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A quantitative model for NZGB ASW spreads

- **This paper provides a non-technical overview of key insights from recent quantitative research into NZ ASW spreads.**
- **Spreads have traded in distinct regimes differentiated by changes in government issuance, RBNZ market participation and macro drivers.**
- **The variables contributing to ASW variation evolve and are dependent on the regime.**
- **The resulting model can be utilised to understand the drivers of 10-year ASW and for scenario analysis.**
- **Net government bond supply is peaking as a proportion of GDP based on HYEFU projections. ASW spreads are expected to narrow over the medium term.**

Background

NZ asset swap spreads (ASW) have exhibited distinct price action since the pandemic, compared with prior years. While spreads have historically exhibited mean-reverting behaviour with NZGBs trading at a premium (lower yield) to the respective swap yield, the post-Covid period has seen increased volatility, driven by supply dynamics, central bank interventions, and evolving risk sentiment, leading to a period of persistent deviation from the previous mean.

By segmenting market behaviour into distinct regimes, our analysis[1] reveals how supply dynamics, central bank participation and macro variables contribute to long-term ASW movements. In addition, this research provides a useful tool to assess the outlook for ASW, based on investor expectations for model inputs.

Since 2020, ASW spreads have displayed increased volatility and persistent deviations from historical levels, driven by:

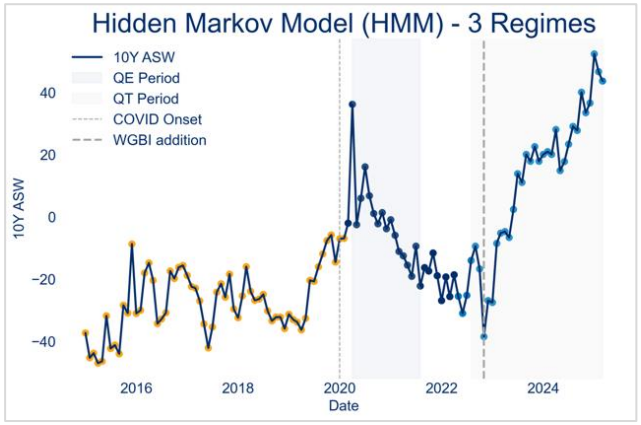
- A surge in government bond issuance to finance fiscal deficits.
- Large-scale central bank participation in the NZGB market through quantitative easing (QE) and the subsequent unwind, quantitative tightening (QT).
- The sell-off in global government bonds, after the decades long trend of lower yields.

Regime Identification

During the pre-Covid period, ASW spreads exhibit stationarity[2], with a high degree of statistical significance, confirming the traditional view that ASW spreads tend to revert to a long-term mean. However, in the post-Covid period ASW spreads do not exhibit this behaviour. Market dynamics have been influenced by persistent supply pressures and the withdrawal of central bank support.

Given this breakdown in stationarity, a Hidden Markov Model (HMM)[3] is applied to formally identify distinct regimes in ASW spreads over time, without imposing predefined breakpoints. A three-regime model aligns with our priors and accurately distinguishes the end of QE, increase in net supply, and the QT period when spreads have trended wider.

Distinct ASW regimes



The regimes identified by the HMM are as follows:

1. **Pre-Covid stability (2015–2020).** NZGB ASW spreads exhibited mean-reverting behaviour. This period corresponded with moderate and predictable issuance levels. ASW mean -25bp.
2. **QE compression regime (2020–2022).** Large-scale RBNZ QE offset heavy government issuance which resulted in tighter ASW spreads and reduced volatility. ASW mean -12bp.

[1] The research was completed by Scott Marsh, BNZ's Head of Trading. This paper provides a non-technical overview of the key insights.
[2] Series mean and variance do not change over time.
[3] HMM is a statistical technique that assumes the data follows a sequence of hidden states, each with distinct statistical properties.

3. **QT & supply driven widening (2022–present).** The end of QE and introduction of QT, alongside large government funding requirements, led to sustained ASW widening. Increased market uncertainty and global rate repricing further exacerbated spread movements. ASW mean +9bp.

Methodology

The dependent variable in the analysis is the 10-year constant maturity NZGB matched maturity asset swap[4]. The modelling process used 10 years of monthly data from January 2015. An iterative technique was used to identify and remove highly correlated variables that could introduce noise into the modelling process. The following variables were selected.

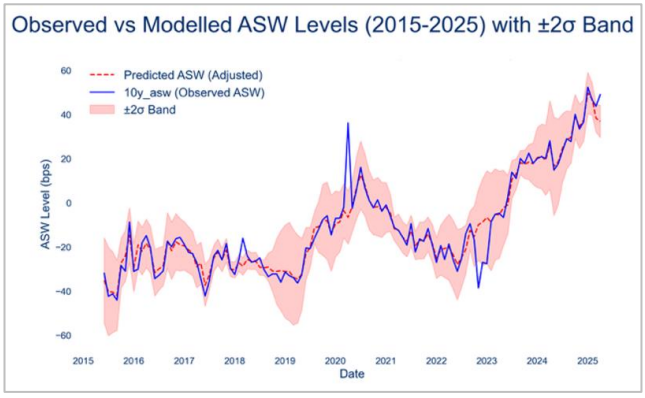
- Bond supply factors:
  - Net free float, (% GDP, t-1).
  - RBNZ large scale asset portfolio (LSAP), (% GDP, t-1)
- Interest rate & market dynamics:
  - 2y NZ swap rate (t).
- Economic variable:
  - NZ unemployment rate (t)

Model selection

To assess the drivers of ASW spreads and forecast future movements, several modelling approaches were tested, ranging from linear regression techniques to advanced machine learning models. These were fitted to single regimes and the whole time series. The predictive power and robustness of the ASW model were evaluated by out-of-sample testing and other statistical validation techniques.

A combination of machine learning techniques[5] were selected as the final model for NZGB ASW predictions. This combination exhibits strong predictive accuracy across both cross-validation and test sets.

Model output



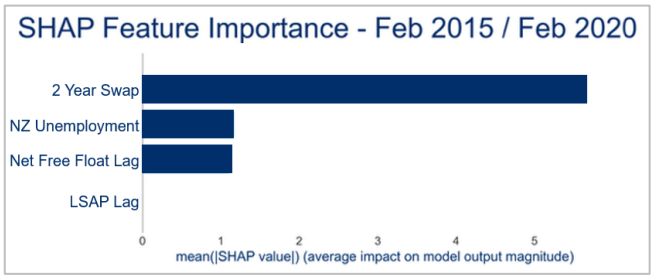
The model benefits from its ability to handle non-linear interactions and regime shifts more effectively than linear models. It displays shifts away from the longer-term mean reflecting changes in supply and demand. The chart above displays the model's ability to predict the NZGB ASW level, both in-and-out of sample.

Time varying drivers of ASW

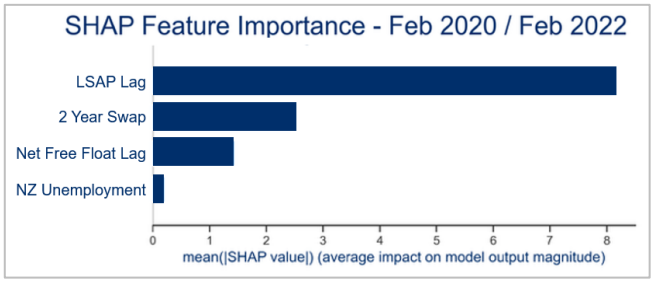
While the predictive ability of the model is of value for asset managers and traders, the drivers are of equal importance to policy makers.

A technique[6] is used to assess how much each variable contributes to the prediction by running the fitted model pre and post covid. The main takeaway from the bar charts below is that rates, via the 2y swap, and economic variables, via the unemployment rate, were the main drivers in the pre-COVID period. This alters post-Covid, where the free-float and size of the RBNZ's LSAP portfolio become the main drivers.

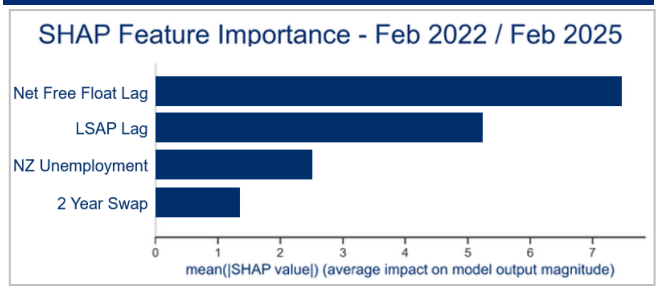
SHAP feature importance – pre-Covid stability



SHAP feature importance – QE compression regime



SHAP feature importance – QT & supply driven widening



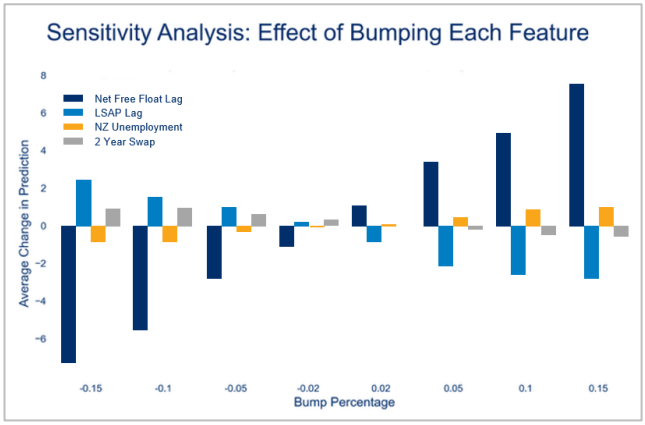
[4] Generated by a non-parametric spline method allowing for a consistent and simple comparison with the 10-year swap level over the sample period.

[5] XGBoost and Random forest

[6] SHAP (Shapley Additive exPlanations)

The shift in importance of variables highlights the impact of increased supply which has deviated from historically stable levels. This change in regime is being identified by the HMM modelling. Focussing on the current post-Covid regime, the model can be stressed to interpret the directional effects of each of the variables.

Post -Covid model stress test summary



Final thoughts

As central banks continue to unwind QE, and government bond issuance remains elevated, the interaction between supply and market risk appetite will be key in determining whether ASW spreads remain at these historically wide levels. Net government bond supply is projected to decline in coming years, particularly when QT is completed by mid-2027, implying ASW spreads will narrow over the medium term.

BNZ Research and BNZ trading will be using the techniques outlined in this paper to inform our views.

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