1. Introduction[1]

How effective is monetary policy in the aftermath of the Global Financial Crisis (GFC), in a world of persistently low interest rates? Our results show that conventional monetary policy is still as effective as before the crisis.

We use three different models to evaluate monetary policy transmission. These models show that a 25 basis point cut in the Official Cash Rate (OCR) leads to an increase in inflation and GDP growth, and that this response is as big today as it was before the GFC. This implies that the recent OCR cuts by the Reserve Bank will lead to – all else equal – higher inflation and GDP growth, and help support maximum sustainable employment (MSE).

2. After the GFC, is monetary policy still effective in achieving the Bank's goals of price stability and supporting MSE?

There is little international evidence on changes in the effects of policy rates on the real economy, before and after the GFC. This is possibly because several advanced economies have experienced prolonged periods of policy rates settled near zero. With no further room for traditional stimulus with policy rates, recent research has focussed on the effectiveness of *unconventional* monetary policy.

This analysis focusses on the effectiveness of *conventional* monetary policy – that is, movements in the OCR. The effectiveness of unconventional monetary policy is still being debated internationally, and the Bank is undertaking a work programme to refresh its understanding of these policies.

3. Why does this question of effectiveness matter to the Bank and New Zealand?

The Monetary Policy Committee (MPC) is tasked with maintaining price stability, and supporting maximum sustainable employment. Its key instrument to achieve these goals is the OCR.[2]

Figure 1 shows a highly simplified representation of how changes in the OCR transmit to employment and inflation. The various channels that facilitate this transmission are outlined in more detail in our *Monetary Policy Handbook*.[3]

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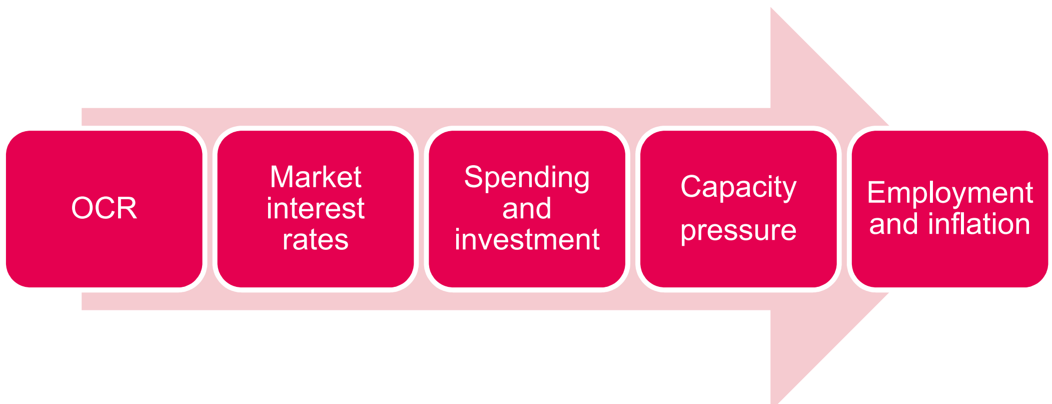
[1] The authors would like to thank colleagues in the Economics Department for their feedback and discussion.

[2] The models presented in this *Note* use the 90-day bank bill rate as a proxy for the OCR, to allow for a longer data sample – given that we introduced the OCR in 1999. Model insights can be generalised to the OCR because of the strong correlation between the 90-day rate and the OCR.

[3] Reserve Bank of New Zealand (2019).

The effectiveness of monetary policy is at the core of the MPC's monetary policy strategy. If changes in the OCR are transmitting to the economy as they have in the past, we can use our past behaviour to guide our current monetary policy strategy. If the pass-through has weakened, it may mean that the MPC will have to use monetary policy more aggressively to achieve the same outcomes. And if the pass-through has been totally muted, then we need to consider other options.

Figure 1: A stylised representation of monetary policy transmission



4. What previous work addresses this question?

The Bank undertook analytical work on the effectiveness of monetary policy in 2008. The results are outlined in Sethi (2008). The key insight at the time was monetary policy was still effective in New Zealand, with no major signs that transmission to GDP or inflation had weakened.

There exists a very rich international literature on the empirics of monetary policy transmission. However, there are fewer papers regarding the effectiveness of monetary policy before and after the GFC. While Borio and Hofmann (2017) review the conceptual mechanisms that imply that monetary transmission may be weaker when interest rates are low, they also conclude that the supporting empirical evidence is scant.

Another strand of the literature focusses on the different effects of monetary policy during various phases of the economic cycle in the advanced economies: Angrist, Jordà and Kuersteiner (2018), Dahlhaus (2017), and Tenreyro and Thwaites (2016) for the United States; and Jannsen, Potjagailo and Wolters (2015) for a sample of 20 advanced economies. Kent (2015) suggests that structural modelling results for the Australian economy imply that the monetary transmission mechanism before and after the GFC looks similar. On the other hand, Ciccarelli, Maddaloni and Peydró (2013) find that monetary policy transmission in the euro area is stronger when the GFC period is added to their sample. This *Note* focusses on monetary policy transmission before and after the GFC, and is similar in spirit to the latter two papers.

5. How do we go about establishing the effectiveness of monetary policy?

In an ideal world, we would have some 'natural experiments' to exploit to answer the question around the effects of monetary policy on the economy. That is, some random movement in the interest rate that affects one group but not another. However, these events do not exist in reality; monetary policy settings are highly dependent on the state of the economy. In order to disentangle the effect of monetary policy on the economy, our analysis uses modelling devices commonly known as monetary policy 'shocks'. These shocks help isolate the effect of a move in the OCR that cannot be explained by the state of the economy.

Since the measurement of a monetary policy shock is dependent on the economic model used, we adopt multiple modelling approaches to understand the impact of monetary policy on the New Zealand economy. These include a dynamic stochastic general equilibrium (DSGE) model, and two different Vector Autoregression (VAR) models. These are standard 'workhorse' models used in macroeconomic analysis, with each model fundamentally different in its design from the others, in order to ensure the results are not driven by any particular class of modelling assumptions. We provide more detail on these models in the technical appendix.

We use an 'expanding window' estimation method in order to verify if the transmission of monetary policy shocks to inflation and economic activity has changed through time. We first estimate each model on data spanning the first quarter of 1993 to the last quarter of 2007, just before the GFC. At this point, we assess what the model implies about the effect of a 25 basis point cut in the OCR on inflation and output. We then repeat this process, adding an additional quarter of information up until the end of 2018.[4]

6. What are the key results of our analysis?

What we are looking for in this exercise is any evidence that the effect of a one-time 25 basis point cut in the OCR on inflation and output has changed through time. Figures 2 and 3 present the key results from the exercise. They show the peak impact of the OCR on annual CPI inflation and quarterly GDP growth for each data sample, respectively.

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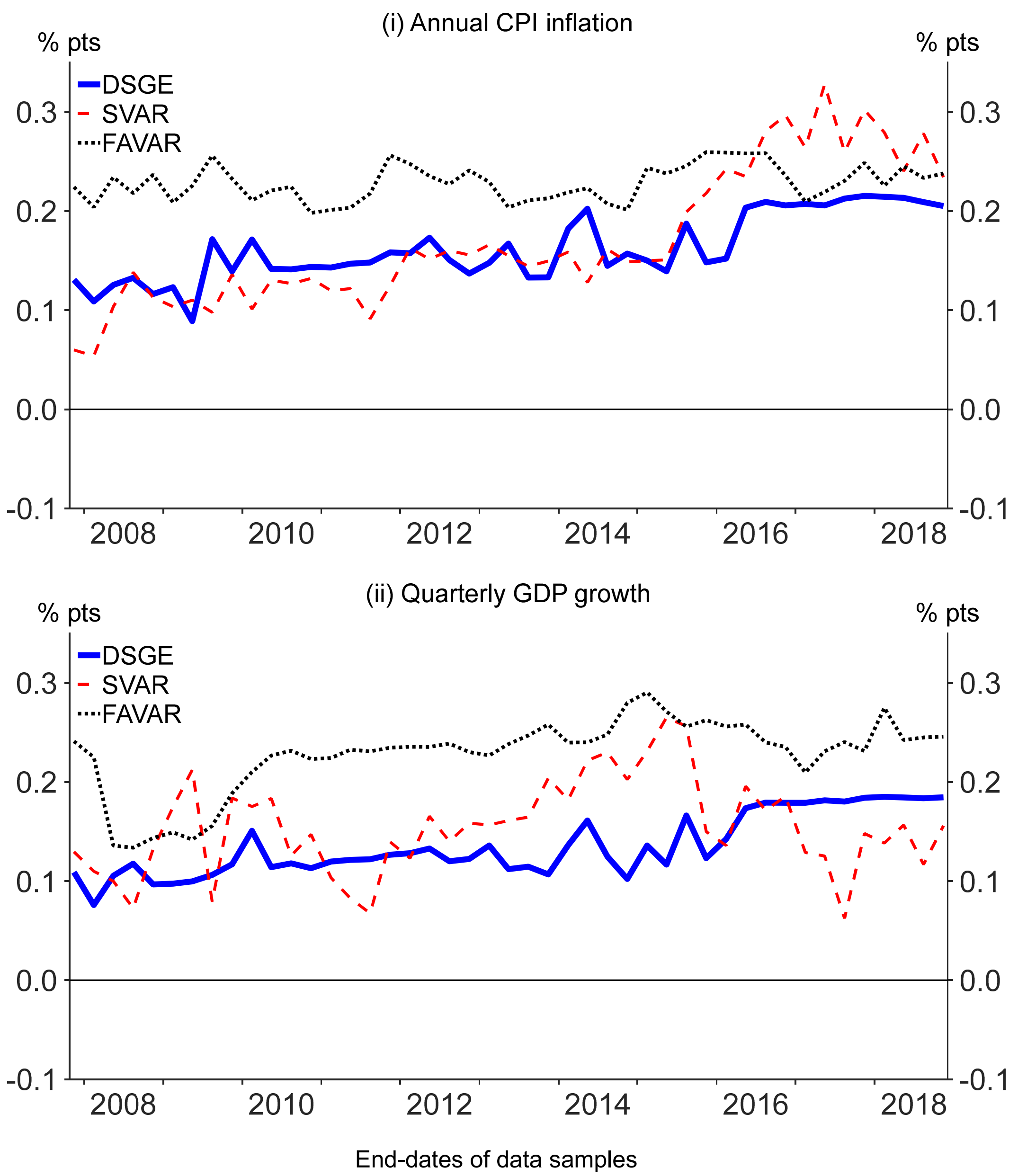
[4] Since we are constrained by the length of the full dataset, about 25 years, we do not adopt a 'rolling' window approach which shifts forward the starting dates of subsequent samples by one quarter at a time. Our 'expanding' window approach enables us to exploit the variation in the data over a longer span of history.

Focussing first on CPI inflation in panel (i) of Figure 2, the charts show that the impact of an OCR cut has been relatively stable through time. This is a common theme across all three modelling options. According to these models, a 25 basis point decrease in the OCR has a peak impact on annual CPI inflation of 0.19 percentage points on average, across the models through all the samples.[5]

Figure 2: Peak impact of a 25 basis point cut in the OCR on CPI and GDP



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5 Figures A1 and A2 in the technical appendix provide more detail on the uncertainty estimated around the CPI and GDP impacts in the three models, as well as the time profile of the dynamics.

The story is similar for the impact of an OCR cut on GDP growth in panel (ii); a 25 basis point decrease in the OCR has a peak impact on quarterly GDP growth of 0.17 percentage points on average. Again, the impact is relatively stable across time, across all of the methodologies we have used.

Overall, these diverse modelling approaches highlight that the transmission of monetary policy shocks has not changed significantly in New Zealand over the last 12 years. There is no sign that OCR moves have become less effective in recent years.

Two caveats to this analysis are worth noting. First, data limitations mean that we cannot directly account for any non-linearities in the transmission of monetary policy. Second, we have not explicitly evaluated the transmission of policy to the labour market – in the context of the Bank's policy goals of supporting maximum sustainable employment. This reflects the absence of a specific measure of maximum sustainable employment.[6] Further, the impact of policy on the labour market is probably well proxied by examining the transmission to GDP growth, as GDP growth is highly correlated with various measures of labour market activity.

7. What do these results mean for the Bank?

Our results suggest that movements in the OCR are still as effective as ever in New Zealand. This means that it is business as usual for the Bank – further cuts in the OCR should boost the economy and inflation, and OCR increases should constrain demand and inflation.

The significant knowledge and experience we have built up during the inflation-targeting era can still be used to guide our monetary policy strategy and achieve our goals of price stability and supporting maximum sustainable employment.

[6] See Robinson, Culling and Price (2019) for a discussion of indicators of labour market capacity pressure.

8. Technical appendix

8.1. Model descriptions

8.1.1. The DSGE model

The general equilibrium model that we use is a much-simplified version of the New Zealand Structural Inflation Model (NZSIM), which the RBNZ uses for macroeconomic forecasting. Essentially, the model is a system of interdependent equations - built from assumptions about firm and household behaviour - that map the key features of the New Zealand macroeconomy. The model is estimated using 8 data series: the 90-day interest rate, quarterly CPI inflation, quarterly GDP growth, quarterly LCI wage inflation, quarterly changes in the trade-weighted exchange rate index, quarterly import price inflation, and 2-year ahead expectations measures for annual price and wage inflation. A formal description of the model equations and estimation methodology are outlined in the appendix of Jacob and Wadsworth (2018).

8.1.2. The sign-restricted VAR

A VAR is one of the most common models used to understand the impact of exogenous shifts in variables of interest on the wider macroeconomy. However, traditional recursive methods for identifying monetary policy shocks in a VAR often produce counterintuitive results, where inflation appears to decrease in response to a decrease in interest rates, reflecting the endogeneity of monetary policy.[7]

In order to overcome this problem, we estimate a VAR model and identify the monetary policy shock with sign restrictions. The reduced-form VAR with one lag is estimated using annual CPI inflation, quarterly GDP growth, the 90-day interest rate, and quarterly changes in the trade-weighted exchange rate. We then identify the monetary policy shock by restricting the model such that after an exogenous decrease in the interest rate,

- The impact on interest rates stays negative for up to 4 quarters
- The impact on CPI inflation is positive for up to 4 quarters
- The exchange rate depreciates in the same quarter.

While this methodology restricts the sign of the impulse responses, it allows the magnitude of the estimated impacts to vary freely.

[7] For example, see Bishop and Tulip (2017); Ramey (2016); Castelnuovo and Surico (2010).

8.1.3. The factor-augmented VAR (FAVAR)

One reason traditional VAR models produce counterintuitive results is that the information set used is too sparse. A monetary policy shock in such models will be 'contaminated' by data that is available to central banks and the private sector, but is not included in the VAR. However, adding more and more data to a VAR leads to a proliferation of parameters which complicates estimation.

Using a factor-augmented-VAR (FAVAR) allows for the addition of a large dataset to a VAR, without significantly increasing the number of estimated parameters. Essentially, a FAVAR uses statistical techniques to represent a very large data set using a smaller number of 'factors'. These factors are then used in the estimation of the VAR.

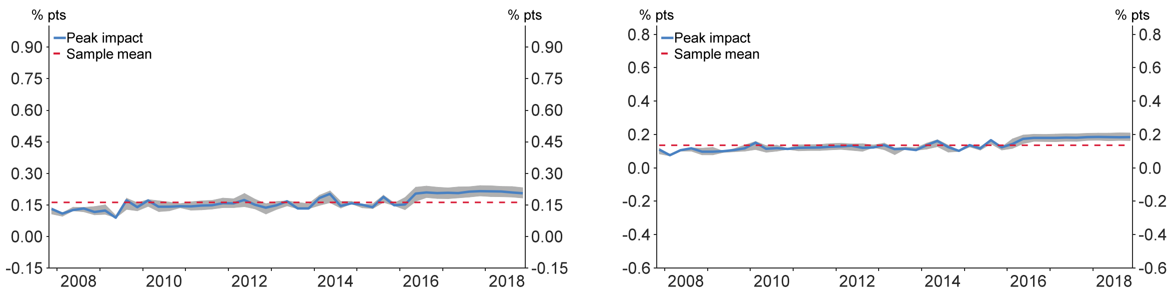
We use the three-variable factor model and the two-step methodology outlined in Bernanke, Boivin and Eliasz (2005) applied to New Zealand data. The VAR includes annual CPI inflation, quarterly GDP growth and the 90-day interest rate as the policy variable. The factors are extracted from a dataset of 660 New Zealand and international macroeconomic series, transformed to be approximately stationary. The dataset and transformations are the same as those described in more detail in Richardson, van Florenstein Mulder and Vehbi (2018). We use four lags in the VAR and six factors. The choice of the number of factors is determined according to Bai and Ng (2002) and the majority of tests identify six factors in the data set. As a robustness check, we achieve similar overall results using two lags and four factors in the model. The model is estimated using the methods outlined in Koop and Korobilis (2010). Overall, the methodology removes the counterintuitive price puzzle seen in recursively identified VARs using New Zealand data.

8.2. Additional results

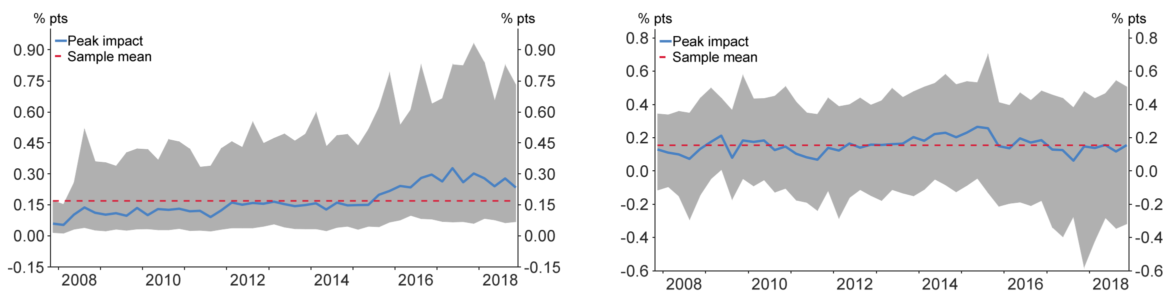
Figure A1: Uncertainty around the peak impact of a 25 basis point cut in the OCR on CPI and GDP

Annual CPI inflation | Quarterly GDP growth

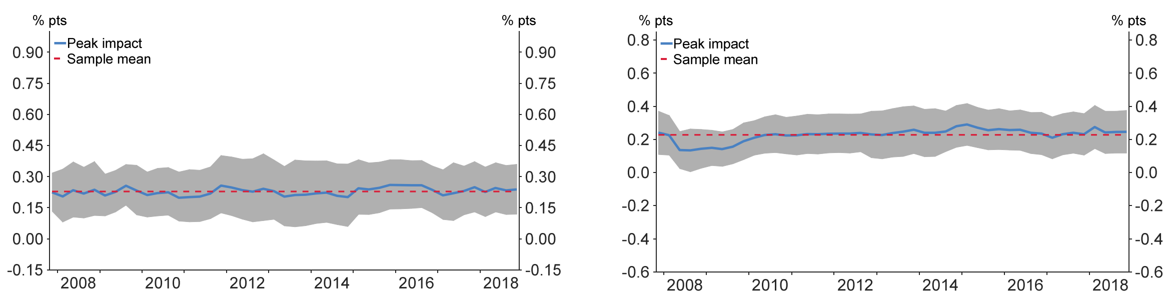
(i) DSGE



(ii) SVAR identified with sign restrictions



(iii) FAVAR identified with a Cholesky decomposition

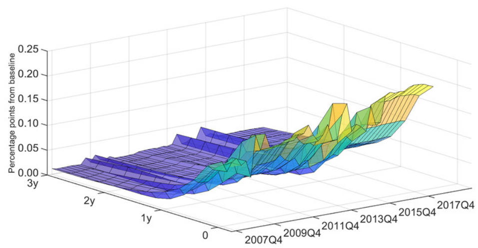


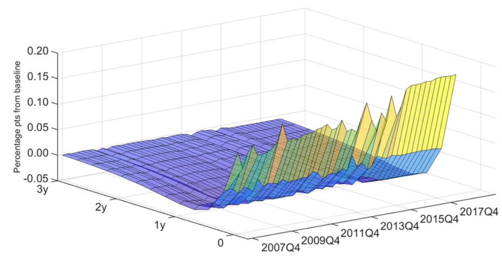
Note: The x-axes plot the endpoints of all the data samples. All samples begin in 1993Q1. For ease of comparison, the panels within each column have been plotted on the same scale. In each panel, the solid blue line indicates the peaks of the median impulse responses across horizons for each sample. The shaded areas in Panels (i) and (iii) indicate the 16^{th} and 84^{th} percentiles for the estimated probability distributions of the impulse responses. For the SVAR in Panel (ii), the shaded area indicates the 16^{th} and 84^{th} percentiles of the distribution of impulse responses based on all random variations of the contemporaneous impact matrix that satisfy the imposed signs.

Figure A2: Effects through time of a 25 basis point cut in the OCR on CPI and GDP

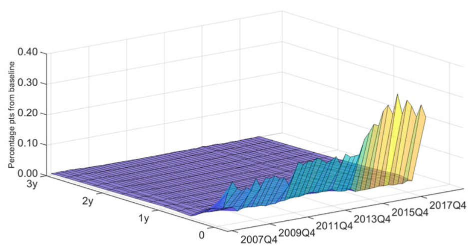
Annual CPI inflation | Quarterly GDP growth

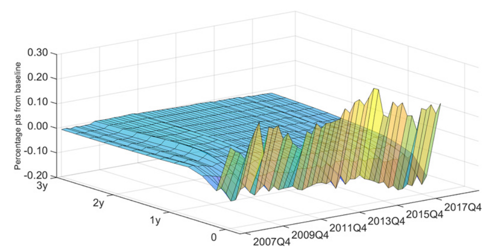
(i) DSGE



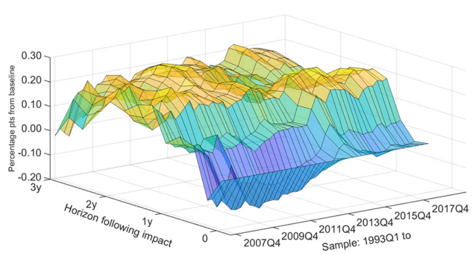


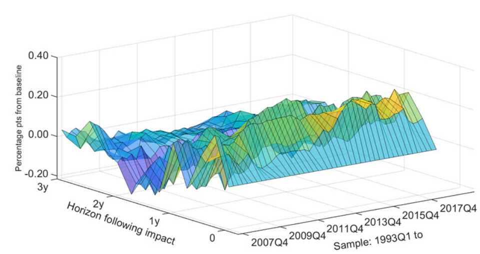
(ii) SVAR identified with sign restrictions





(iii) FAVAR identified with a Cholesky decomposition





Note: The 3D graphs in Panels (i) and (iii) indicate the medians for the estimated probability distributions of the impulse responses. For the SVAR in Panel (ii), we plot the medians of the distribution of impulse responses based on 200 random variations of the contemporaneous impact matrix that satisfy the imposed signs.

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