictions then have a ripple effect on long-term market interest rates and ultimately affect the spending habits of consumers in the transmission mechanism (D'Acunto et al., 2022).

This study explored the role of forward guidance in enhancing the pass-through of central bank policy rates to retail interest rates in New Zealand, contributing to the understanding of its efficacy as a tool of monetary policy. The findings indicate the importance of forward guidance in stabilizing long-term expectations, which can amplify the central bank's influence on financial markets. Overall, our findings show that:

1) the implementation of forward guidance has significantly enhanced the degree of long-term pass-through, particularly for longer-term fixed mortgage rates and time-deposit rates. This indicates that forward guidance effectively aligns market expectations with the central bank's intentions, fostering stronger links between policy and market rates;

2) the markups on various lending rates declined post-forward guidance implementation, suggesting that forward guidance may enhance competition or reduce risk premiums, leading to lower borrowing costs for consumers and businesses; and,

3) while the impact on short-term pass-through was modest, the overall findings demonstrate that forward guidance improved the transmission mechanism of monetary policy in New Zealand, particularly for longer-term rates where expectations about future policy actions play a more significant role.

Forward guidance shows promise as an alternative to quantitative easing (QE) in unconventional monetary policy scenarios. Both tools aim to influence long-term interest rates, shape market expectations, and stimulate economic activity when the central bank's policy rate is near or at the zero lower bound. While QE effectively lowers longer-term interest rates, it carries significant drawbacks, such as the potential for asset bubbles and distortions in financial markets.

By increasing transparency and reducing uncertainty in monetary policy, forward guidance offers a more flexible and cost-effective tool, particularly in navigating periods when traditional policy rates approach the zero lower bound. However, relying solely on forward guidance during periods of acute crisis may raise credibility concerns if market participants question the central bank's ability or commitment to sustaining low interest rates. While forward guidance supports more efficient monetary policy transmission, its implementation should be carefully managed to preserve central bank credibility and avoid over-reliance during economic crises.

Our study is constrained by its reliance on aggregate data for the New Zealand banking system. Future research could address these limitations by: 1) analyzing bank-level data to explore how specific factors such as funding costs, funding composition, and market power affect pass-through dynamics; and, 2) investigating the heterogeneity among banks to provide more granular insights into the effectiveness of forward guidance across different segments of the financial system.

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Figure 1 Monthly interest rates (December 2004 to March 2023)

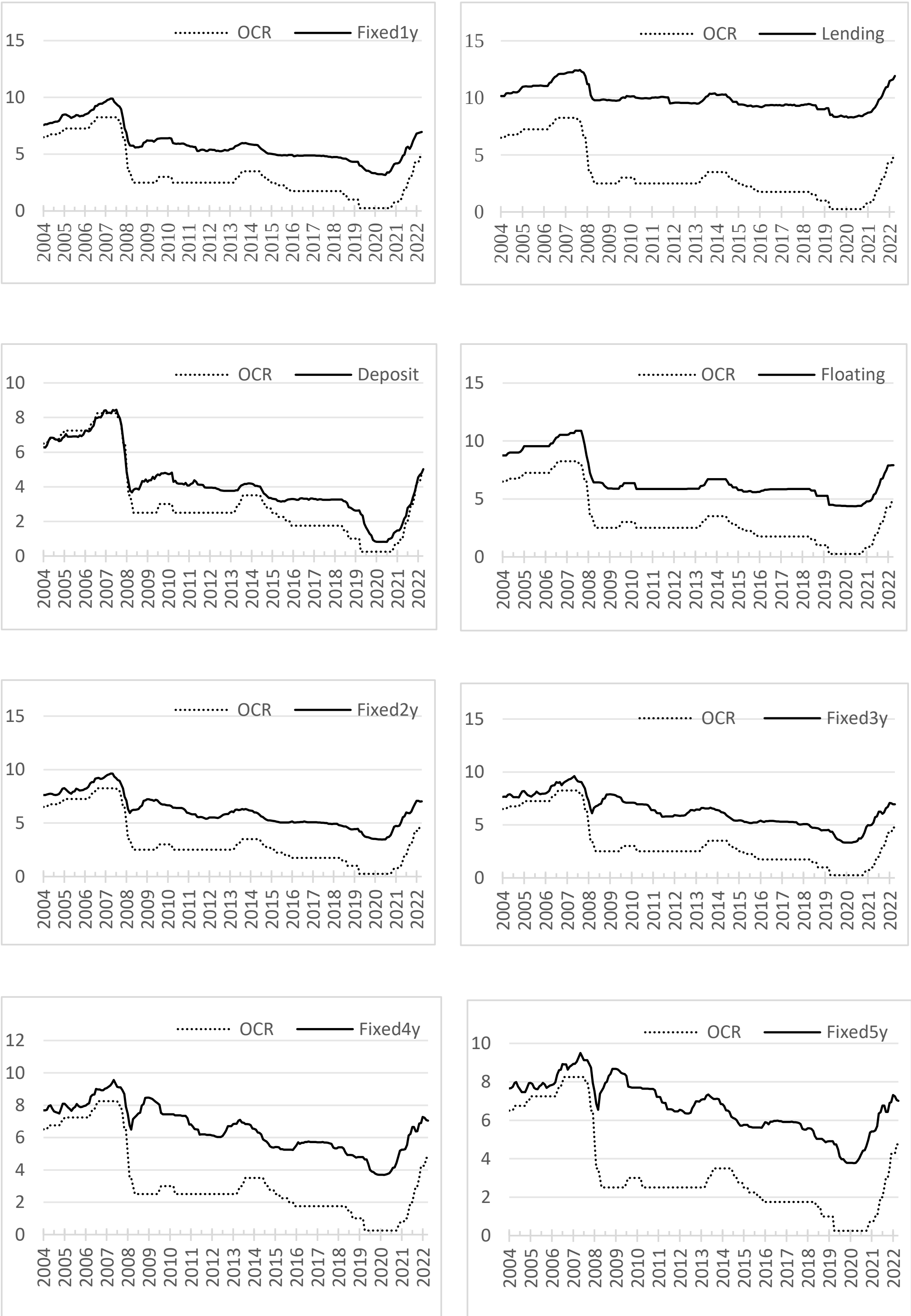
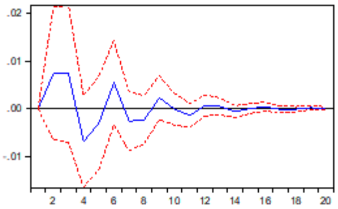
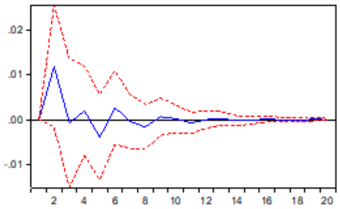


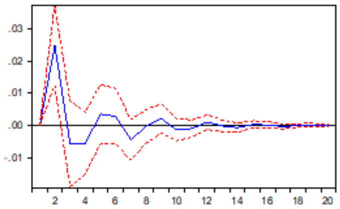
Figure 2 Impulse response of retail interest rates to policy rate shock



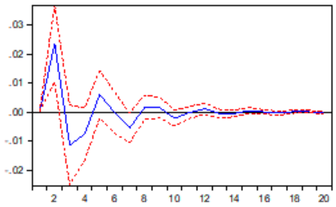
OCR to Deposits



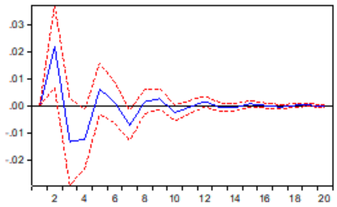
OCR to Floating



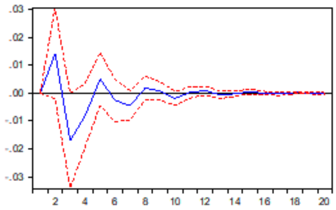
OCR to Fixed1y



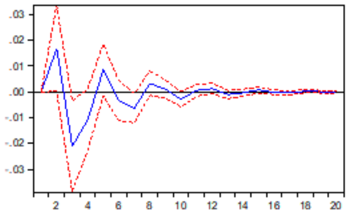
OCR to Fixed2y



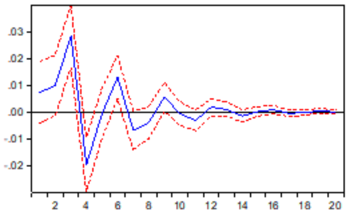
OCR to Fixed3y



OCR to Fixed4y



OCR to Fixed5y



OCR to Business Lending

Note: The x-axis is the number of months since a 100 basis points change in the OCR.

Table 1 Descriptive Statistics

Panel A: Level Data

	OCR	Deposit	Floating	Fixed1y	Fixed2y	Fixed3y	Fixed4y	Fixed5y	Lending
Mean	3.313	4.240	6.690	5.931	6.124	6.312	6.548	6.715	9.963
Median	2.500	3.940	5.870	5.610	5.925	6.235	6.515	6.805	9.800
Maximum	8.250	8.450	10.880	9.900	9.630	9.610	9.560	9.500	12.450
Minimum	0.250	0.820	4.370	3.170	3.460	3.330	3.690	3.770	8.270
Std. Dev.	2.370	1.888	1.781	1.656	1.518	1.495	1.427	1.367	1.002

Panel B: 1st Differenced Data

	OCR	Deposit	Floating	Fixed1y	Fixed2y	Fixed3y	Fixed4y	Fixed5y	Lending
Mean	-0.008	-0.006	-0.004	-0.003	-0.003	-0.003	-0.003	-0.003	0.008
Median	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Maximum	0.750	0.460	0.480	0.600	0.510	0.540	0.660	0.840	0.490
Minimum	-1.500	-0.980	-0.910	-0.890	-0.790	-0.750	-0.780	-0.810	-0.970
Std. Dev.	0.224	0.176	0.171	0.155	0.151	0.165	0.171	0.174	0.143

Notes:

Deposit = fixed deposit rates
Floating = floating mortgage rates
Fixed1y, Fixed2y, …, Fixed5y = fixed mortgage rates with one year, two years, …, five years maturity
Lending = small and medium-sized enterprise overdraft lending rates.

Table 2 Correlation Coefficients

Panel A: Level Data

	OCR	Deposit	Floating	Fixed1y	Fixed2y	Fixed3y	Fixed4y	Fixed5y	Lending
OCR	1.000								
Deposit	0.966	1.000							
Floating	0.991	0.959	1.000						
Fixed1y	0.978	0.985	0.972	1.000					
Fixed2y	0.942	0.966	0.932	0.986	1.000				
Fixed3y	0.890	0.939	0.875	0.953	0.988	1.000			
Fixed4y	0.837	0.901	0.825	0.917	0.967	0.993	1.000		
Fixed5y	0.791	0.870	0.774	0.880	0.940	0.980	0.994	1.000	
Lending	0.915	0.916	0.928	0.939	0.927	0.897	0.866	0.838	1.000

Panel B: 1st Differenced Data

	OCR	Deposit	Floating	Fixed1y	Fixed2y	Fixed3y	Fixed4y	Fixed5y	Lending
OCR	1.000								
Deposit	0.633	1.000							
Floating	0.776	0.759	1.000						
Fixed1y	0.588	0.793	0.748	1.000					
Fixed2y	0.501	0.707	0.627	0.893	1.000				
Fixed3y	0.390	0.641	0.533	0.794	0.926	1.000			
Fixed4y	0.329	0.571	0.462	0.729	0.877	0.948	1.000		
Fixed5y	0.282	0.548	0.428	0.680	0.843	0.936	0.963	1.000	
Lending	0.498	0.616	0.691	0.549	0.473	0.414	0.329	0.298	1.000

Notes:

Deposit = fixed deposit rates
Floating = floating mortgage rates
Fixed1y, Fixed2y, …, Fixed5y = fixed mortgage rates with one year, two years, …, five years maturity
Lending = small and medium-sized enterprise overdraft lending rates.

Table 3 United-Root Tests

Panel A: ADF Tests

Level					1st Difference				
Series	Prob.	Lag	Max Lag	Obs	Series	Prob.	Lag	Max Lag	Obs
OCR	0.234	4	14	215	D(OCR)	0.002	3	14	215
Deposit	0.225	2	14	217	D(Deposit)	0.000	1	14	217
Floating	0.264	2	14	217	D(Floating)	0.000	1	14	217
Fixed1y	0.294	3	14	216	D(Fixed1y)	0.000	1	14	217
Fixed2y	0.415	2	14	217	D(Fixed2y)	0.000	1	14	217
Fixed3y	0.559	1	14	218	D(Fixed3y)	0.000	0	14	218
Fixed4y	0.542	1	14	218	D(Fixed4y)	0.000	0	14	218
Fixed5y	0.540	1	14	218	D(Fixed5y)	0.000	0	14	218
Lending	0.171	3	14	216	D(Lending)	0.001	2	14	216

Panel B: Philips-Perron Tests

Level				1st Difference			
Series	Prob.	Bandwidth	Obs	Series	Prob.	Bandwidth	Obs
OCR	0.467	10	219	D(OCR)	0.000	9	218
Deposit	0.470	9	219	D(Deposit)	0.000	4	218
Floating	0.464	10	219	D(Floating)	0.000	7	218
Fixed1y	0.495	10	219	D(Fixed1y)	0.000	6	218
Fixed2y	0.516	9	219	D(Fixed2y)	0.000	4	218
Fixed3y	0.530	8	219	D(Fixed3y)	0.000	3	218
Fixed4y	0.540	7	219	D(Fixed4y)	0.000	2	218
Fixed5y	0.558	6	219	D(Fixed5y)	0.000	4	218
Lending	0.537	9	219	D(Lending)	0.000	8	218

Notes:

Deposit = fixed deposit rates
Floating = floating mortgage rates
Fixed1y, Fixed2y, …, Fixed5y = fixed mortgage rates with one year, two years, …, five years maturity
Lending = small and medium-sized enterprise overdraft lending rates.

Table 4 Granger Causality Test

Null Hypothesis	F-Statistic	Prob.
Deposit does not Granger Cause OCR	67.462	0.000
OCR does not Granger Cause Deposit	8.705	0.004
Floating rate does not Granger Cause OCR	58.992	0.000
OCR does not Granger Cause Floating rate	6.015	0.015
Fixed-1Y does not Granger Cause OCR	51.783	0.000
OCR does not Granger Cause Fixed-1Y	32.420	0.000
Fixed-2Y does not Granger Cause OCR	40.207	0.000
OCR does not Granger Cause Fixed-2Y	24.873	0.000
Fixed-3Y does not Granger Cause OCR	29.631	0.000
OCR does not Granger Cause Fixed-3Y	19.958	0.000
Fixed-4Y does not Granger Cause OCR	25.021	0.000
OCR does not Granger Cause Fixed-4Y	12.382	0.001
Fixed-5Y does not Granger Cause OCR	22.486	0.000
OCR does not Granger Cause Fixed-5Y	13.582	0.000
Lending does not Granger Cause OCR	51.708	0.000
OCR does not Granger Cause Lending	49.026	0.000

Notes:

Deposit = fixed deposit rates
Floating = floating mortgage rates
Fixed1y, Fixed2y, …, Fixed5y = fixed mortgage rates with one year, two years, …, five years maturity
Lending = small and medium-sized enterprise overdraft lending rates.

Table 5 Johansen Cointegration Test

	Trace		Max-Eigenvalue	
Dependent Variable	Trace r=0	Trace r≤1	Trace r=0	Trace r≤1
Deposit	63.380***	20.679	42.702***	8.959
Floating	85.422***	28.166	57.256***	20.211
Fixed1y	52.810***	17.298	35.512***	11.080
Fixed2y	72.559***	29.815	42.744***	16.147
Fixed3y	74.285***	30.483	43.801***	16.179
Fixed4y	76.046***	30.134	45.912***	16.107
Fixed5y	78.414***	30.831	47.583***	15.179
Lending	78.827***	26.509	52.318***	16.107

Notes: *** indicates significance at 1% level.

Deposit = fixed deposit rates
Floating = floating mortgage rates
Fixed1y, Fixed2y, …, Fixed5y = fixed mortgage rates with one year, two years, …, five years maturity
Lending = small and medium-sized enterprise overdraft lending rates.

Table 6 Long-term relationship

	Constant		OCR		Dummy (D)		Slope Dummy(D*OCR)	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Deposit	1.877***	3.578	0.736***	9.897	-0.604	-1.097	0.255**	2.434
Floating	4.182***	15.041	0.756***	19.192	0.190	0.649	-0.093*	-1.669
Fixed1y	3.699***	9.450	0.672***	12.113	-0.283	-0.688	0.135*	1.724
Fixed2y	4.793***	9.150	0.496***	6.681	-1.139**	-2.070	0.327***	3.128
Fixed3y	5.820***	8.795	0.348***	3.712	-2.127***	-3.060	0.570*	4.310
Fixed4y	6.579***	8.603	0.244**	2.248	-2.502***	-3.115	0.629***	4.115
Fixed5y	7.115***	8.978	0.160	1.427	-2.895***	-3.478	0.759***	4.795
Lending	8.190***	24.557	0.432***	9.142	0.052	0.148	0.179***	2.680

Notes: The degree of pass-through rate is measured by the coefficient of OCR and change in the degree of pass-through is measured by the coefficient of the coefficient of the slop dummy.

*** indicates significance at 1% level.

** indicates significance at 5% level.

* indicates significance at 10% level.

Deposit = fixed deposit rates

Floating = floating mortgage rates

Fixed1y, Fixed2y, …, Fixed5y = fixed mortgage rates with one year, two years, …, five years maturity

Lending = small and medium-sized enterprise overdraft lending rates.

Table 7 Short-term pass through and adjustment speed

Variable	Coefficient							
	Fixed 1y	Fixed 2y	Fixed 3y	Fixed 4y	Fixed 5y	Floating	Deposit	Lending
D(Y(-1))	0.227***	0.318***	0.283***	0.321***	0.311***	0.010	0.272***	-0.257***
	(3.304)	(4.813)	(4.423)	(4.959)	(4.907)	(0.139)	(4.040)	(-3.837)
D(OCR)	0.305***	0.259***	0.273***	0.250***	0.225***	0.438***	0.422***	0.167***
	(6.001)	(4.725)	(4.234)	(3.597)	(3.211)	(9.375)	(7.489)	(3.874)
D(OCR(-1))	0.320***	0.306***	0.320***	0.316***	0.387***	0.259***	0.124**	0.108***
	(6.671)	(6.095)	(5.416)	(4.931)	(6.053)	(5.698)	(2.304)	(2.740)
D(OCR(-2))	-0.046	-0.131**	-0.153**	-0.243***	-0.313***	0.178***	0.133***	0.452***
	(-0.913)	(-2.497)	(-2.528)	(-3.723)	(-4.753)	(4.119)	(2.659)	(11.522)
D(OCR(-3))	-0.160***	-0.174***	-0.235***	-0.184***	-0.210***	-0.131***	-0.217***	-0.068**
	(-4.064)	(-4.074)	(-4.633)	(-3.292)	(-3.704)	(-3.807)	(-5.076)	(-1.802)
DUMMY*D(OCR)	0.004	-0.012	-0.062	-0.122	-0.088	0.238***	-0.074	0.226***
	(0.059)	(-0.168)	(-0.725)	(-1.312)	(-0.940)	(3.983)	(-1.009)	(3.878)
DUMMY(-1)*D(OCR(-1))	-0.239***	-0.265***	-0.290***	-0.331***	-0.418***	-0.175***	-0.013	0.195***
	(-3.421)	(-3.553)	(-3.265)	(-3.431)	(-4.328)	(-2.736)	(-0.169)	(3.126)
DUMMY(-2)*D(OCR(-2))	0.277***	0.315***	0.407***	0.489***	0.579***	-0.007	0.165**	-0.153***
	(4.000)	(4.264)	(4.640)	(5.116)	(6.019)	(-0.112)	(2.218)	(-2.610)
ECM(-1)	-0.057**	-0.036**	-0.033**	-0.028*	-0.026*	-0.084***	-0.052***	-0.009
	(-2.558)	(-2.089)	(-2.020)	(-1.824)	(-1.745)	(-3.088)	(-2.886)	(-0.419)

Notes: *** indicates significance at 1% level.
** indicates significance at 5% level.
* indicates significance at 10% level.
t-statistics are in brackets.

Deposit = fixed deposit rates
Floating = floating mortgage rates
Fixed1y, Fixed2y, …, Fixed5y = fixed mortgage rates with one year, two years, …, five years maturity
Lending = small and medium-sized enterprise overdraft lending rates.

Table 8 Long-term relationship (Dec. 2004 to Oct. 2009 vs Nov. 2009 to Feb. 2020)

	Constant		OCR		Dummy		OCR*Dummy	
	Coef.	T-value	Coef.	T-value	Coef.	T-value	Coef.	T-value
Deposit	1.877***	4.573	0.736***	12.649	0.374	0.774	-0.102	-0.854
Floating	4.182***	17.806	0.756***	22.721	0.703**	2.543	-0.309***	-4.539
Fixed1y	3.699***	9.349	0.672***	11.983	0.025	0.055	0.022	0.190
Fixed2y	4.793***	8.931	0.496***	6.522	-0.965	-1.528	0.275*	1.767
Fixed3y	5.820***	8.929	0.384***	3.769	-1.875**	-2.443	0.500***	2.645
Fixed4y	6.579***	8.735	0.244***	2.283	-2.174**	-2.452	0.536**	2.453
Fixed5y	7.115***	9.300	0.160**	1.478	-2.620***	-2.908	0.694***	3.131
Lending	8.190***	23.693	0.432***	8.821	0.256	0.630	0.082	0.820

Notes: The degree of long-term pass-through rate is measured by the coefficient of OCR and change in the degree of pass-through is measured by the coefficient of the coefficient of the slope dummy.
*** indicates significance at 1% level.
** indicates significance at 5% level.
* indicates significance at 10% level.

Deposit = fixed deposit rates
Floating = floating mortgage rates
Fixed1y, Fixed2y, …, Fixed5y = fixed mortgage rates with one year, two years, …, five years maturity
Lending = small and medium-sized enterprise overdraft lending rates.
Dummy is equal to 0 prior to November 2009 and 1 afterwards.

Table 9: Long-term relationship (Dec. 2004 to Oct. 2009 vs March 2020 to March 2023)

	Constant		OCR		Dummy		OCR*Dummy	
	Coef.	T-value	Coef.	T-value	Coef.	T-value	Coef.	T-value
Deposit	1.877***	6.444	0.736***	17.824	-1.023***	-3.261	0.129	1.267
Floating	4.182***	18.631	0.756***	23.773	-0.010	-0.040	0.108	1.373
Fixed1y	3.699***	12.554	0.672***	16.092	-0.449	-1.414	0.071	0.687
Fixed2y	4.793***	12.608	0.496***	9.207	-1.271***	-3.102	0.158	1.192
Fixed3y	5.820***	12.922	0.348***	5.454	-2.314***	-4.769	0.260*	1.649
Fixed4y	6.579***	13.478	0.244***	3.522	-2.709***	-5.151	0.295*	1.731
Fixed5y	7.115***	13.197	0.160**	2.097	-3.086***	-5.312	0.329*	1.748
Lending	8.190***	21.019	0.432***	7.825	-0.037	-0.089	0.346**	2.540

Notes: The degree of long-term pass-through rate is measured by the coefficient of OCR and change in the degree of pass-through is measured by the coefficient of the coefficient of the slope dummy.

*** indicates significance at 1% level.

** indicates significance at 5% level.

* indicates significance at 10% level.

Deposit = fixed deposit rates

Floating = floating mortgage rates

Fixed1y, Fixed2y, …, Fixed5y = fixed mortgage rates with one year, two years, …, five years maturity

Lending = small and medium-sized enterprise overdraft lending rates.

Dummy is equal to 0 prior to November 2009 and 1 after February 2020.