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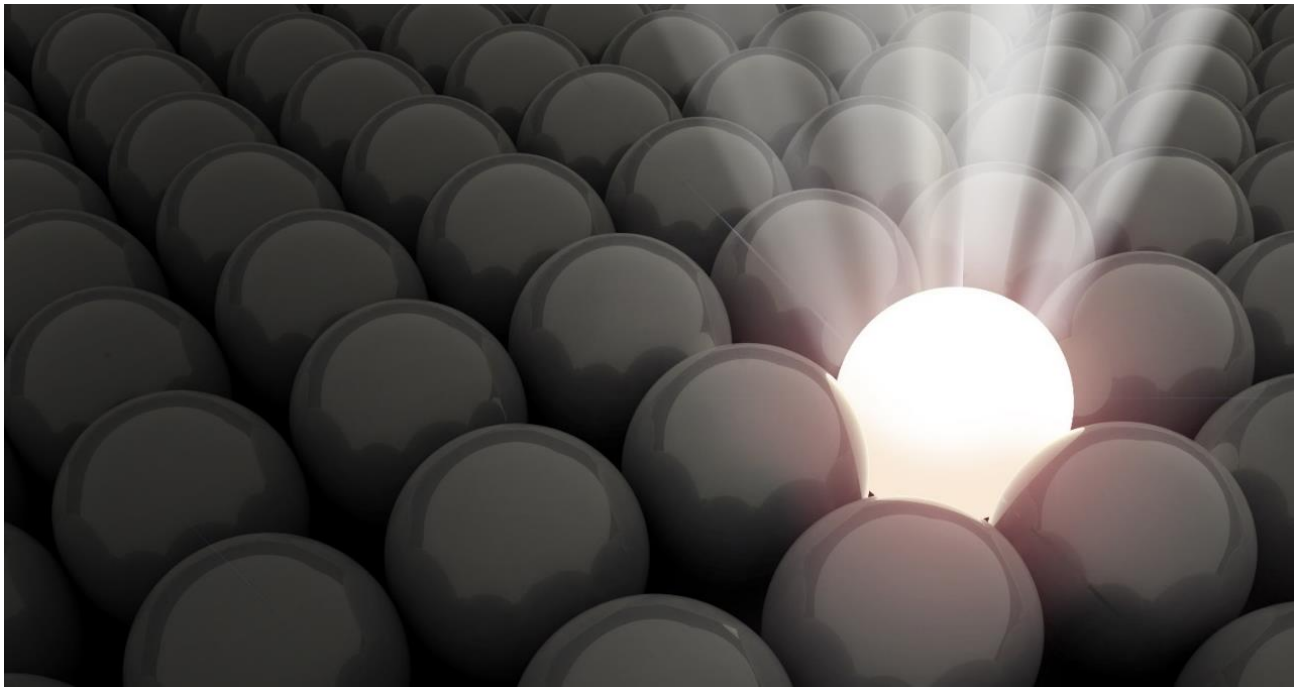
20 years

Capital Markets Memorandum

Capital Markets and Asset Allocation insights from Frontier Advisors

Frontier's Quantitative "Fair Value" Bond Models

November 2014



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Frontier's quantitative "fair value" bond models

Global government bonds have experienced a multi-decade (secular) bull market since yields peaked in the early 1980s. However, for a number of years, many in the investment industry have described global government bond yields as being too low.

Based on our qualitative assessment of the macroeconomic environment Frontier agrees with this assessment, but we also conduct systematic (quantitative) analyses to determine why market pricing might be similar or different to our view.

The purpose of this Capital Markets Memorandum is to introduce Frontier's government bond models.

These models attempt to provide fair value estimates of US and Australian 10 year government bond yields. As well, we model the steepness of the two countries' respective yield curves, as measured by the difference between 10 year and 3 month yields. Based on a combination of fundamental economic drivers and technical factors, we find that bond yields in the US and Australia have been materially below fair value since mid-2012.

We also explore why current market metrics are different to our expectations.

Government bond yield model methodology

We examine a combination of fundamental and technical factors for possible inclusion in our government bond yield models.

The macroeconomic variables we investigate are split into growth and inflation categories. We view these as the underlying fundamental drivers of bond yields. However, we are also wary that some of these variables can lag markets.

To capture other drivers of yields, we also investigate a range of technical and market indicators. We think they can capture valuable non-macroeconomic information such as investor flows and risk appetite.

Using these candidate variables, we systematically[1] examine their effectiveness in explaining movements in 10 year US government (UST 10y) and Australian government (AGB 10y) bond yields. To maintain a relatively longer history while avoiding regime changes, our analysis starts from 1998.

For the US, we settle on the following variables for our final model:

- Unemployment gap[2];
- UST 10y yield volatility; and
- UST 10y yield momentum

We find the unemployment gap is correlated with growth and exhibits sensible econometric properties (statistically significant[3] and a negative coefficient[4]).

However, in our process of analysis we did not find any of our inflation related variables to be statistically significant. We take this as evidence they are too backward looking. We considered using market derived measures of inflation expectations but, due to their shorter history (around a decade once sufficiently liquid), decided against this.

The correlation of the unemployment gap with nominal growth, which itself contains an inflation component, does provide us with some comfort. As for the other two variables, their inclusion captures risk on/risk off behaviour and investor flows. During periods of market stress, realised volatility tends to pick up rapidly, with yields compressing as investors seek shelter in the UST market. Momentum likely picks up investor flows and other transitory factors the market focuses on from time to time.

As for Australia, we decide to model yields as a spread above the US equivalent by including our fair value estimate from our UST10y model. The final model includes:

- Our fair value yield estimate for UST 10y yields;
- Capacity utilisation difference between Australia and the US;
- AGB yield curve momentum; and
- AGB 10y momentum

Similar to the US, inflation was found to be an insignificant factor, while the capacity utilisation difference between Australia and the US neatly proxies the growth difference between the two economies.

However, we do not find AGB10y yield volatility to be a significant factor. We suspect this is because investors do not view AGBs as a global safe haven market.

In its place, we include AGB yield curve (10 year minus 3 month yields) momentum. We take this as evidence monetary policy expectations play a greater role in influencing longer term yields in the Australian market.

Finally, these models are designed to estimate "fair value" given **current** economic and financial conditions. As we are not seeking to make any judgements on how the models' underlying variables will evolve in the future, we implicitly assume market yields will revert to their fair value over time.

Government bond yield models

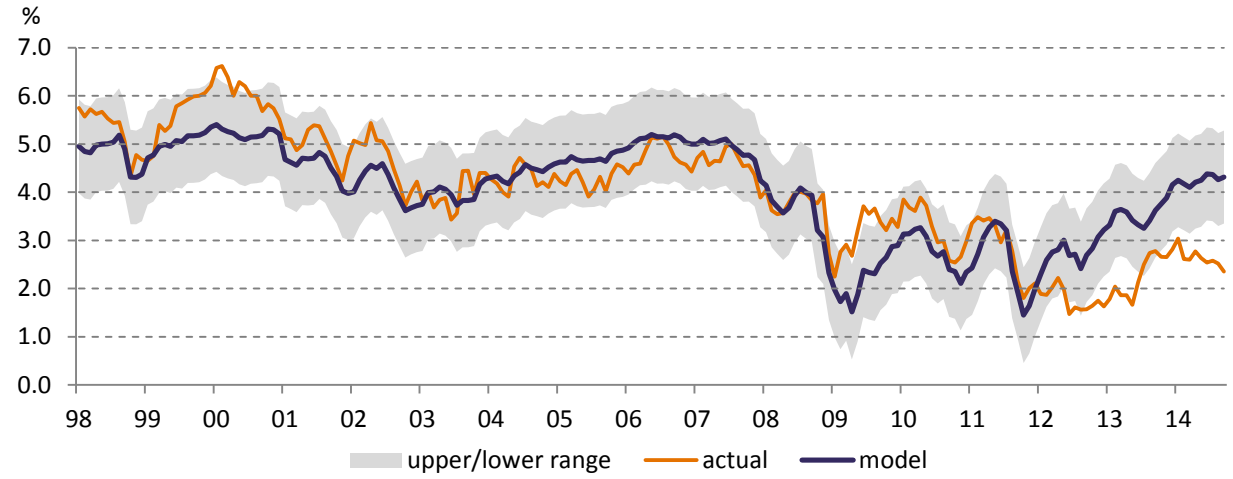
Charts 1 and 2 show actual UST 10y and AGB 10y yields, respectively, compared with our models' estimates of fair value. The grey strip in each chart provides an upper and lower range for fair value yields, beyond which market yields are said to deviate significantly from their fair value.

Our models suggest yields in the US and Australia are significantly below fair value and have remained so since mid-2012.

The sustained and significant gap between our estimate of fair value and actual market yields is a cause for concern. We also have concerns over the diverging trend between actual and fair value yields since early-2014 – rather than gradually increasing, as we expected, US and Australian yields have declined.

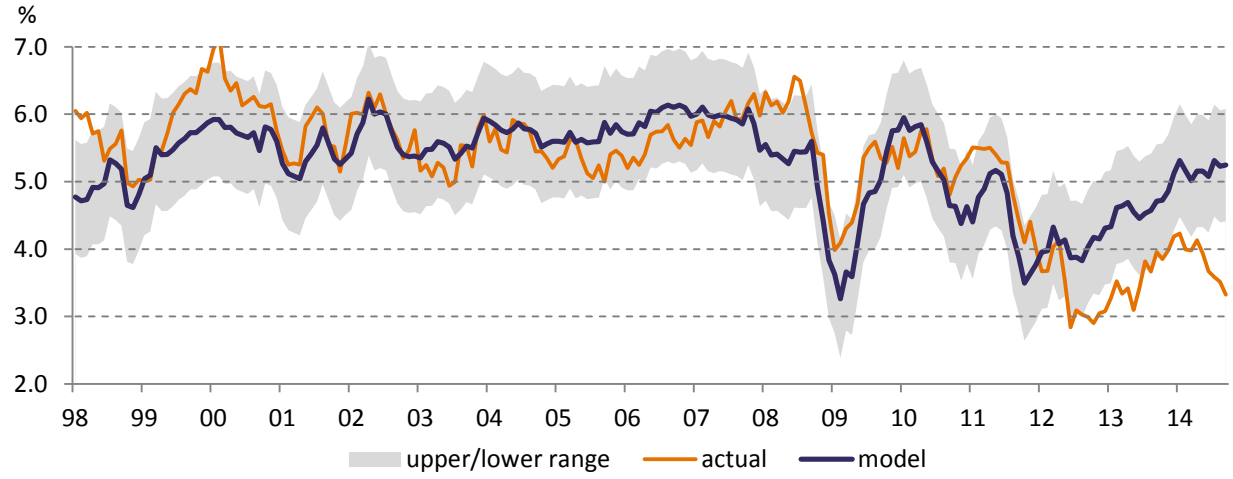
We offer some of our thoughts on the possible causes later in this memorandum.

Chart 1: US 10 Year Government Bond Yield Model



Source: DataStream, Frontier

Chart 2: Australian 10 Year Government Bond Yield Model



Source: DataStream, Frontier

Government bond yield curve models methodology

To extend our analysis, we also construct models for the fair value of both the UST and AGB yield curves, as measured by the difference between 10 year and 3 month yields. The results of these models can be used to make qualitative assessments as to why longer term fair value yields differ from market yields. For example, if our earlier modelling suggests 10 year bonds are richly priced, but our yield curve models suggest the gap between 10 year and 3 month yields is within fair value, then we can infer the discrepancy lies with the level of short term yields.

Using the same techniques and principles as before, we settle on the following variables for our US yield curve model:

- y/y change in core CPI;
- capacity utilisation;
- y/y change in industrial production; and
- UST yield curve momentum.

In contrast to our UST10y yield model, we find inflation to be significant. We also find two proxies for growth – capacity utilisation and industrial production growth – to be significant.

The combination of growth and inflation factors, which resemble the variables in the Taylor Rule[5], leads us to believe our model is capturing the market's expectations of monetary policy in the future, which in turn drives the steepness of the yield curve.

We also include a momentum factor, which measures whether or not, and how quickly, the yield curve is flattening or steepening, to capture investor flows and other transient factors.

Similarly to the approach we used in our AGB10y model, we incorporate our fair value estimate for the UST yield curve in our AGB yield curve model. This allows for the significant influence of USTs on the Australian market.

For the AGB yield curve model, we settle on the following variables:

- our fair value estimate for the UST yield curve;
- NAB Business Survey: business conditions;
- capacity utilisation; and
- AGB yield curve momentum.

Unlike our UST yield curve model, we find inflation to be an insignificant factor. We think this may be linked to the spill over effects of US monetary policy[6] and possibly the difficulties in dealing with the terms of trade-driven capital inflows and currency appreciation during the mid-2000s.

The other significant factors are as expected – two proxies for growth, with the NAB Business Survey being more forward looking, and momentum.

Again, we note that these models are designed to estimate "fair value" given **current** economic and financial conditions.

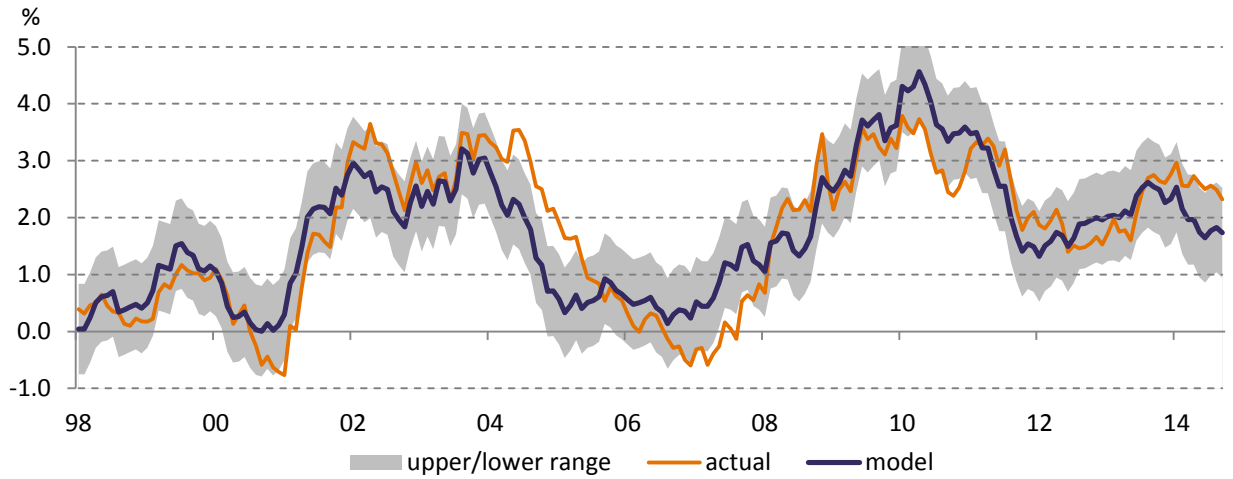
Government bond yield curve models

Charts 3 and 4 show the actual UST and AGB yield curves, respectively, compared with our models' estimates of fair value. Again, the grey strip in each chart provides an upper and lower range for fair value yield curve steepness, beyond which market yield curves are said to deviate significantly from their fair value.

The models suggest the current steepness of the US and Australian yield curves are, respectively, within their acceptable range.

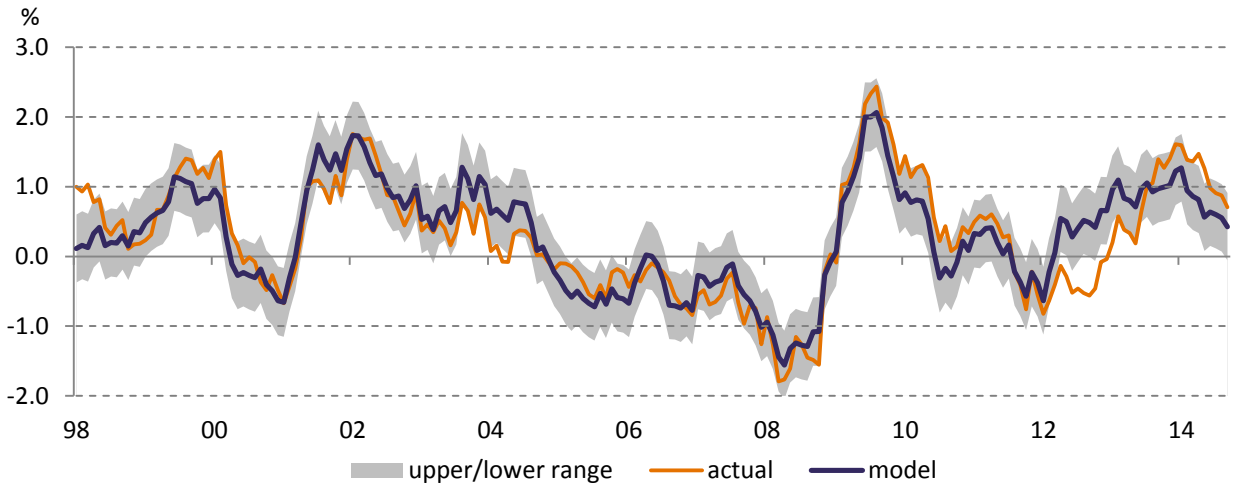
We can take this a step further though. Combining this information with our earlier results suggests to us that extraordinarily low policy rates are a major reason why markets are pricing longer term bonds so richly (i.e. why bond yields are so low).

Chart 3: US Government Bond Yield Curve Model



Source: DataStream, Frontier

Chart 4: Australian Government Bond Yield Curve Model



Source: DataStream, Frontier

Divergence between fair value and market yields

In this section we discuss possible reasons why our models' estimate of fair value yields currently differ significantly from market yields.

Firstly, examining the individual components of our fair value UST 10y model, we find that the divergence between fair value and market yields since mid-2012 has coincided with a reduction in realised market volatility. Over the same period, US growth conditions have improved (the unemployment gap has narrowed). Therefore, the combination of the two – better fundamentals and the absence of a flight-to-safety driven spike in volatility – would normally be associated with a gradual increase in yields (a lessening of investor appetite for safe/defensive assets, pushing up the term premium).

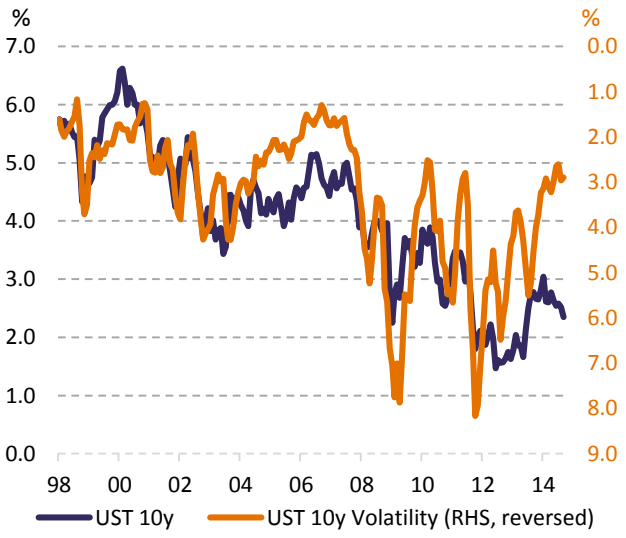
As for Australia, the prime culprit appears to be the gradually higher fair value estimate of UST 10y yields – a key input to our AGB 10y yield model.

What about the diverging trend in fair value and market yields since early 2014?

We suspect weaker growth momentum is likely to blame for this. We provide evidence of this in Chart 6 which shows the year on year change in the OECD's Composite Leading Indicator (CLI) for the G7 group of countries against UST 10y yields. The CLI is most commonly used to make judgements about the *rate* of growth in the future (e.g. growth is forecast to be above trend). By taking a year on year change in growth expectations, we can therefore obtain a proxy for the *rate of change* of growth expectations (e.g. compared with earlier expectations, growth is now expected to be above trend by a larger or smaller amount than before).

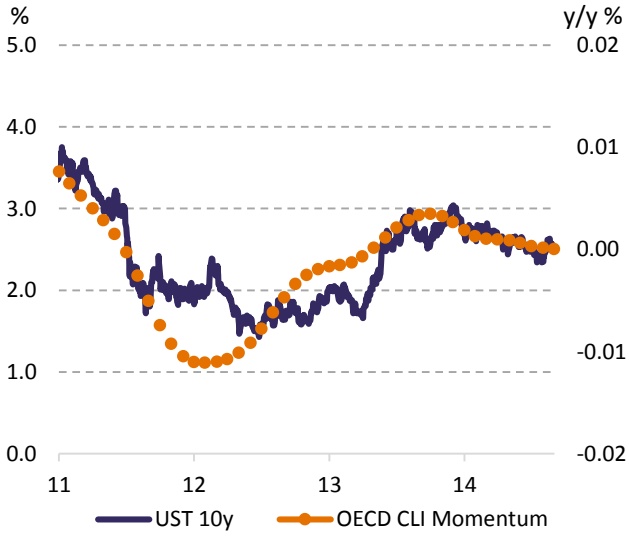
We also suspect the recent drastic downward revision to inflation expectations in the US and elsewhere has played an important role, but note that this has been reflected in market pricing only since late September.

Chart 5: UST 10y Yields vs. UST 10Y Yield Volatility



Source: DataStream, Frontier

Chart 6: UST 10y Yield vs. OECD G7 CLI Momentum



Source: DataStream, Frontier

Why are yields lower than our modelling?

Beyond these more recent developments, are there longer term reasons why current yields are significantly lower than what we would expect?

One possibility is we have not correctly incorporated lower terminal central bank policy rates in the future. Judging by 10 year forward UST 10y yields (UST 10Y10Y[7]), the market certainly believes this to be the case. Current pricing has UST 10y yields increasing by less than 1% over the next ten years. While we have advocated the US Federal Reserve will employ a "lower-for-longer" monetary policy, chart 7 suggests that markets are pricing much lower terminal rates than we think likely.

Another possibility is forward guidance has been exceedingly effective at dampening the bond market's reaction to economic data, even at the long end of the curve. Recent research by Swanson and Williams (see source for Chart 8) attempts to quantify this.

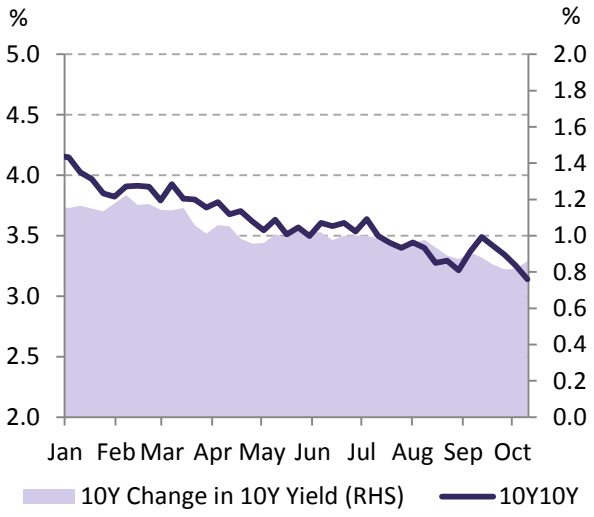
By examining the reaction of UST yields to economic data during a reference period (1990-2000), these researchers are able to index the sensitivity of yields to data releases over the subsequent period.

In Chart 8, the blue line measures the sensitivity of UST 10y yields to economic data releases. When the line is at 1, yields are reacting with the same degree of sensitivity as they did from 1990-2000, while a value of 0 implies yields are completely insensitive to the data.

What is interesting is the significant decline in UST 10y's sensitivity after 2012, which coincides with the US Federal Reserve extending its forward guidance on maintaining a near zero policy rate – market yields have become less sensitive to data releases.

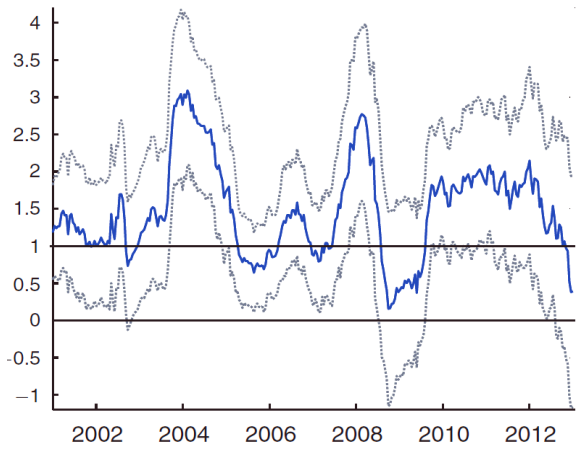
If this has indeed been a significant factor, we would expect fundamentals to reassert themselves over time as policy rates begin to normalise.

Chart 7: UST 10Y10Y Forward Yield



Source: DataStream, Frontier

Chart 8: UST 10y Yield Sensitivity to News



Source: Swanson and Williams, *Measuring the Effect of the Zero Lower Bound on Medium- and Longer-Term Interest Rates,* American Economic Review: Vol. 104 No. 10 (October 2014

Conclusion

In this Capital Markets Memorandum we have presented our proprietary government bond yield and yield curve models for the US and Australia. We believe the results to be reasonable and broadly in line with our qualitative assessment of both markets. However, we acknowledge that our models' estimates of fair value have significantly differed from market yields for a sustained period of time.

In the coming months we will continue to monitor both our models and the market, and will seek to improve and refine our models. **We continue to recommend clients hold an underweight allocation to Australian and international sovereign government bonds.**

[1] We use a statistical technique called step-wise ordinary least squares regression. At each step, we examine the incremental improvement to our model by including a given variable as measured by the increase in the model's adjusted R-squared. To minimise the risk of over-fitting, we make a qualitative assessment on when to stop adding new variables.

[2] The difference between the unemployment rate and the Congressional Budget Office estimate of the non-accelerating inflation rate of unemployment.

[3] Makes a meaningful (non-zero) contribution in explaining the variation in UST10y yields.

[4] A negative coefficient implies there is an inverse relationship between the unemployment gap and UST10y yields. i.e. all else equal, a lower unemployment gap (higher growth) results in higher yields.

[5] The Taylor Rule describes the link between monetary policy with inflation and the output gap. Capacity utilisation and industrial production growth are considered as proxies for the output gap.

[6] Hofmann and Bogdanova, *Taylor rules and monetary policy: a global "Great Deviation"*, BIS Quarterly Review, September 2012

[7] Historically 10Y/10Y forward rates are not a good predictor of actual rates 10 years hence

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