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# Analytical Notes

# Evaluating measures of price-setting behaviour: New evidence for New Zealand

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## Key findings

- The Reserve Bank of New Zealand – *Te Pūtea Matua* uses the term 'price-setting behaviour' to describe how firms dynamically adjust their prices based on past and expected future inflation.
- Price-setting behaviour plays an important role in shaping inflationary pressures in New Zealand and the Reserve Bank quantifies it in two ways: using modelled measures, such as those derived from past inflation outcomes, and relying on survey measures based on reporting by households and firms. Understanding price-setting behaviour is essential for understanding and forecasting non-tradables inflation, and therefore for setting monetary policy.
- In line with past Reserve Bank research, I find that modelled measures that place greater weight on recent data generally forecast non-tradables inflation better. However, I also find that households' perceptions of current inflation (not previously studied) perform well. I further consider firms' own cost and price expectations and find that, in some circumstances, they contain useful information for predicting non-tradables inflation.
- The performance of price-setting behaviour measures varies over time. In general, they contribute more to predicting non-tradables inflation than other inflation drivers during periods of inflation volatility, such as during the COVID-19 pandemic.
- Pairing price-setting behaviour measures together in one model can improve forecasting accuracy.
- This research suggests that policymakers should consider a suite of price-setting behaviour indicators that perform well in different circumstances to understand evolving inflation dynamics rather than relying on any single 'best' measure.

# 1. Introduction

Inflation ultimately reflects how firms set prices. These pricing decisions are shaped by both macroeconomic conditions and firm- or industry-specific factors.

When demand exceeds supply, inflation tends to rise as firms face higher costs and pass them on to customers by increasing prices. Economists capture this demand–supply balance using the output gap, i.e., the difference between the amount of goods and services the economy is producing – economic output – and the long-run productive potential of the economy which is determined by supply-side factors. However, the output gap alone cannot explain all inflation movements.

Past and expected future inflation also affect firms' costs and pricing decisions. For example, when overall inflation rises sharply or unexpectedly, firms may adjust their expectations of future inflation and continue to increase their prices, creating persistent inflation even when aggregate supply and demand are balanced.

In this *Analytical Note*, 'price-setting behaviour' refers to how prices adjust over time in response to past and expected inflation. This includes factors such as inflation expectations, the degree of indexation to past inflation, and the costs of changing prices. While price-setting behaviour influences both tradables and non-tradables inflation, it plays a relatively larger role in non-tradables inflation, as tradables inflation is more heavily driven by volatile import costs. Accordingly, this *Note* focuses on the role of price-setting behaviour in determining non-tradables inflation. Improving how the Reserve Bank monitors and models price-setting behaviour – or providing additional supporting evidence – can therefore meaningfully enhance our understanding and forecasting of non-tradables inflation.

In the Reserve Bank's core forecasting model – the New Zealand Structural Inflation Model (NZSIM) – price-setting behaviour is a key component of the 'Phillips curve', the equation used to model non-tradables inflation.[1] Currently, NZSIM models the variable governing price-setting behaviour as a function of its own value in the previous quarter and inflation in the previous quarter.[2] This formulation implies that the measure adjusts only gradually as inflation changes.

An alternative approach to quantify price-setting behaviour is to use survey measures that capture households' and firms' inflation expectations. These may be expected to adjust more quickly to economic developments, as they are relatively more forward looking than the modelled measures.[3] Chadwick and Smith (2023) explore the relative performance of several surveyed inflation expectations measures in predicting headline inflation. Until 2015, NZSIM relied on a survey measure, but this was replaced after analyses showed that modelled measures provided a better explanation of inflation dynamics (Karagedikli and McDermott, 2016; McDonald, 2017). More recent research by Kendall and Sing (2025) confirmed this result.

The aim of this *Note* is to test the predictive power of a broad set of modelled and survey measures for explaining and forecasting non-tradables inflation within an econometric framework similar to the Phillips curve in NZSIM. I address four key research questions:

1. How well do price-setting behaviour measures predict non-tradables inflation, both in-sample and out-of-sample?
2. How do modelled measures compare with a broader set of survey measures?
3. How does the predictive performance of different price-setting behaviour measures vary over time?
4. Does combining multiple measures improve predictive power?

This *Note* complements recent Reserve Bank research by Kendall and Sing (2025) by testing more measures of price-setting behaviour, exploring the usefulness of the measures in a wider range of contexts, and adding an additional method to evaluate forecast performance.

I find that, in line with past Reserve Bank research, modelled measures generally perform well, but they can – at certain times – be outperformed by certain survey measures, including businesses' 1-year-ahead inflation expectations, households' perceptions of current inflation, and firms' own cost and price expectations.

Price-setting behaviour measures contribute more to predicting non-tradables inflation during periods of inflation volatility, such as during the COVID-19 pandemic.

[1] The NZSIM non-tradables Phillips curve directly relates quarterly non-tradables inflation to movements in four variables: lagged non-tradables inflation, price-setting behaviour, the output gap, and the relative real wage gap.

[2] This formulation implies that price-setting behaviour is essentially a weighted combination of past CPI inflation outturns, with more recent data being assigned higher weights.

[3] Typically, modelled measures are highly dependent on past inflation. For example, adaptive expectations are formed by looking at past inflation and adjusting slowly over time. People 'adapt' their beliefs based on what has already happened, rather than on forecasts of what is about to happen.

Furthermore, pairing firms' own cost and price expectations with other price-setting behaviour measures together in one model can improve forecasting accuracy. These results suggest that while some measures generally perform better than others, policymakers should consider a suite of price-setting behaviour measures rather than relying on any single 'best' measure.

The rest of the *Note* is constructed as follows. Section 2 describes the measures of price-setting behaviour that are evaluated. Section 3 outlines the methodology. Section 4 presents the results, and Section 5 concludes.

## 2. Measures of price-setting behaviour

I compare the explanatory power and forecast performance of 23 different variables that could potentially measure or proxy price-setting behaviour (**Table 1**). These comprise:

- 7 modelled measures
- 13 survey measures of inflation perceptions or expectations
- 3 survey measures of firms' own cost and price expectations

While past Reserve Bank research on price-setting behaviour has also focused on modelled and survey measures, firms' own cost and price indicators are novel additions to the set of survey measures.

**Table 1: Price-setting behaviour measures.**[4]

| Price-setting behaviour measures | |
|---|---|
| **Modelled measures** | |
| **Adaptive measures** | **Moving average measures** |
| Adaptive ($\rho$=0.95)[a] | 2-year average of CPI inflation |
| Adaptive ($\rho$=0.90)[a] | 3-year average of CPI inflation[a] |
| Adaptive ($\rho$=0.85)[a] | 4-year average of CPI inflation |
| Adaptive ($\rho$=0.80) | |
| **Survey measures** | |
| **Household inflation perceptions/expectations** | **Business inflation expectations** |
| RBNZ HHES current (mean) | RBNZ SOE 1 year (mean)[a,b] |
| RBNZ HHES current (median) | RBNZ SOE 1 year (median) |
| RBNZ HHES 1 year (mean)[a,b] | RBNZ SOE 1 year (standard deviation) |

[4] $\rho$ represents the persistence in the adaptive expectations process (Equation 1). HHES stands for Household Expectations Survey; SOE stands for Survey of Expectations; ANZBO stands for ANZ Business Outlook; QSBO stands for Quarterly Survey of Business Opinion.

| Price-setting behaviour measures | |
|---|---|
| RBNZ HHES 1 year (median)[b] | RBNZ SOE 2 year (mean)[a,b] |
| RBNZ HHES gap between 1-year and current perceptions (mean) | RBNZ SOE 1 year wage (mean) |
| RBNZ HHES gap between 1-year and current perceptions (median) | RBNZ SOE 2 year wage (mean) |
| | ANZBO 1 year (mean) (quarterly average of monthly data)[b] |
| **Firms' own cost and price measures** | |
| **Own selling price expectations** | **Own cost expectations** |
| ANZBO selling price (3 months) | QSBO cost (3 months) |
| QSBO selling price (3 months) | |

[a] Featured in Kendall and Sing (2025)

[b] Featured in Chadwick and Smith (2023)

## 2.1 Modelled measures

Modelled measures are estimates of price-setting behaviour based on past inflation. I consider two types of modelled measures: adaptive measures and simple moving averages.

Adaptive measures of price-setting behaviour reflect the notion that people in the economy form inflation expectations based on what has happened in the past; they only gradually adapt their expectations in response to new information.

Adaptive measures akin to that modelled in NZSIM, also used in Kendall and Sing (2025) and McDonald (2017), follow the law of motion:

$$\widetilde{pb}_t^A = \rho\,\widetilde{pb}_{t-1}^A + (1-\rho)\,\pi_{t-1}^{CPI}, \tag{1}$$

where $\widetilde{pb}_t^A$ is the adaptive measure of price-setting behaviour in period $t$ and $\pi_{t-1}^{CPI}$ is annualised (GST-adjusted) CPI inflation last quarter, i.e., the quarterly percentage change in CPI multiplied by four.

Equation (1) implies that the NZSIM adaptive measure is essentially a weighted combination of past CPI inflation outturns.[5] How much weight households and firms place on recent information relative to more historical information is governed by a persistence parameter, $\rho$.

High values of $\rho$ imply that people place a relatively low weight on the recent inflation outturn, i.e. they are less adaptive and move more gradually. Low values of $\rho$ imply that people place a relatively high weight on the most recent data, i.e., they are more adaptive and move quickly in response to new information. Four values of $\rho$ are considered to construct different adaptive measures from NZSIM (**Table 1**).

[5] This can be easily seen by substituting analogous expressions for the adaptive measure in periods $t-1$, $t-2$, and so on, into the period $t$ definition presented in Equation (1).

Moving-average measures aim to capture similar behaviour but use a simplified moving-average approach to measurement. They differ from the adaptive measures in that they only look back a given amount of time and place an even weight on all quarters. Three moving-average CPI inflation measures are constructed following Kendall and Sing (2025). These are calculated by averaging the annual inflation rate in the previous quarter with that from one year earlier (2-year average) and two years earlier (3-year average), as well as three years earlier (4-year average).

## 2.2 Surveyed inflation expectations measures

Following Chadwick and Smith (2023) and Kendall and Sing (2025), I consider a range of surveyed inflation expectations measures from:

- The Tara-ā-Whare Household Expectations Survey (HHES) from the Reserve Bank of New Zealand,[6]
- The Survey of Expectations (SOE) from the Reserve Bank of New Zealand, and
- The ANZ Business Outlook (ANZBO) survey.

These measures report the expectations for CPI and sometimes wage inflation of households and professional forecasters/businesses across a range of different time horizons.

For households, I include two measures not previously considered by Chadwick and Smith (2023) or Kendall and Sing (2025):

- Current inflation perceptions (what households believe inflation is currently at the time of the survey), and
- The gap between 1-year-ahead inflation expectations and current perceptions. The motivation to include the gap is that households often have perceptions of current inflation that differ materially from inflation as measured by official statistics. The difference between their perception of current inflation and 1-year-ahead expectations may therefore provide a better signal of the direction they expect inflation is heading.

I also include the following SOE measures that were not examined in earlier research:

- The median and standard deviation of 1-year-ahead inflation expectations, to test whether the central tendency and dispersion contain useful information about price-setting behaviour.
- Hourly wage inflation expectations (1 year and 2 years ahead), since wage costs are an important input into firms' price-setting decisions.

## 2.3 Firms' own cost and price expectation measures

In addition, I include data from 1) ANZBO and 2) NZIER's Quarterly Survey of Business Opinion (QSBO) on firms' selling price intentions and own cost expectations. These series have not been examined in this context in previous Reserve Bank research.

While expectations of own selling price and costs do not necessarily reflect an aggregate view of inflation expectations, the rationale for incorporating these additional indicators is that they may be more directly linked to price-setting behaviour than general inflation expectations. Rather than reflecting views about the economy, they capture how firms perceive inflationary pressures

[6] This survey has undergone several methodological redevelopments since 1995. See the RBNZ website for more information.

affecting their own costs and pricing decisions – arguably one step closer to the actual mechanics of price-setting. However, caution is warranted when comparing these indicators with other measures, as they are fundamentally different in nature.

Both the ANZBO and QSBO report a measure of selling price intentions, defined as the net percentage of firms expecting to raise prices in the next three months (those planning increases less those planning decreases). Additionally, they report a cost expectations series, which captures the net percentage of firms expecting higher input costs over the same horizon. The ANZBO cost expectations series is not included as it only begins in 2019.

# 3. Methodology

## 3.1 Data

The analysis uses quarterly data from 1995Q1 to 2025Q2, giving 122 observations. All variables are expressed in cyclical gaps from trend, consistent with the NZSIM non-tradables Phillips curve specification. The non-tradables inflation gap, output gap, and real wage gaps are those used in the Reserve Bank's official forecast system, while gaps for price-setting behaviour measures are calculated as deviations from their sample means.  No constant term is included.

## 3.2 Baseline model

The baseline regression specification used to evaluate the price-setting behaviour measures follows the non-tradables inflation Phillips curve in NZSIM.[7] In particular, in quarter $t$,

$$\pi_t^{NT} = b_1 x_t + b_2 \pi_{t-1}^{NT} + b_3 w_t + b_4 y_t + \epsilon_t, \tag{2}$$

where $\pi_t^{NT}$ represents seasonally-adjusted quarterly non-tradables inflation, $x_t$ indicates price-setting behaviour, $\pi_{t-1}^{NT}$ denotes the previous quarter's non-tradables inflation, $w_t$ stands for the cyclical deviation of the real wage,[8] $y_t$ indicates the output gap, the $b_{()}$ are the slope coefficients, and $\epsilon_t$ is a white noise prediction error. This specification is estimated separately for each measure of price-setting behaviour, $x_t$.  I also estimate a restricted model which excludes the price-setting behaviour term. The restricted model is used as the benchmark for comparison.

Note that the coefficients on firms' own cost and price expectations are not directly comparable to the other price-setting behaviour measures since these series are expressed in net percentage terms. However, I focus on the overall predictive performance of the measures and less on the interpretation of the coefficients.

Variables in the restricted equation are measured using current (ex-post) historical estimates from the Reserve Bank's forecast system. For robustness, the estimation and prediction analysis are also repeated using real-time output gap data, as output gap data can be subject to large revisions. The related results are reported in the appendix.

[7] In NZSIM, parameter values are disciplined by economic theory, and some parameters are calibrated to match long-run relationships. Specifically, in line with theory, NZSIM assumes that coefficients on price-setting behaviour and the lagged term sum to 1 and the coefficients on the output gap and the real wage gap are strictly positive.

[8] The real wage is defined as the labour cost index relative to non-tradables CPI.

This approach complements the methods used by Kendall and Sing (2025). They considered in-sample fit and forecast performance using the NZSIM Phillips curve but used the parameter values from NZSIM, rather than estimating the coefficients in regression models outside NZSIM.

## 3.3 Prediction evaluation metrics

I apply two complementary approaches to evaluate the performance of price-setting behaviour measures:

### In-sample model fit

I estimate each unrestricted model and compare it with the restricted version to evaluate the extent to which price-setting behaviour measures help explain historical variation in non-tradables inflation. I evaluate in-sample fit using a nested model F-test, comparing the unrestricted model with a restricted specification that sets the coefficient on the price-setting behaviour measure to zero, thereby testing whether its inclusion improves model fit.

### Out-of-sample nowcasts

To evaluate whether measures of firms' price-setting behaviour improve predictive performance, I conduct an out-of-sample (pseudo) nowcasting exercise. Model parameters are estimated recursively using either a 50-quarter rolling window or an expanding window beginning with 50 quarters of data and increasing by one quarter at each iteration. For each forecast, parameters are estimated using data available through quarter $t-1$, and a prediction for non-tradables inflation in quarter $t$ is generated using contemporaneously observed explanatory variables in quarter $t$. Forecast accuracy is then compared between unrestricted models that include a price-setting behaviour measure (as specified in Equation 2) and restricted models that exclude it.

For example, the first nowcast is generated by estimating the model using observations $t = 1, \ldots, 50$, which corresponds to 1995Q1-2007Q2. The estimated coefficients are then combined with the explanatory variables observed in period $51$ (2007Q3) to generate a nowcast of non-tradables inflation in period $51$. For the rolling-window specification, the second nowcast, i.e. for $t = 52$, is generated using observations $t = 2, \ldots, 51$. For the expanding-window specification, the second nowcast is generated using observations $t = 1, \ldots, 51$.

I evaluate forecast performance using the Diebold-Mariano-West test for equal predictive accuracy, which assesses whether the mean loss differential between two competing forecasts is statistically different from zero (Diebold and Mariano 1995, West 1996). In this application, forecast accuracy is measured using squared forecast errors.

I report relative root mean squared errors (rRMSEs) alongside Diebold-Mariano-West p-values. Values of the rRMSE below 1 indicate that the unrestricted model has a lower root mean squared forecast error than the restricted model and therefore delivers more accurate forecasts.

## 3.4 Other evaluation metrics

I also consider several alternative metrics and specifications to assess the robustness of the baseline results.

**Stability of in-sample fit.** I evaluate in-sample fit across different time horizons using rolling and expanding windows. This approach assesses the extent to which price-setting behaviour measures explain variation in non-tradables inflation over time.

**Forecasting performance across subperiods.** To examine whether predictive performance differs across regimes, I split the forecast evaluation sample into a pre-COVID-19 period (1995Q1–2019Q4) and a post-COVID-19 period (2020Q1–2025Q2). Model estimation is unchanged from the main analysis: coefficients are estimated recursively using either 50-quarter rolling windows or expanding windows beginning with 50 quarters of data. The resulting sequence of out-of-sample forecast errors is then partitioned into the pre- and post-COVID-19 periods, and RMSEs are computed separately for each subperiod. This yields four sets of forecast evaluation results: *pre-COVID rolling*, *post-COVID rolling*, *pre-COVID expanding*, and *post-COVID expanding*. However, since the post-COVID-19 evaluation period contains only 22 forecast observations, inference based on the Diebold-Mariano-West test should be interpreted cautiously, as the test's asymptotic approximation is less reliable in such a small sample and statistical power is likely to be limited.

**Including multiple price-setting behaviour measures.** I test pairwise combinations between five selected measures – Adaptive ($\rho$ = 0.85), 3-year average of CPI inflation, Household Expectations Survey (HHES) current perception of inflation (median), Survey of Expectations (SOE) 1 year ahead (mean), and QSBO cost expectations – and each of the remaining 22 measures. These five were chosen because they performed strongly in the single-variable tests and represent the main categories of modelled and survey measures. The unrestricted model takes the form:

$$\pi_t^{NT} = c_1 x_{1,t} + c_2 x_{2,t} + c_3 \pi_{t-1}^{NT} + c_4 w_t + c_5 y_t + \eta_t, \tag{3}$$

where $x_1$ and $x_2$ represent the pair of price-setting behaviour measures and the other variables are the same as in Equation (2). I compare the performance of pairwise combinations with single-variable specifications, both in- and out-of-sample, to see if different types of measures provide independent information useful for explaining inflation developments.

**Using the real-time output gap.** Out-of-sample nowcasts are generated using real-time estimates of the Reserve Bank's output gap. While the baseline regression is estimated with the latest available estimate of the output gap, it is useful to check if results are sensitive to the use of real-time data. Due to the endpoint problems associated with statistical filtering as well as data revisions by Stats NZ, output gap estimates in real time may be quite different from the final estimate that is based on more data. Hence, it is valuable to assess whether using real-time data changes the performance of the price-setting behaviour measures. Due to the two-quarter lag in the release of GDP data, the real-time specification yields one less forecast in total (71 instead of 72) compared with the version using final historical estimates.

# 4. Results

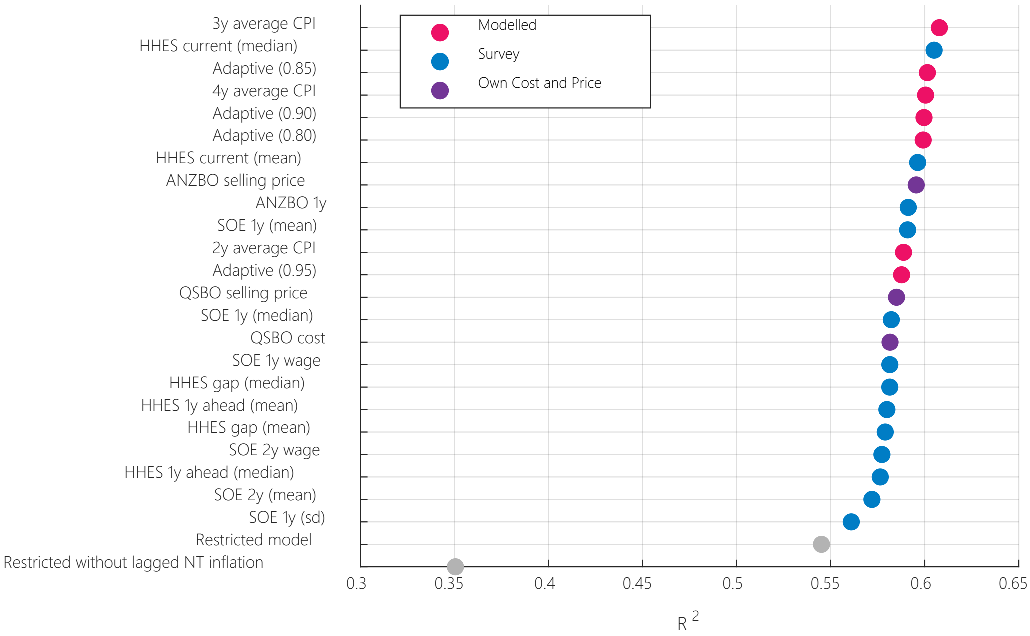
## 4.1 In-sample fit

### Including price-setting behaviour measures improves in-sample fit

Price-setting behaviour measures add explanatory power to the Phillips curve, with all nested model F-statistics being statistically significant at the 1% level (see **Table A1** in the appendix).

Although the inclusion of price-setting behaviour measures leads to only modest increases in $R^2$ relative to the restricted Phillips curve (**Figure 1**), this should not be interpreted as evidence that price-setting behaviour is uninformative. The restricted model already incorporates lagged non-tradables inflation (along with the real wage gap and the output gap). Lagged non-tradables inflation captures inflation persistence and can plausibly be interpreted as reflecting firms' price-setting behaviour. When this variable is removed, the explanatory power of the model declines substantially, with the $R^2$ falling to 0.35. This suggests that price-setting behaviour plays a meaningful role in explaining inflation dynamics, even if its incremental contribution appears limited once related effects are already embedded in the baseline specification.

**Figure 1: $R^2$ statistics from in-sample regressions.**




**Note:** Across all specifications, the nested F-tests show that the inclusion of the price-setting behaviour measure adds statistically significant explanatory power at the 1% level.

**Source:** RBNZ, ANZ, NZIER.

## Modelled measures and household current perceptions perform well, but the best measure varies depending on sample period

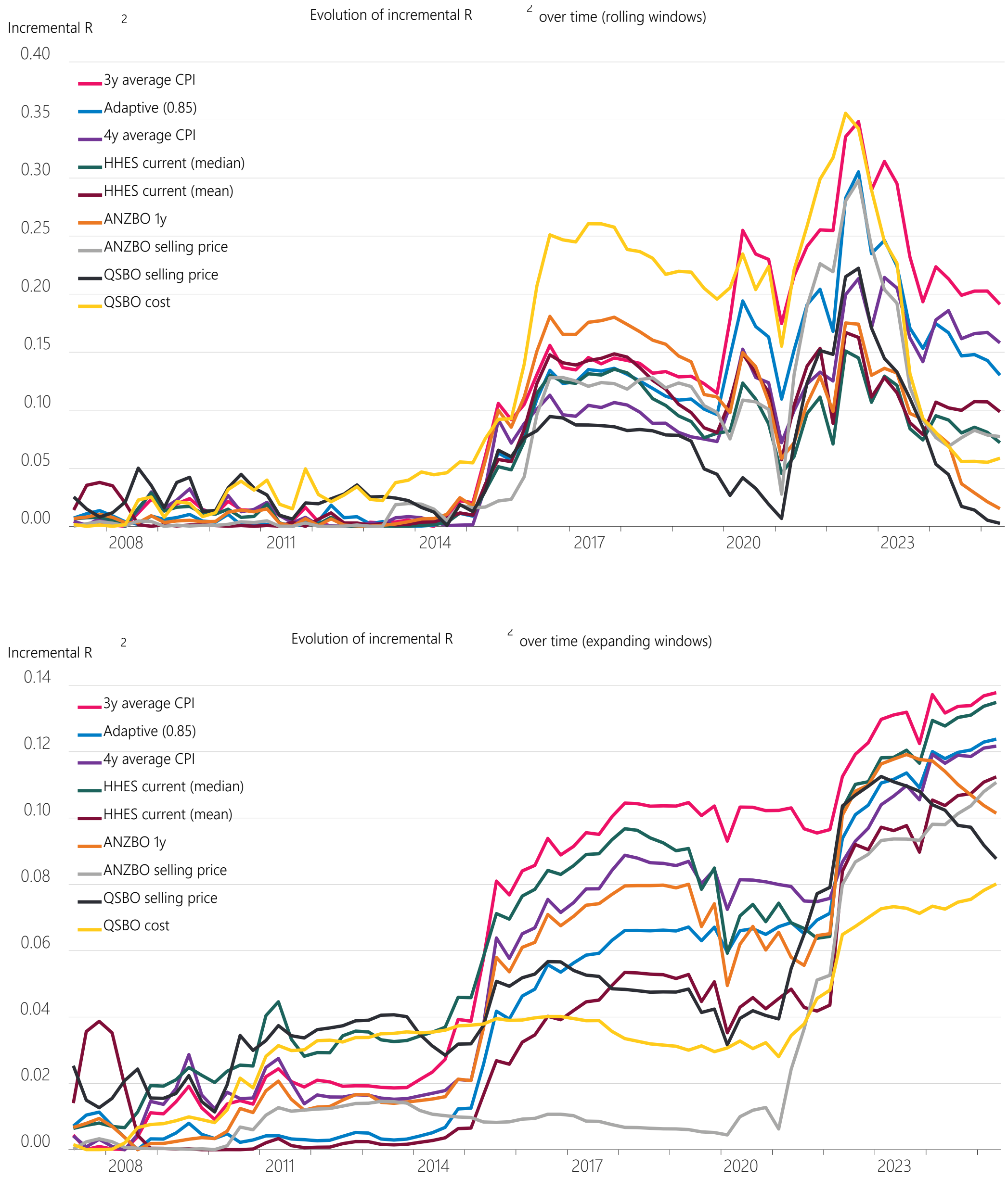
Modelled measures generally outperform other measures, with the 3-year moving average of CPI inflation emerging as the best predictor. Households' current perceptions also perform well, with the household median expectation ranking second and the mean ranking seventh overall. ANZBO selling price expectations perform best among the own cost and price measures.

The explanatory power of different price-setting behaviour measures is sensitive to the sample period considered. **Figure 2** reports the incremental $R^2$ of the unrestricted model (which includes price-setting behaviour variables) relative to a restricted model across time. The incremental $R^2$ can be interpreted as the additional share of variation in inflation explained by including these measures. It is defined as the difference between the $R^2$ of the unrestricted model and that of the restricted model.

In the top panel of **Figure 2**, estimates based on 50-quarter rolling windows show that indicators that perform well in full-sample regressions do not necessarily stand out in shorter samples. For example, measures such as median household current perceptions – strong performers in full-sample tests – appear less prominent when evaluated over shorter windows. Conversely, some indicators exhibit strong explanatory power in specific subperiods. For instance, QSBO cost expectations perform well in the 50 quarters leading up to 2023, but do not consistently rank highly over the full sample.

Rolling estimates are sensitive to individual observations, and some sharp movements in incremental $R^2$ reflect the inclusion or exclusion of influential data points. As a result, periods of strong performance should be interpreted with caution. Nonetheless, these patterns suggest that some measures derive much of their explanatory power from particular historical episodes, while others provide more stable signals over time. This may reflect changing dynamics in the relationship between price-setting behaviour and inflation, with some measures performing better when coefficients are allowed to vary over time rather than being constrained to be constant over the full sample.

**Figure 2: Incremental $R^2$ for rolling and expanding estimation windows (selected measures).**




**Note:** Selected measures are the top three from each category (modelled, survey, and own cost and price) based on in-sample fit.
**Source:** RBNZ, ANZ, NZIER.

### Price-setting behaviour measures matter most during bigger moves in inflation

The bottom panel of **Figure 2** presents expanding-window estimates of incremental $R^2$ for selected measures, beginning with a 50-quarter estimation window and extending the sample forward over time. These results show that, collectively, price-setting behaviour measures add more explanatory power during certain periods, particularly after 2015, when a reduction in ACC levies on vehicle licensing fees contributed to a sharp decline in non-tradables inflation, and during the post-COVID-19 inflation surge around 2022.

This pattern is intuitive. When inflation is relatively stable, there is limited variation for explanatory variables to account for, making relationships more difficult to identify. In contrast, periods of larger inflation movements – such as after 2015 and during the post-COVID-19 surge – provide greater variation, allowing differences in price-setting behaviour to translate more clearly into observed inflation dynamics. As a result, the incremental explanatory power of these measures tends to be higher in more volatile inflation environments. This highlights the importance of considering time-variation when evaluating the usefulness of price-setting indicators.

### Including additional measures marginally improves performance

Earlier results compare the relative performance of alternative measures of price-setting behaviour, many of which are highly correlated with each other (see **Table A2** in the appendix). However, some measures are less correlated with each other – for example, ANZBO selling price and the 4-year average of CPI inflation have a correlation of only 0.21. This suggests that different types of measures may provide independent information useful for explaining inflation developments. It is therefore useful to consider how indicators can be combined to predict non-tradables inflation, both in-sample and out-of-sample.

I find that combining multiple price-setting behaviour measures in the Phillips curve improves model fit, with pairwise combinations generally achieving higher $R^2$ than single-variable specifications. For example, combining the 3-year average of CPI inflation with QSBO selling price expectations increases $R^2$ to 0.63 – around 2 percentage points higher than the model using the 3-year average alone – and represents the best-performing two-variable specification. The nested F-test comparing these specifications indicates that this improvement is statistically significant at the 0.01 level.

While a 2-percentage point increase in $R^2$ may appear modest, gains of this magnitude are meaningful in this context. The best-performing single-variable model improves on the fully restricted specification by only around 5–6 percentage points in total. Hence, a 2-percentage point increase represents a substantial share of the achievable improvement.

## 4.2 Out-of-sample nowcasting

### Price-setting behaviour measures improve out-of-sample nowcast performance

Including price-setting behaviour measures improves nowcasting performance relative to the restricted model, as indicated by rRMSEs that are (statistically) significantly below 1 (see **Table 2**). More of these measures improve forecast performance under expanding estimation windows than under rolling windows.

**Table 2: Full sample relative RMSEs.**

| Candidate | Rolling | Expanding |
|---|---|---|
| 3y average CPI | 0.89** | 0.87*** |
| QSBO cost | 0.90** | 0.93*** |
| Adaptive (0.85) | 0.90** | 0.88*** |
| Adaptive (0.80) | 0.90** | 0.89*** |
| SOE 1y (mean) | 0.90** | 0.92*** |
| Adaptive (0.90) | 0.91** | 0.89*** |
| 4y average CPI | 0.91** | 0.89*** |
| SOE 1y (median) | 0.92** | 0.94** |
| SOE 1y wage | 0.92** | 0.93*** |
| HHES current (median) | 0.93 | 0.87*** |
| 2y average CPI | 0.94** | 0.91*** |
| ANZBO selling price | 0.94 | 0.90*** |
| Adaptive (0.95) | 0.94* | 0.93** |
| SOE 2y wage | 0.94* | 0.94*** |
| ANZBO 1y | 0.94 | 0.92** |
| SOE 2y (mean) | 0.95 | 0.95** |
| HHES current (mean) | 0.96 | 0.90** |
| HHES 1y ahead (mean) | 0.96 | 0.95 |
| HHES gap (median) | 0.97 | 0.95 |
| HHES 1y ahead (median) | 0.97 | 0.95* |
| QSBO selling price | 0.98 | 0.93 |
| HHES gap (mean) | 0.98 | 0.93 |
| SOE 1y (sd) | 0.98 | 0.99 |

**Note**: The superscripts ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Darker cells indicate lower rRMSE, i.e., better model performance.

## Modelled measures perform well in most, but not all, circumstances

Modelled measures generally perform well across specifications, although their relative performance varies across samples. Over the full evaluation period, modelled measures generally perform best, with the 3-year average of CPI inflation producing the lowest forecast errors overall. More adaptive modelled measures – particularly the one with $\rho = 0.85$ – also perform well. Among survey measures, two measures stand out: median current household perceptions (under expanding windows) and QSBO cost expectations (under rolling windows).

Splitting the evaluation into pre- and post-COVID-19 periods yields broadly similar patterns (see **Table 3**). Prior to COVID-19, most measures provide little improvement in forecast performance relative to the benchmark model. In contrast, forecast gains are generally larger in the post-COVID-19 period. The best performers post-COVID-19 are disproportionately the more adaptive modelled measures, suggesting that during periods of rapid inflation adjustment, measures that place greater weight on recent inflation outcomes become substantially more informative.

**Table 3: Sub-sample relative RMSEs.**

| | Rolling | | Expanding | |
|---|---|---|---|---|
| **Candidate** | **Pre-COVID** | **Post-COVID** | **Pre-COVID** | **Post-COVID** |
| SOE 1y (mean) | 0.96 | 0.83* | 0.95* | 0.87** |
| 3y average CPI | 0.96 | 0.78** | 0.92** | 0.80*** |
| QSBO cost | 0.96 | 0.80* | 0.98 | 0.87*** |
| HHES current (median) | 0.97 | 0.88 | 0.94* | 0.79** |
| HHES gap (median) | 0.97 | 0.95* | 1.00 | 0.88** |
| SOE 1y (median) | 0.98 | 0.84* | 0.98 | 0.90 |
| SOE 2y (mean) | 0.98 | 0.92 | 0.96* | 0.94 |
| ANZBO 1y | 0.98 | 0.89 | 0.96 | 0.86 |
| SOE 1y wage | 0.98 | 0.84** | 0.98** | 0.87** |
| Adaptive (0.90) | 0.98 | 0.80** | 0.96 | 0.81*** |
| Adaptive (0.85) | 0.98 | 0.78** | 0.96 | 0.78*** |
| 4y average CPI | 0.99 | 0.81*** | 0.94 | 0.82*** |
| Adaptive (0.80) | 0.99 | 0.77** | 0.97 | 0.77*** |
| QSBO selling price | 0.99 | 0.94 | 0.98 | 0.88* |
| SOE 2y wage | 1.00 | 0.86* | 0.98 | 0.90** |
| HHES gap (mean) | 1.00 | 0.95 | 1.00 | 0.85* |
| 2y average CPI | 1.00 | 0.84*** | 0.97* | 0.82*** |
| HHES current (mean) | 1.00 | 0.90 | 0.99 | 0.78** |
| Adaptive (0.95) | 1.00 | 0.84** | 0.97 | 0.88** |
| ANZBO selling price | 1.01 | 0.83 | 1.00 | 0.77*** |
| HHES 1y ahead (mean) | 1.02 | 0.89 | 1.00 | 0.89* |
| HHES 1y ahead (median) | 1.02 | 0.90 | 1.00 | 0.90* |
| SOE 1y (sd) | 1.02 | 0.93 | 0.99 | 0.98 |

**Note**: The superscripts ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Darker cells indicate lower rRMSE, i.e., better model performance.

Among survey measures, median current household perceptions again perform well in the expanding window estimations. The ANZBO selling price expectations measure also performs strongly in the post-COVID-19 expanding-window exercise, despite showing little predictive value prior to COVID-19. This suggests that the relative usefulness of different expectation measures may depend on the economic environment and highlights the sensitivity of forecast performance to the evaluation period.

When using real-time output gap data instead of the final vintage output gap, modelled measures and current household inflation perceptions continue to perform well. However, own cost and price measures also show particularly strong performance. Specifically, the ANZBO selling price and QSBO cost expectations measures outperform other measures. The strong performance of the ANZBO selling price measure is driven by its post-COVID-19 forecasting accuracy, while the QSBO cost expectations measure performs well when rolling estimation windows are used. One caveat when interpreting the strong performance of the own cost and price measures is that they may forecast well when real-time output gap estimates are used because they are more closely correlated with the true (ex-post) output gap than other measures. In that case, these variables could be improving forecasts for the 'wrong reason' – by compensating for mismeasurement in the real-time output gap rather than capturing price-setting behaviour especially well. The full set of results are presented in **Table A3** of the appendix.

Considering the results from both the baseline forecasts and those incorporating real-time output gap data, across the full and split samples, the findings are broadly consistent. First, modelled measures perform well, with more adaptive specifications tending to outperform less adaptive ones. This is consistent with past Reserve Bank research (Kendall and Sing, 2025). Second, several survey and own cost and price measures not previously examined – particularly households' current perceptions of inflation, ANZBO selling price expectations, and QSBO cost expectations – also perform strongly across a range of metrics, and in some cases, outperform modelled measures.

Overall, while modelled measures appear to provide more consistent signals, alternative price-setting behaviour measures can be particularly informative in specific periods and under certain model specifications.

## Price-setting behaviour measures matter more in the post-COVID-19 period

There is a clear difference in the predictive value of price-setting behaviour measures before and after COVID-19. As shown in **Table 3**, the post-COVID-19 evaluation period (2020Q1–2025Q2) generally exhibits substantially lower relative RMSEs than the pre-COVID-19 period (1995Q1–2019Q4). While most measures provide little improvement in forecast accuracy before COVID-19, many reduce forecast errors materially during the post-COVID-19 period, with several specifications lowering RMSEs by 15–25 percent relative to the benchmark model.

The post-COVID-19 results should be interpreted with some caution, as the evaluation period contains only 22 quarterly observations. Consequently, the Diebold-Mariano-West tests are based on a relatively small sample, and the reported p-values should be viewed as indicative rather than definitive. Nevertheless, the broad pattern of results is highly consistent across candidate measures and across both rolling and expanding estimation windows.

Further insight is provided by the cumulative forecast error plots shown in **Figure A1**. Forecast performance is broadly similar across the restricted and unrestricted models until around 2022, after which the restricted model accumulates substantially larger forecast errors. This indicates that price-setting behaviour measures became particularly informative during the post-pandemic inflation episode.

More generally, the results suggest that these measures are most valuable during periods of elevated inflation volatility and rapid changes in firms' pricing behaviour, when conventional demand or activity variables may be less able to capture evolving inflation dynamics.

### Including pairs of price-setting behaviour measures improves forecast accuracy, especially post-COVID

Pairwise combinations of price-setting behaviour measures can improve out-of-sample nowcasting performance relative to single-measure models (see **Table A4** in the appendix). For example, in the rolling-window scenario, the best-performing single variable – the 3-year moving average of CPI inflation – drops to 19$^{th}$ place when pairwise measures are considered. Under the expanding-window specification, the 3-year average of CPI inflation continues to perform well when paired with other measures, while under rolling windows, QSBO cost expectations perform strongly when paired with other variables.

The gains from pairwise measures appear to be largely driven by stronger performance after COVID-19 (see **Table A5** in the appendix), although the small sample post-COVID-19 makes this finding more tentative. This is consistent with the earlier result that price-setting behaviour measures were most useful during the post-COVID-19 inflation episode. In an environment where inflation dynamics are shifting rapidly, combinations of indicators may be more useful because no single measure captures all relevant dimensions of price-setting behaviour. Pairing measures may therefore help capture complementary information from recent realised inflation, household perceptions, business costs, and firms' pricing intentions.

## 4.3 Discussion of overall results

### There is value in considering price-setting behaviour measures beyond modelled measures

Price-setting behaviour measures improve both the in-sample fit and the out-of-sample nowcasting performance of estimated non-tradables inflation Phillips curve specifications analogous to that used in NZSIM. In line with past Reserve Bank research, modelled measures perform well, particularly the 3-year moving average of CPI inflation and some adaptive measures ($\rho$=0.80 and $\rho$=0.85). Also consistent with earlier results, is the finding that more adaptive measures tend to outperform more persistent ones.

However, modelled measures do not always perform well, and they may be dominated by other measures depending on the model specification, the sample period considered and other methodological details (e.g., rolling versus expanding estimation windows and forecast horizons). Some of the measures examined in this *Note* that have not previously been considered in Reserve Bank research – such as the gap between households' 1-year-ahead expectations and current perceptions, the median and standard deviation of firms' expectations, and hourly wage expectations – show limited predictive power. However, there are three notable exceptions: current household perceptions (particularly the median), QSBO own cost expectations, and ANZBO own selling price expectations. This suggests that there is valuable information in inflation expectations and business activity surveys that can inform our understanding of inflation. It is however important to recognise that the own cost and price measures are different in nature from the other inflation expectations measures and their comparative forecasting strength should be interpreted carefully.

### Price-setting behaviour measures matter most when inflation dynamics shift

Both the in-sample and out-of-sample prediction results suggest that the relevance of price-setting behaviour measures varies over time. Incremental $R^2$ are highest, and improvements in forecast performance are most notable in the post-COVID-19 period. This highlights that while price-setting measures may not always add much to model fit or forecast accuracy in periods of stable inflation, they can become important sources of information when inflation dynamics are shifting rapidly.

Because of this, results can differ depending on whether shorter, recent windows or longer, historical samples are used. Policymakers should therefore be cautious about relying too heavily on either approach in isolation. A measure that appears strong in the recent past may not yield robust results, while one that looks reliable overall may not be especially informative for current conditions.

### Including additional measures can produce improvements

Both the in-sample and nowcasting tests suggest that combining multiple measures of price-setting behaviour generally results in marginal improvements. Pairwise combinations improved forecast performance to a greater degree in the post-COVID-19 period, reinforcing that these measures may be particularly valuable during times of volatility in inflation.

### These results support the results of previous Reserve Bank research while adding new insights

Overall, the results from the methods in this *Note* are consistent with the results of previous Reserve Bank research. More adaptive modelled measures tend to outperform both less adaptive modelled measures and survey measures, particularly over longer sample periods (although differences in performance are relatively small). However, this research also highlights households' current inflation perceptions as a strong performer.

I also find that other measures, particularly firms' own cost and pricing expectations, can provide valuable information for understanding and predicting non-tradables inflation in some applications. Incorporating these measures into near-term forecasting models may help to improve forecasting performance or illustrate risks to other model predictions.

## Conclusion

This *Note* evaluated both the in-sample and out-of-sample predictive ability of price-setting behaviour measures for non-tradables inflation using a Phillips curve specification akin to that used in the Reserve Bank's forecasting model, NZSIM. Overall, the results reinforce previous Reserve Bank research, showing that relatively more adaptive modelled measures of price-setting behaviour often perform best, while also demonstrating that other measures can provide useful information in some circumstances.

Compared with earlier Reserve Bank research, two new findings stand out. First, the usefulness of these indicators varies over time, becoming more important during periods of inflation variability such as COVID-19. Second, while some measures, particularly the adaptive modelled measures, tend to perform better and more consistently, other measures may outperform them for some use cases under certain conditions and in certain time periods. Overall, differences in performance are generally modest.

Taken together, these results suggest that policymakers should not rely on a single 'best' measure of price-setting behaviour. Instead, they should draw on a range of indicators that provide complementary information under different conditions.

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# Appendix

**Table A1: In-sample regression results.**

| Measure of price setting behaviour | Nested model F-statistic | $R^2$ | Coefficients | | | |
|---|---|---|---|---|---|---|
| | | | Price-setting behaviour | Lagged non-tradables | Relative wage | Output Gap |
| 3y average CPI | 18.9*** | 0.61 | 0.42 | 0.24 | -0.04 | 0.12 |
| HHES current (median) | 18.4*** | 0.60 | 0.34 | 0.25 | -0.05 | 0.11 |
| Adaptive (0.85) | 16.7*** | 0.60 | 0.47 | 0.23 | -0.05 | 0.11 |
| 4y average CPI | 16.3*** | 0.60 | 0.45 | 0.27 | -0.02 | 0.12 |
| Adaptive (0.90) | 16.1*** | 0.60 | 0.55 | 0.25 | -0.04 | 0.11 |
| Adaptive (0.80) | 15.9*** | 0.60 | 0.43 | 0.22 | -0.05 | 0.10 |
| HHES current (mean) | 14.9*** | 0.60 | 0.23 | 0.28 | -0.04 | 0.10 |
| ANZBO selling price | 14.7*** | 0.60 | 0.03 | 0.36 | -0.06 | 0.08 |
| ANZBO 1y | 13.3*** | 0.59 | 0.45 | 0.29 | -0.05 | 0.09 |
| SOE 1y (mean) | 13.2*** | 0.59 | 0.48 | 0.31 | -0.05 | 0.09 |
| 2y average CPI | 12.5*** | 0.59 | 0.31 | 0.28 | -0.05 | 0.10 |
| Adaptive (0.95) | 12.2*** | 0.59 | 0.76 | 0.30 | -0.02 | 0.12 |
| QSBO selling price | 11.3*** | 0.59 | 0.02 | 0.40 | -0.07 | 0.07 |
| HHES gap (median) | 10.7*** | 0.58 | -0.45 | 0.36 | -0.05 | 0.11 |
| SOE 1y (median) | 10.5*** | 0.58 | 0.44 | 0.33 | -0.05 | 0.09 |
| QSBO cost | 10.3*** | 0.58 | 0.02 | 0.38 | -0.06 | 0.08 |
| SOE 1y wage | 10.2*** | 0.58 | 0.49 | 0.36 | -0.05 | 0.07 |
| HHES 1y ahead (mean) | 9.8*** | 0.58 | 0.35 | 0.33 | -0.03 | 0.10 |
| HHES gap (mean) | 9.5*** | 0.58 | -0.27 | 0.36 | -0.05 | 0.11 |
| HHES 1y ahead (median) | 9.2*** | 0.58 | 0.32 | 0.34 | -0.04 | 0.09 |
| SOE 2y wage | 9.0*** | 0.58 | 0.81 | 0.38 | -0.05 | 0.08 |
| SOE 2y (mean) | 7.4*** | 0.57 | 0.64 | 0.39 | -0.04 | 0.09 |
| SOE 1y (sd) | 4.3*** | 0.56 | 0.77 | 0.40 | -0.05 | 0.10 |
| Restricted model | | 0.55 | | 0.47 | -0.04 | 0.10 |

Note: The superscripts ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels respectively.

**Table A2: Correlation between price-setting behaviour measures.**

| | 1. Adaptive (0.95) | 2. Adaptive (0.90) | 3. Adaptive (0.85) | 4. Adaptive (0.80) | 5. 2y average CPI | 6. 3y average CPI | 7. 4y average CPI | 8. HHES current (mean) | 9. HHES current (median) | 10. HHES 1y (mean) | 11. HHES 1y (median) | 12. HHES gap (mean) | 13. HHES gap (median) | 14. SOE 1y (mean) | 15. SOE 1y (median) | 16. SOE 1y (sd) | 17. ANZBO 1y | 18. SOE 2y (mean) | 19. SOE 1y wage | 20. SOE 2y wage | 21. ANZBO selling price | 22. QSBO selling price | 23. QSBO cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Adaptive (0.95) | 1 | | | | | | | | | | | | | | | | | | | | | | |
| 2. Adaptive (0.90) | 0.96 | 1 | | | | | | | | | | | | | | | | | | | | | |
| 3. Adaptive (0.85) | 0.91 | 0.99 | 1 | | | | | | | | | | | | | | | | | | | | |
| 4. Adaptive (0.80) | 0.85 | 0.96 | 0.99 | 1 | | | | | | | | | | | | | | | | | | | |
| 5. 2y average CPI | 0.87 | 0.95 | 0.96 | 0.95 | 1 | | | | | | | | | | | | | | | | | | |
| 6. 3y average CPI | 0.95 | 0.97 | 0.93 | 0.89 | 0.92 | 1 | | | | | | | | | | | | | | | | | |
| 7. 4y average CPI | 0.96 | 0.94 | 0.88 | 0.83 | 0.85 | 0.96 | 1 | | | | | | | | | | | | | | | | |
| 8. HHES current (mean) | 0.85 | 0.92 | 0.93 | 0.91 | 0.9 | 0.91 | 0.86 | 1 | | | | | | | | | | | | | | | |
| 9. HHES current (median) | 0.86 | 0.93 | 0.94 | 0.93 | 0.91 | 0.9 | 0.86 | 0.98 | 1 | | | | | | | | | | | | | | |
| 10. HHES 1y (mean) | 0.79 | 0.87 | 0.9 | 0.91 | 0.85 | 0.77 | 0.74 | 0.85 | 0.9 | 1 | | | | | | | | | | | | | |
| 11. HHES 1y (median) | 0.76 | 0.83 | 0.87 | 0.89 | 0.84 | 0.73 | 0.7 | 0.82 | 0.88 | 0.96 | 1 | | | | | | | | | | | | |

| | 1. Adaptive (0.95) | 2. Adaptive (0.90) | 3. Adaptive (0.85) | 4. Adaptive (0.80) | 5. 2y average CPI | 6. 3y average CPI | 7. 4y average CPI | 8. HHES current (mean) | 9. HHES current (median) | 10. HHES 1y (mean) | 11. HHES 1y (median) | 12. HHES gap (mean) | 13. HHES gap (median) | 14. SOE 1y (mean) | 15. SOE 1y (median) | 16. SOE 1y (sd) | 17. ANZBO 1y | 18. SOE 2y (mean) | 19. SOE 1y wage | 20. SOE 2y wage | 21. ANZBO selling price | 22. QSBO selling price | 23. QSBO cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **12. HHES gap (mean)** | -0.69 | -0.74 | -0.72 | -0.68 | -0.72 | -0.8 | -0.75 | -0.88 | -0.8 | -0.5 | -0.49 | 1 | | | | | | | | | | | |
| **13. HHES gap (median)** | -0.62 | -0.65 | -0.61 | -0.57 | -0.6 | -0.73 | -0.7 | -0.76 | -0.72 | -0.39 | -0.3 | 0.89 | 1 | | | | | | | | | | |
| **14. SOE 1y (mean)** | 0.65 | 0.75 | 0.8 | 0.83 | 0.75 | 0.65 | 0.59 | 0.71 | 0.8 | 0.88 | 0.89 | -0.39 | -0.29 | 1 | | | | | | | | | |
| **15. SOE 1y (median)** | 0.64 | 0.73 | 0.78 | 0.81 | 0.72 | 0.63 | 0.57 | 0.68 | 0.76 | 0.86 | 0.87 | -0.36 | -0.26 | 0.99 | 1 | | | | | | | | |
| **16. SOE 1y (sd)** | 0.45 | 0.5 | 0.54 | 0.57 | 0.48 | 0.41 | 0.36 | 0.45 | 0.54 | 0.62 | 0.64 | -0.18 | -0.13 | 0.64 | 0.63 | 1 | | | | | | | |
| **17. ANZBO 1y** | 0.73 | 0.83 | 0.88 | 0.9 | 0.84 | 0.73 | 0.67 | 0.82 | 0.89 | 0.95 | 0.95 | -0.5 | -0.38 | 0.94 | 0.91 | 0.66 | 1 | | | | | | |
| **18. SOE 2y (mean)** | 0.61 | 0.66 | 0.69 | 0.7 | 0.66 | 0.59 | 0.58 | 0.57 | 0.68 | 0.77 | 0.8 | -0.26 | -0.19 | 0.9 | 0.88 | 0.5 | 0.84 | 1 | | | | | |
| **19. SOE 1y wage** | 0.56 | 0.68 | 0.75 | 0.78 | 0.72 | 0.6 | 0.51 | 0.7 | 0.74 | 0.79 | 0.8 | -0.44 | -0.32 | 0.88 | 0.86 | 0.36 | 0.87 | 0.79 | 1 | | | | |
| **20. SOE 2y wage** | 0.55 | 0.65 | 0.7 | 0.72 | 0.67 | 0.59 | 0.53 | 0.63 | 0.69 | 0.75 | 0.76 | -0.37 | -0.28 | 0.87 | 0.86 | 0.32 | 0.81 | 0.85 | 0.93 | 1 | | | |
| **21. ANZBO selling price** | 0.38 | 0.53 | 0.6 | 0.63 | 0.53 | 0.49 | 0.44 | 0.65 | 0.67 | 0.63 | 0.63 | -0.51 | -0.42 | 0.72 | 0.68 | 0.37 | 0.69 | 0.61 | 0.68 | 0.68 | 1 | | |
| **22. QSBO selling price** | 0.21 | 0.35 | 0.44 | 0.49 | 0.41 | 0.28 | 0.21 | 0.42 | 0.48 | 0.57 | 0.58 | -0.18 | -0.11 | 0.74 | 0.71 | 0.36 | 0.68 | 0.71 | 0.71 | 0.74 | 0.79 | 1 | |
| **23. QSBO cost** | 0.34 | 0.5 | 0.57 | 0.61 | 0.53 | 0.45 | 0.39 | 0.55 | 0.58 | 0.61 | 0.63 | -0.36 | -0.25 | 0.75 | 0.72 | 0.31 | 0.67 | 0.69 | 0.73 | 0.77 | 0.84 | 0.82 | 1 |

**Note**: Darker cells indicate lower rRMSE, i.e., better model performance.

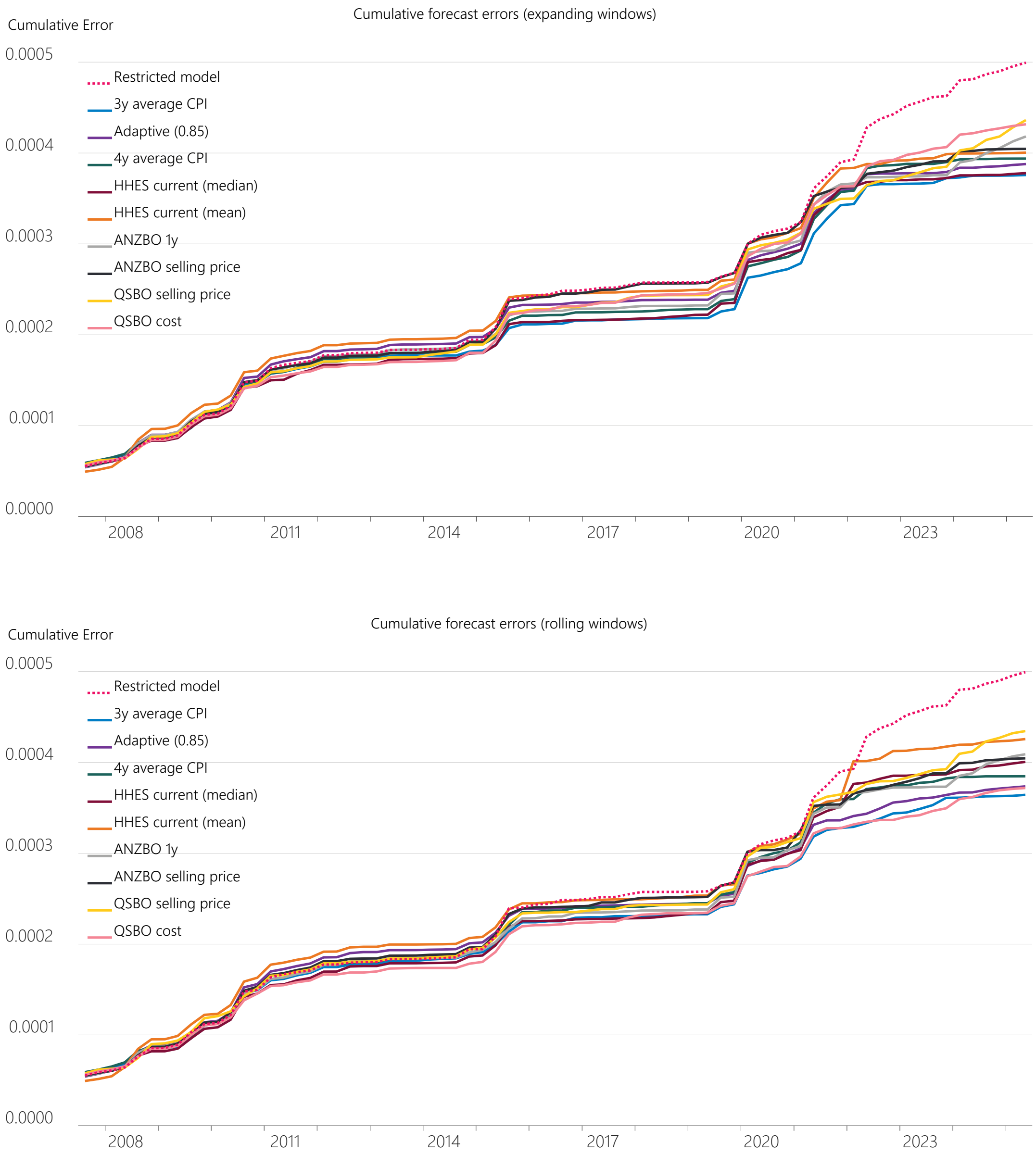
Table A3: Relative RMSEs with real-time output gap data.

| | | | Rolling | | Expanding | |
|---|---|---|---|---|---|---|
| Candidate | Rolling | Expanding | Pre-COVID | Post-COVID | Pre-COVID | Post-COVID |
| QSBO cost | 0.79*** | 0.89*** | 0.90*** | 0.70*** | 0.94*** | 0.85*** |
| ANZBO selling price | 0.82** | 0.86*** | 0.99 | 0.66** | 0.99 | 0.76*** |
| Adaptive (0.80) | 0.88*** | 0.88*** | 0.96** | 0.82*** | 0.95*** | 0.82*** |
| Adaptive (0.85) | 0.88*** | 0.88*** | 0.94*** | 0.84*** | 0.93*** | 0.84*** |
| SOE 1y wage | 0.89*** | 0.91*** | 0.96** | 0.83*** | 0.96*** | 0.88*** |
| 3y average CPI | 0.90*** | 0.88*** | 0.92** | 0.88** | 0.88*** | 0.89* |
| Adaptive (0.90) | 0.90*** | 0.90*** | 0.94** | 0.87** | 0.91*** | 0.89** |
| 4y average CPI | 0.91*** | 0.92** | 0.95 | 0.88** | 0.91** | 0.92 |
| SOE 1y (mean) | 0.91** | 0.93** | 0.93** | 0.90* | 0.94*** | 0.93 |
| HHES current (median) | 0.92** | 0.89** | 0.95* | 0.90** | 0.92** | 0.87* |
| QSBO selling price | 0.93* | 0.91** | 0.98 | 0.89 | 0.98 | 0.85** |
| SOE 1y (median) | 0.93** | 0.96 | 0.96* | 0.91* | 0.97* | 0.96 |
| 2y average CPI | 0.93** | 0.90*** | 1.00 | 0.88*** | 0.96*** | 0.86*** |

| Candidate | Rolling | Expanding | Rolling | | Expanding | |
|---|---|---|---|---|---|---|
| | | | Pre-COVID | Post-COVID | Pre-COVID | Post-COVID |
| **SOE 2y wage** | 0.93** | 0.94*** | 0.99 | 0.89** | 0.96** | 0.92*** |
| **ANZBO 1y** | 0.94* | 0.92* | 0.96 | 0.92 | 0.94* | 0.91 |
| **Adaptive (0.95)** | 0.94** | 0.96 | 0.96 | 0.92 | 0.93** | 0.98 |
| **HHES gap (mean)** | 0.94* | 0.93 | 1.00 | 0.89** | 0.99 | 0.87* |
| **HHES gap (median)** | 0.96 | 0.95 | 1.00 | 0.93** | 1.02 | 0.90* |
| **HHES 1y ahead (mean)** | 0.97 | 0.96 | 1.04* | 0.90* | 1.02 | 0.92* |
| **HHES current (mean)** | 0.97 | 0.89** | 1.00 | 0.96 | 0.98 | 0.82** |
| **SOE 2y (mean)** | 0.98 | 0.98 | 0.98 | 0.97 | 0.95** | 1.00 |
| **HHES 1y ahead (median)** | 0.98 | 0.97 | 1.03** | 0.95 | 1.01 | 0.94 |
| **SOE 1y (sd)** | 0.99 | 1.00 | 1.01 | 0.98 | 0.98 | 1.01 |

**Note**: The superscripts ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Darker cells indicate lower rRMSE, i.e., better model performance.

**Figure A1: Cumulative forecast errors from out-of-sample nowcasting (selected measures).**




**Note:** Selected measures are the top three from each category (modelled, survey, and own cost and price) based on in-sample fit.

**Source:** RBNZ, ANZ, NZIER.

**Table A4: Relative RMSEs for top 20 configurations (based on rolling windows) when pairwise combinations are included.**

| Candidate | Rolling | Expanding | Rolling Pre-COVID | Rolling Post-COVID | Expanding Pre-COVID | Expanding Post-COVID |
|---|---|---|---|---|---|---|
| QSBO cost + HHES gap (median) | 0.85*** | 0.88** | 0.93* | 0.74** | 0.96 | 0.78*** |
| QSBO cost + 3y average CPI | 0.85** | 0.84*** | 0.96 | 0.68** | 0.92** | 0.75*** |
| QSBO cost + HHES gap (mean) | 0.86** | 0.88*** | 0.95* | 0.72** | 0.97 | 0.75*** |
| QSBO cost + Adaptive (0.90) | 0.86** | 0.86*** | 0.97 | 0.69** | 0.95** | 0.75*** |
| QSBO cost + Adaptive (0.85) | 0.87** | 0.86*** | 0.97 | 0.70** | 0.96** | 0.74*** |
| QSBO cost + 4y average CPI | 0.87** | 0.86*** | 0.98 | 0.69*** | 0.94* | 0.77*** |
| SOE 1y (mean) + HHES gap (median) | 0.87*** | 0.86*** | 0.92** | 0.80* | 0.94 | 0.76*** |
| QSBO cost + Adaptive (0.80) | 0.88** | 0.87*** | 0.98 | 0.71** | 0.97 | 0.74*** |
| 3y average CPI + ANZBO selling price | 0.88** | 0.82*** | 0.98 | 0.72* | 0.92** | 0.69*** |
| 3y average CPI + HHES gap (median) | 0.88** | 0.89** | 0.93* | 0.79** | 0.93* | 0.85* |
| 3y average CPI + QSBO selling price | 0.88** | 0.83*** | 0.97 | 0.74** | 0.91* | 0.71*** |
| QSBO cost + Adaptive (0.95) | 0.88** | 0.89*** | 0.99 | 0.70*** | 0.96 | 0.80*** |
| QSBO cost + 2y average CPI | 0.88** | 0.88*** | 0.98 | 0.74** | 0.96** | 0.77*** |
| 3y average CPI + SOE 1y (mean) | 0.89** | 0.86*** | 0.97 | 0.76** | 0.94 | 0.77*** |
| SOE 1y (mean) + 4y average CPI | 0.89** | 0.88*** | 0.99 | 0.73*** | 0.96 | 0.78*** |
| QSBO cost + HHES current (median) | 0.89** | 0.85*** | 0.97 | 0.77** | 0.93** | 0.75*** |
| 3y average CPI + SOE 1y wage | 0.89** | 0.87*** | 0.97 | 0.76** | 0.92** | 0.79*** |
| HHES gap (median) + Adaptive (0.85) | 0.89** | 0.89** | 0.95* | 0.80* | 0.96 | 0.80** |
| 3y average CPI | 0.89** | 0.87*** | 0.96 | 0.78** | 0.92** | 0.80*** |
| QSBO cost + SOE 1y wage | 0.89** | 0.90*** | 0.96 | 0.78** | 0.96 | 0.83*** |

**Note**: The superscripts ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Darker cells indicate lower rRMSE, i.e., better model performance.

**Table A5: Relative RMSEs for top single-variable versus top two-variable combination.**

| | | | Rolling | | Expanding | |
|---|---|---|---|---|---|---|
| **Candidate** | **Rolling** | **Expanding** | **Pre-COVID** | **Post-COVID** | **Pre-COVID** | **Post-COVID** |
| Top single variable | 0.89 | 0.87 | 0.96 | 0.77 | 0.92 | 0.77 |
| Top two-variable combination | 0.85 | 0.82 | 0.92 | 0.68 | 0.91 | 0.68 |
| Improvement | 4pp | 5pp | 4pp | 9pp | 1pp | 9pp |