

MEMORANDUM

To: Vector New Zealand
From: John McDermott
Date: 9 November 2020
Subject: **Performance of and Prospects for Inflation Forecasts**

1. Introduction

The purpose of this report is to examine the issue of forecasting inflation over long horizons.ⁱ Inflation forecasts matter for electricity distribution businesses because the current regulatory regime, governed by the Commerce Commission, requires a real return on the regulatory asset base (RAB). Inflation forecasts are needed to convert a nominal weighted average cost of capital (WACC) to real WACC over five regulatory periodsⁱⁱ.

The main points covered in this report are:

1. Forecasting inflation over five years is a near-impossible task to achieve with any degree of confidence. Many unanticipated events can, and do, happen in a five-year period, such that forming a long horizon forecast will lead to large errors in the calculation of the desired real returns. Given the long-lasting effects of economic events like the global financial crisis (GFC) or the covid-19 pandemic, it is implausible that such errors will wash out in five years.
2. Most inflation forecasting methods used in New Zealand are focused on a 12 to 18-month horizon and are not suitable for a five-year horizon. Even then, the trick to accurate forecasting is constant revision. The Reserve Bank's forecasts are updated publicly every three months, and private sector forecasts more frequently than that. Forming a five-year forecast without any updates through time is a risky approach, especially when there are significant resources at stake.
3. Inflation rates in advanced economies have remained lower than targeted ever since the GFC. There is no consensus among policymakers or the academic research community as to what has caused this "missing inflation". Leading suggestions are the acceleration in technological innovation and the rise of e-commerce, increases in precautionary savings in response to a more volatile economic environment, and the limitations of monetary policy in a period of ultra-low interest rates.



4. Over the past decade, inflation forecasts in most economies at horizons of up to five years have been higher than actual inflation. That is, inflation forecasts have been upwardly biased, and the bias has been significant. This bias has occurred despite many economies having expansionary monetary policies for an extended period.
5. The four-leading methods of constructing inflation expectations (model-based, market-implied, professional surveys, and business and household surveys) have all resulted in significantly biased results in the past decade. In New Zealand, the market-implied measures have performed better than the alternatives for forecasting five year-ahead inflation.
6. Forecasting inflation over the next decade looks set to be even more challenging than it was in the preceding decade. Given the unprecedented scale of monetary and fiscal policy support in the wake of the covid-19 pandemic, the inflation outlook is substantially more uncertain than it has been for decades. Interest rates are now at or near-zero in many countries, leaving limited opportunities to stimulate inflation further. All economies are looking more and more like Japan, where many years of substantial fiscal deficits and ultra-low interest rates have not seen a lift in inflation to the desired target level.
7. Since forecasting inflation over five years is fraught with significant problems, a different regime to determining returns on the regulatory asset base is probably warranted. However, if the same regime is maintained, then a switch to using market-based measures of inflation expectations provides the best option.

2. Problems from inflation forecasting errors

Two issues arise in the context of calculating real returns for electricity distribution businesses. First, the upwardly biased inflation-forecasts result in an inflated deduction from the nominal WACC. This exaggerated deduction results in low real WACC. Second, the electricity distribution businesses issue and pay interest on nominal debt while the regulatory framework focuses on a real return. If inflation forecasts are upwardly biased, then there will be a shortfall between the regulatory allowance and the nominal debt-servicing obligations, which must be made up by equity investors.

3. Recent developments

In the wake of the GFC, inflation rates in advanced economies remained low and undershoot the targets central banks are required to achieve. Figure 1 shows recent inflation developments in some selected economies since the GFC. The salient feature of these figures is the downward trend in inflation over a decade (except Japan) and the extended periods that inflation has spent below 2 percent.ⁱⁱⁱ

Inflation stayed low in many economies despite massive monetary expansions. Factors keeping inflation low were a weak global economy, historically low oil prices, changes in pricing behaviour as e-commerce became more common, and less effective monetary policy.^{iv}

Figure 1. Inflation in selected countries



Source: Federal Reserve Bank of St Louis

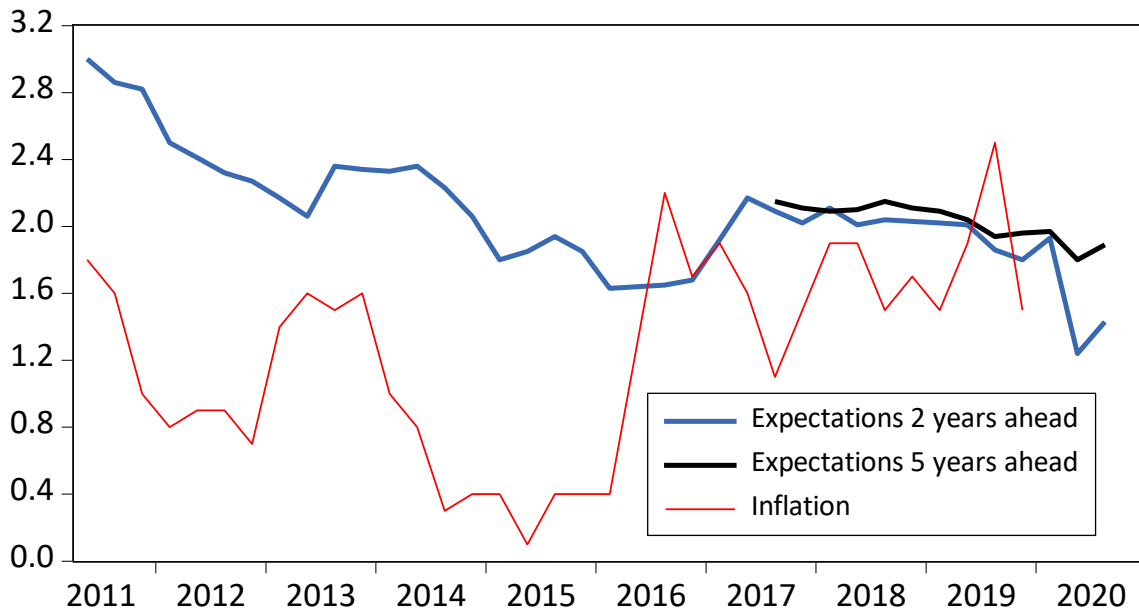
The behaviour of inflation over the past decade has presented two puzzles. First, the massive collapse in output and the rise in unemployment caused by the GFC did not immediately see inflation fall. Second, the economic recovery that took hold globally around 2013 did not result in a surge of inflation as was widely expected.

Central bankers, policymakers, and financial market forecasters around the world have consistently failed to predict the behaviour of inflation over the past decade. To some extent forecast errors for inflation are to be expected, particularly when commodity prices, such as those for oil, move around wildly. However, the one-sided and persistent nature of the forecast errors since the GFC is unusual. The situation is even more unusual since the “missing inflation puzzle” seems to be occurring in nearly all economies.

New Zealand has also witnessed the missing inflation puzzle. Figure 2 shows that New Zealand’s inflation rate has remained below professional forecasters expectations for the past decade. The Reserve Bank of New Zealand and many local professional forecasters have been surprised at how persistently low inflation has been.^v

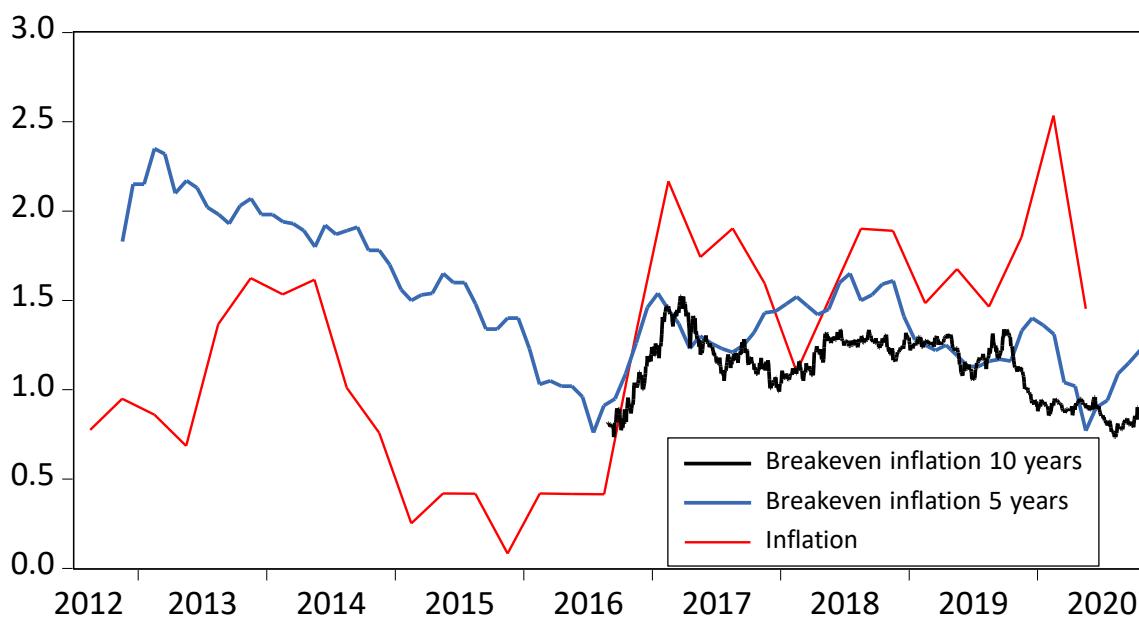
In the first five years following the GFC, all inflation forecasting methods were biased upwards. As can be seen from figure 3, market-based measures of generating inflation expectations corrected to the changed economic environment faster than professional forecasters. The market-based measures look to be unbiased from 2016 onwards.

Figure 2. Inflation and inflation expectations in New Zealand



Source: Reserve Bank of New Zealand and author's calculations

Figure 3. Inflation and breakeven inflation in New Zealand



Source: Reserve Bank of New Zealand and author's calculations. Inflation breakeven expectations have been calculated using yields on 5 and 10-year government bonds less the yield on the inflation index bonds for the 2025 contract.

4. Methods of forming inflation expectations

Several approaches to forecasting inflation are available, each with their advantages and disadvantages. Each method is briefly described and then assessed for how well it predicted inflation in the preceding decade.

4.1. Model-based forecasts

Central banks in advanced economies often rely on quantitative macroeconomic models to generate inflation forecasts. These models are quantitative versions of theoretical views about inflation. See the sidebar for a brief synopsis of the leading theories of inflation.

Most central banks use a macroeconomic model where the forcing variable for inflation is some measure of excess economic capacity (economic slack for short). These model-based forecasts have low out-of-sample predictive power. Also, the forecasts have been no more accurate than naïve forecasts, where inflation for the next year is assumed to be equal to current inflation (Stock and Watson, 2010).

4.2. Market-implied measures

The most straightforward measures of inflation expectations are those derived from financial market prices. A typical market-based measure is to calculate the difference between spot and forward rates on inflation-linked and nominal government bonds (the breakeven inflation rate).^{vi} The advantages of market-based measures are that they are available immediately, they cover expectations going out for long horizons, and they embed the views of well-informed and well-resourced financial market participants.

The disadvantages of market-based measures are they often do not adjust for risk premia on assets that have different risk or liquidity characteristics. Adjustments need to be made for the risk premia to avoid getting a distorted view of inflation expectations, especially if these risk premia vary over time. The liquidity in the New Zealand inflation index bond market has improved considerably over the past decade, making this a more sensible option than would have been the case previously.^{vii}

4.3. Professional forecasts

Historically, one of the most accurate measures of long-horizon inflation expectations is that provided by professional forecasters. There are organizations, such as *Consensus Economics*, that poll private sector economists on their views about inflation. Professional predictions are only slightly better than chance, but this slight advantage in accuracy can provide real insight. Professional economists are more accurate in many countries because they can incorporate a broad range of economic conditions into the inflation forecasts and they can continuously update their forecasts in response to new information (Tetlock and Gardner 2016).

There are several drawbacks of using survey methods like *Consensus Economics*. First, they are proprietary information; consequently, the general public and other interested parties may not have access to the surveys. Without access, it is impossible to replicate or evaluate the inflation forecasts provided by *Consensus Economics*.^{viii} Second, most of the effort and resources that go into producing forecasts is focused on short horizons since that has the biggest payoff for financial market participants. Third, survey forecasts are prone to manipulation. When a forecaster wants to grab headlines, they can be tempted to provide a forecast that is widely out-of-line to those of other predictions. Mistakes are often forgotten but correct long-shots are remembered for many years.

4.4. Business and household surveys

Surveys can capture the inflation expectations of businesses and households who set and face prices.^{ix} However, there are few incentives for businesses or households to devote much effort in constructing informed and useful inflation forecasts. Typically, business and household surveys on inflation are upwardly biased by large margins.

5. Regulator criteria

When setting rules, regulators will want to base these rules on a set of clear criteria. For example, The *Australian Energy Regulator* emphasizes the need for forecasts to be simple, transparent, replicable, and congruent.

From a regulator's point of view using inflation forecasts from a central bank is very appealing. The process is simple, transparent, possible to replicate, and most tellingly, central banks (in advanced economies) are independent agencies that carry respect.^x Moreover, the Reserve Bank of New Zealand operates monetary policy in a manner that aims to make the forecasts a reality.

From a regulated network investor's point of view using an inflation forecast from a central bank is not congruent. The Reserve Bank's horizon for inflation is 12 to 18 months, whereas the regulated network investor's horizon must be five years, given the regulatory framework.

The current approach adopted by the Commerce Commission does not change when the economic environment is changing. Unfortunately, since whatever method the Commerce Commission chooses will be in place for five years, it may be that no technique is fit for purpose for determining the regulated network investor's five-year view of inflation.

6. The Performance of Inflation Forecasts

Two criteria are commonly used to assess the performance of inflation forecasts (XX are): (i) bias and (ii) accuracy.^{xi}

Bias: measures the average difference between the forecasts and the actual outturns of inflation. Accuracy is calculated as the root mean squared error, which depends on both the bias and variance of a forecast. Sometimes a biased forecast is more suitable if it comes with a sufficiently small variance.

Theories of Inflation

The quantity theory of money.

One of the oldest theories of inflation is that an increase in the money supply causes an increase in nominal activity. Since changes in the money supply only have a temporary effect on real activity, any change in the money supply simply changes the price level. Therefore, in the long run, changes in the growth rate of money lead one-for-one to changes in the inflation rate.

The fiscal theory of the price level. In the long run it is government taxes that back fiat currencies. Thus, it is government fiscal policy that affects the price level: for the price level to be stable (to control inflation) government finances must be sustainable.

The output gap theory of inflation. Surplus capacity in an economy (a negative output gap or positive unemployment gap) reduces firms pricing power in the short run, making it more difficult to increase prices. Periods of economic weakness reduces inflation while economic booms increase inflation.

Expectations theory of inflation. Typically, the output gap theory is augmented by expectations of future inflation. Changes in the way inflation varies over time affects the way firms set prices.

At very low rates of inflation, the relationship between the output gap and inflation becomes weak.

6.1. Bias

The majority of findings from the research literature indicates that inflation forecasts over the past decade have been upwardly biased in most advanced countries.^{xii} That is, inflation forecasts have, on average, been higher than realized inflation.

Professional forecasters and market-based measures have been better than business and household expectations. On average, across many countries, professional forecasters have tended to have the least bias, particularly at longer horizons. However, the results vary widely across countries. For New Zealand, market-based measures had a better track record.

Despite their better performance, market-based measures are positively biased beyond the one-year horizon, reflecting the risk and liquidity premia in bond prices. Risk-adjusted forecasts are unbiased, albeit a complex and uncertain adjustment.

Business and household inflation-forecasts are massively biased, and this has been the case for a very long time.

The bias in all these forecasting methods has been increasing in many countries. Internationally, professional forecasters' bias had been trending downwards before the GFC but has varied with the economic and regulatory environment.

6.2. Accuracy

Following the GFC the world has been a more volatile place, and this has made forecasting inflation even more complicated than it was previously. As uncertainty over economic and policy developments has increased the accuracy of forecasts have declined, even as the bias has been reduced somewhat.

Professional and market-based forecasts have been more accurate at anticipating future inflation than those of businesses and households at all horizons, and model-based forecasts at long horizons. The professional and market-based forecasts are not statistically different and tend to be at least as accurate as statistical models. Since the GFC, the accuracy of the professional and household forecasts has declined.

In terms of accuracy, the Reserve Bank's model-based forecasts are usually the best in the market for horizons of one year or less. Beyond a one-year horizon, the Reserve Bank's approach is to have inflation forecasts revert to the 2 percent mid-point, and this has generated large forecast errors.^{xiii} Unfortunately, there has been a growing habit that the longer the forecast horizon, the more likely private-sector forecasters in New Zealand adopt the Reserve Bank's forecasts. Most financial market participants have financial incentives which are geared towards short-term outcomes.

7. Documented shortcomings of (gap) model forecasts

Econometric models have a long and proud history when it comes to inflation. The use of models to understand inflation goes back to the work of New Zealander Bill Phillips in the 1950s. Five different people would win Nobel prizes following the lines of inquiry started by Phillips. Today, the workhorse model for forecasting inflation is the so-called New Keynesian Phillips curve. This model characterizes inflation as a function of inflation expectations and economic slack.

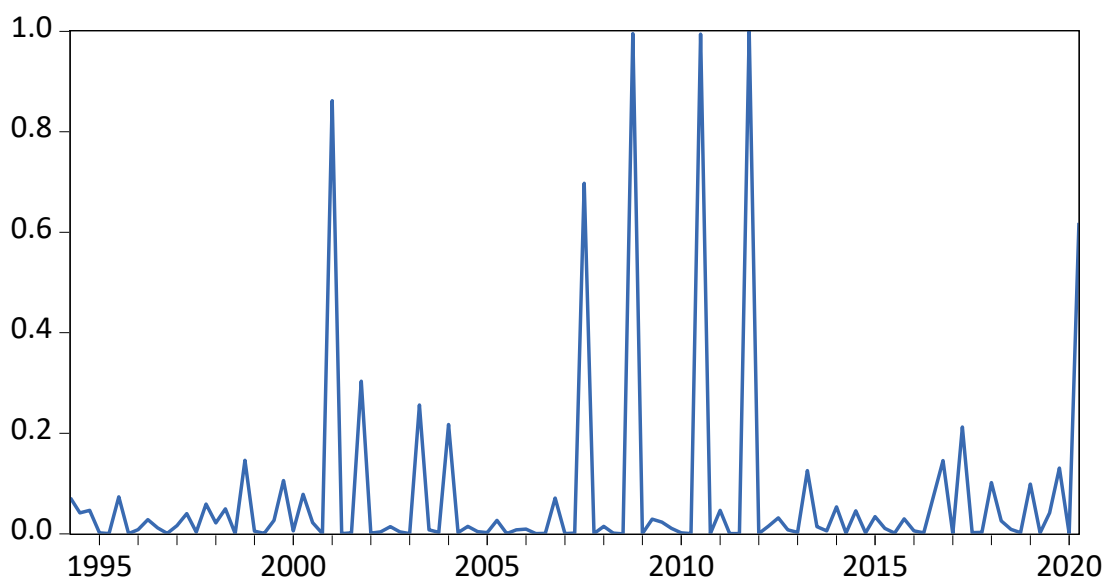
In the hands of an experienced modeller, econometric models are incredibly useful for generating and improving inflation forecasts. However, research on inflation has identified

several shortcomings of the Phillips curve approach. It is worth keeping in mind those shortcomings when evaluating inflation forecasts.

7.1. Model instability

Most econometric models ignore the possibility of changes in core inflation or inflation dynamics. By doing so, econometric models yield results that are fraught with uncertainty and prone to serious misspecification. Figure 3 shows evidence for a regime change in a simple autoregressive model of inflation. The probability of a regime change spikes higher during periods of global turmoil. Examples of these regime changes are the US recession of 2001, the GFC of 2008-09, and the global pandemic of 2020.

Figure 3. Probability of a regime change in the dynamics of inflation in New Zealand.



Source: Author's calculations. The figure depicts the probability of changes in the dynamics of inflation. The higher the probability, the greater the evidence of instability in the underlying inflation process. The probabilities are estimated using a Markov switching model.

7.2. Low out-of-sample predictive power

Estimated models of inflation typically generate forecasts that are no more accurate than those caused by a naïve model where inflation is assumed to be equal to inflation from the previous year.

7.3. Excess sensitivity to the measure of economic slack used

Models of inflation require a measure of an economy's slack to be the forcing variable in the system. Unfortunately, different measures of slack, such as the unemployment rate, the output gap, or the labour share of income, all produce very different inflation forecasts. The forecast sensitivity to the slack variable used adds another layer of uncertainty to any set of forecasts.

8. The global world and covid-19: Will developments change how inflation unfolds?

In the wake of the covid-19 pandemic, economies around the world have come under extreme stress leading to unprecedented monetary and fiscal policy responses. These changes have created significant uncertainty about how inflation will respond to economic changes. In all likelihood, we could go through another decade where inflation falls below expectations. Equally, with government budget deficits and central bank balance sheets expanding rapidly, we could be heading into a period where inflation may miss expectations for more than a decade.^{xiv}

8.1. Technological innovation and globalization

Technological innovation and the rise of e-commerce is changing the way inflation operates. Inflation dynamics have changed in significant ways. Even before covid-19 hit, there was a long-lasting negative trend in inflation around the globe, especially in goods such as clothing, communication, and transportation with the emergence of new services like Uber. Given the rapid developments and disruptive nature of information technology, this trend is likely to continue. Moreover, more sectors do not look to be under any cost pressure and are increasingly prone to innovative product development.

Other structural drivers of inflation that have been discussed widely in the literature have also been causing a downward trend. These include increased globalization, demographic changes with older populations having a lower propensity to spend, and the declining bargaining power of labour putting a cap on costs.

8.2. Persistently weak demand

Most medium-term forecasts predict low inflation in line with weak demand. There has been a substantial increase in households' saving behaviour that has reduced aggregate demand massively. Concerns about joblessness and the risk of falling sick have seen households' 'rainy-day' savings increase. Also, the loss of employment has fallen mostly on low-income households which have a much higher propensity to spend than high-income households, reinforcing the weak demand trend.

8.3. Pent-up demand from lockdown

Many consumers altered their usual spending behaviour during the lockdown, and there may be a release of pent-up demand as these lockdowns are eased. This sudden surge in demand could cause a short-term increase in inflation. While this increase in inflation will be temporary, it could alter expectations for a long time, adding more uncertainty and bias to inflation forecasts.

8.4. Monetary policy ineffectiveness

As interest rates have fallen to near zero, and to negative levels in some economies, concerns about the bounds of monetary policy's effectiveness are increasing. It may be that central banks may no longer be able to stimulate demand in a way they once did. As faith in central banks' ability to control inflation wane, this will lead to inflation expectations becoming unanchored, which will, in turn, lead to disinflation.

8.5. Fiscal dominance

The world has entered a phase of fiscal dominance. Governments have started to run substantial fiscal deficits. In this situation, monetary policy becomes subordinated to fiscal policy. In such an environment, a central bank is often called upon to keep the government's borrowing costs low, which undermines the credibility of the monetary policy framework.

9. Recap

The Commerce Commission's task is to forecast five-year ahead inflation for investors. The Commerce Commission's task is difficult since it needs to anticipate events far into the future. All approaches to forecasting inflation this far forward have proven to be inadequate in the decade following the GFC.

The prospects for an extended period of subdued economic growth, large fiscal deficits, unprecedented but ineffective monetary policy, and disruptive technological and other structural changes provide a complex combination of forces that highlight the uncertainty that characterizes the current macroeconomic environment. In such an environment, the Commerce Commission's task is even more difficult than it has been in the past.

The challenge is also asymmetric in nature. Should inflation reemerge as the economy recovers, the Reserve Bank can increase interest rates to control it. However, should there be further adverse economic developments the Reserve Bank has few options left at its disposal since interest rates are already at their lower bound. Moreover, the Reserve Bank is already committed to purchasing a large portion of the government bond market, limiting its options in using further unconventional monetary policy. Stimulating inflation is much more problematic than curbing inflation, and this reinforces the likelihood of bias in the inflation forecasts.

Given the uncertainty, the Commerce Commission's current approach of reverting back to the Reserve Bank's mid-point over 5 years is not reasonable. Using market-based data would provide a better view of investor expectations for inflation.

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- ⁱ The vast bulk of evidence used in this report has been put together by surveying the existing literature and research findings, supplemented by primary research where necessary.
- ⁱⁱ Real returns are the percentage increase in the real purchasing power of financial assets, calculated as the nominal return less expected inflation.
- ⁱⁱⁱ Most advanced economies have a mid-point inflation target of 2 percent. Australia's mid-point target is 2.5 percent and the United States targets inflation in the personal consumption expenditure deflator rather than the consumer price index.
- ^{iv} Hall and McDermott (forthcoming) provide empirical evidence that the New Zealand economy's response to interest rate changes declined after the GFC.
- ^v Problems with inflation forecasts have been well documented in New Zealand by Karagedikli and McDermott (2018) and Lewis and McDermott (2016) and for the United States by Mavroeidis and Stock (2014), the United Kingdom by Haldane (2015), and the euro area by Constancino (2015).
- ^{vi} Another market-based measure can be derived from spot and forward rates from inflation swaps. These swap instruments nicely abstract from short-term inflation developments. Unfortunately, inflation swap markets are relatively new, so it is difficult to evaluate their performance.
- ^{vii} The market value of New Zealand issued inflation-indexed bonds now stand at \$14 billion making up nearly 20 percent of the government bond market.
- ^{viii} Concerns have also been raised about professional forecasters being willing to compromise accuracy to gain publicity. However, using consensus forecast mitigates this problem since outlier publicity seeking forecasts carry little weight in the overall weight (especially when median forecasts are used).
- ^{ix} In New Zealand surveys asking businesses about inflation are conducted the New Zealand Institute of Economic Research (NZIER) and the ANZ Bank. Surveys asking households about inflation are conducted by the Reserve Bank.
- ^x The process is straightforward from the regulator's perspective in that the forecasts are supplied on the Reserve Bank's website and so are easy to find for everyone. That said, the modelling infrastructure that goes into the Reserve Bank's forecasting process is large and complex and not easy to understand from an external perspective. For details on the role of forecasting at the Reserve Bank see McDermott (2013).
- ^{xi} Formally, for a forecast $\hat{\pi}$ of inflation π , the bias is $bias(\hat{\pi}) = E(\hat{\pi} - \pi)$ and accuracy (as measured by the root mean square error) is $RMSE(\hat{\pi}) = \sqrt{E\{(\hat{\pi} - \pi)^2\}}$. The two concepts are related by the formula $RMSE(\hat{\pi}) = \sqrt{Var(\hat{\pi}) + bias(\hat{\pi})^2}$.
- ^{xii} For example, see Coiboin, Gordnichenko, and Kamdar (2018), Adency, Arsov and Evans (2017), Reid (2016), Lees (2016), and Bonam et al (2019).
- ^{xiii} The Reserve Bank only forecasts out to a three-year horizon, so they do not take into account longer risks required in the current context.
- ^{xiv} The implications of recent global developments have been surveyed by Ebrahimy, Igan, and Martinez Peria (2020); Stock and Watson (2019); Freitag and Lain (forthcoming), and the International Monetary Fund (2020).