InTouch Capital Markets

Attractive alpha generating opportunities: Spread trading Eurex and ASX bond futures

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Executive Summary

On 10 December 2018, Eurex Exchange has extended its trading hours into the Asian morning, allowing for effective spread trading between Eurex Bund and Schatz futures, and ASX 3y and 10y bond futures. This paper shows that spread trading between Eurex and ASX fixed income futures can offer attractive alpha generating opportunities. Choosing regression-based hedge ratios for Eurex Bunds and Schatz Futures vs ASX 10s, or ASX 3s, and sometimes mixing in some Treasuries, creates mean-reverting spreads that can be traded when they reach their extremes, with high likelihood of profitable retracement.

Extended Eurex trading hours present an opportunity for Australia versus German Fixed Income futures trading

Eurex Exchange has announced that, as of the 10 December 2018, trading hours are extended further in the Asian time zones for select benchmark products such as EURO STOXX 50®, DAX® and German fixed income futures, as well as the MSCI futures suite. While originally available from 15:00 Singapore Time, upon the launch, these select products will be available from 08:00 Singapore Time. These new extended hours will overlap with local exchanges in the Asian and Pacific regions, such the Australian Securities Exchange (ASX).

The ASX 24 new trading platform (NTP) operates on a 24/6 basis, open 21 hours and 50 minutes every trading day that gives access to products listed on the ASX 24 market including debt, equity index and commodity products and a full suite of trading order management functionalities. The availability of German fixed income futures at Eurex in parallel with Australian fixed income futures at ASX, during Asian trading hours, presents spread trading opportunities for market participants.

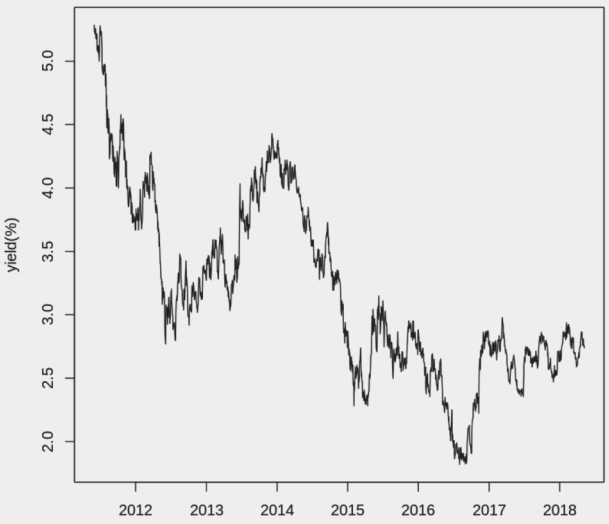
Quantitative links between German and Australian fixed income futures

In this paper, we investigate how to improve the risk reward of trading 3y and 10y Australian bond futures, by hedging them using Eurex Bund and Schatz futures, and also, for completeness, US treasury futures. As economic cycles have integrated globally, bond markets have become more correlated. Indeed, it is difficult for a country which is fully part of the global economy, such as Australia, to escape such correlations. This is a fortuitous development for traders because it means that country bond yields can less justifiably move too far away from those of their peers, and when they do, profitable opportunities arise.

The purpose of this piece is to test the viability of spread trading Australian futures against Eurex Bund / Schatz futures and potentially US Treasury futures. However, for reasons of normalized analysis, underlying yields will be used. These relate directly to futures prices in a linear way, since the movements being relatively small, convexity is not an issue. All analysis is performed in DV01 terms therefore, and it is up to investors to translate DV01 to cash notionals in the respective futures. Please note that the term "Bund" refers to the German Government Bond Futures with a 10y maturity while the term "Schatz" refers to the 2y maturity of the German Government Bond Futures.

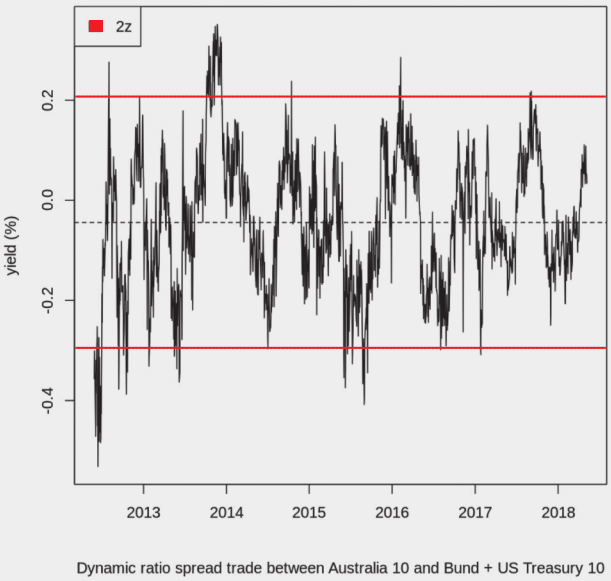
First, let us examine a "naked" Australia 10y futures yield history.

Australia 10y yield



It is clear from the above graph that this yield series is not mean reverting. Indeed, trading it effectively essentially depends on macroeconomic analysis, a field notorious for being unreliable. It would be better to have a series that looks like this:

A stationary (mean reverting) series



This series is highly mean reverting, in a range from –30 to +20bps. In other words, whenever the series reaches either of those extremes, we have a high chance that it will reverse back towards the mean. This behavior is optimal for generating alpha. This paper will explain how to construct such a series, with as few spread trades as possible, using Eurex Bund, Schatz and ASX Australian bond futures, and where necessary, a small mix of US Treasury futures.

In order to find the best hedges for Australian bonds, we turn to a brute force regression in the R programming language (although Excel could also be used – see contact details at the end of this document). We are able to brute force this problem. Which means we test all possible combinations, as opposed to using combinatorial optimization algorithms, because the number of series under consideration is relatively small. The regsubsets function from the leaps package tries all possible regressions for the target variable, from a set of other variables, and gives us a summary of the best ones:

(As already mentioned, all analyses are performed on yield of the underlying instruments.)

Output of R programming language "regsubsets" function for Australia 10y
(commands in red, output in black)

```
summary(regsubsets(AU10 ~ ., data = rx[, -which
(colnames(rx) == "AU3")], nvmax = 3, nbest = 3))
Subset selection object
Call: regsubsets.formula(AU10 ~ ., data = rx[, -which
(colnames(rx) == "AU3")], nvmax = 3, nbest = 3)
6 Variables  (and intercept)
     Forced in Forced out
US2      FALSE      FALSE
US10     FALSE      FALSE
DE2      FALSE      FALSE
DE10     FALSE      FALSE
UK2      FALSE      FALSE
UK10     FALSE      FALSE
3 subsets of each size up to 3
Selection Algorithm: exhaustive
         US2 US10 DE2 DE10 UK2 UK10
1  ( 1 ) " " " "  " " "*"  " " " "
1  ( 2 ) " " " "  " " " "  " " "*"
1  ( 3 ) " " " "  "*" " "  " " " "
2  ( 1 ) " " "*"  " " "*"  " " " "
2  ( 2 ) " " " "  " " "*"  " " "*"
2  ( 3 ) " " " "  " " "*"  "*" " "
3  ( 1 ) "*" "*"  " " "*"  " " " "
3  ( 2 ) " " "*"  " " "*"  " " "*"
3  ( 3 ) "*" " "  " " "*"  " " "*"
```

Explanation

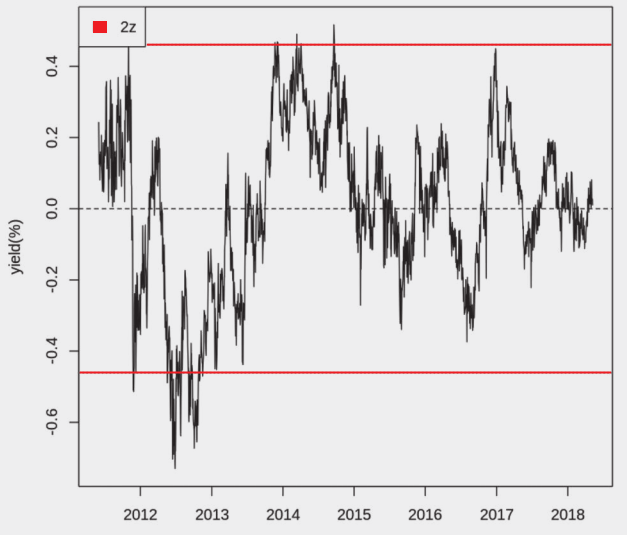
In the above output, and in later outputs for this paper, the following abbreviations have been used:

US2 US Treasury 2y yield
US10 US Treasury 10y yield
AU3 Australian 3y bond yield
AU10 Australian 10y bond yield
DE2 Schatz (German 2y) yield
DE10 Bund (German 10y) yield
UK2 UK 2y generic yield
UK10 UK 10y generic yield

The nine rows on the bottom show us three solutions for each of three regression types: single variable, double variable and triple variable. We are going to ignore triple variable for reasons of excessive hedging costs. Single and double variable scenarios are what interest us. The top line out of the nine shows us the best hedge for Australia 10s and its Bunds. The second best hedge is UK10s and the third best is Schatz. We will look at all of these shortly. Lines four, five and six tell us that if we are to use two hedges, Bunds are best coupled, not with UK10s as we might have thought, but with US Treasury 10s. This is because UK10s are probably too correlated to Bunds and do not provide enough additional entropy (information) to the system.

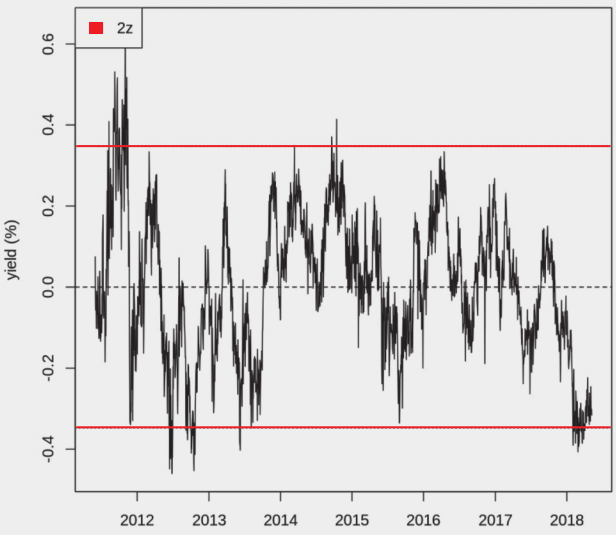
Let us proceed to look at the very first suggested spread trade, hedging Australia 10s with Bunds:

Australia 10 vs Bund residuals



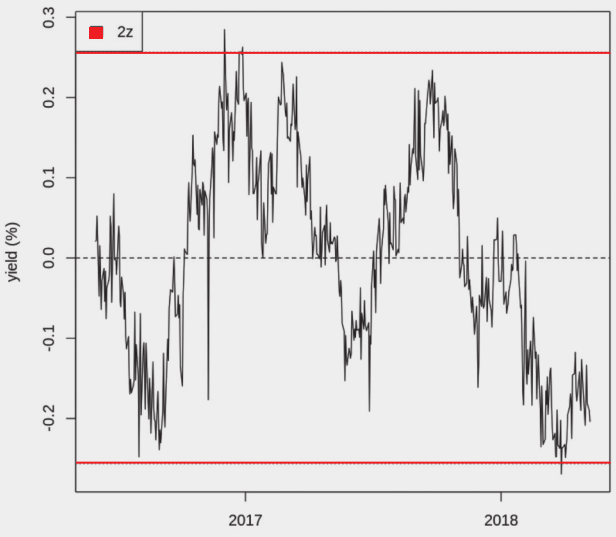
We note that we have created a much more stationary series than the "naked" Australia 10s, with fairly clear areas where buying or selling should be entertained. However, the mean reversion is not perfect with some fairly large divergences from the "2z" (two Z-score) limits. Let us try to improve this, as suggested by the regsubsets formula, by adding in US Treasury 10s:

Australia 10 vs Bund + Treasury 10 residuals



We are getting something much better, with overshoots significantly reduced. The sample period considered here is 7 years. Does a shorter sample period also work?

Australia 10 vs Bund + US Treasury 10 residuals, 2y sample



Indeed it does, with clear mean reversion from the 2z (2 standard deviation) lines. Let us repeat the process for the Australia 3y:

Output of R programming language "regsubsets" function for Australia 3y

(commands in red, output in black)

```
summary(regsubsets(AU3 ~ ., data = rx[, -which
(colnames(rx) == "AU10")], nvmax = 3, nbest = 3))
Subset selection object
Call: regsubsets.formula(AU3 ~ ., data = rx[, -which
(colnames(rx) ==
    "AU10")], nvmax = 3, nbest = 3)
6 Variables  (and intercept)
     Forced in Forced out
US2      FALSE      FALSE
US10     FALSE      FALSE
DE2      FALSE      FALSE
DE10     FALSE      FALSE
UK2      FALSE      FALSE
UK10     FALSE      FALSE
3 subsets of each size up to 3
Selection Algorithm: exhaustive
         US2 US10 DE2 DE10 UK2 UK10
1  ( 1 ) " " " "  " " "*"  " " " "
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1  ( 3 ) " " " "  " " " "  " " "*"
2  ( 1 ) " " " "  "*" "*"  " " " "
2  ( 2 ) " " " "  " " "*"  "*" " "
2  ( 3 ) "*" " "  " " "*"  " " " "
3  ( 1 ) "*" " "  "*" "*"  " " " "
3  ( 2 ) " " "*"  "*" "*"  " " " "
3  ( 3 ) " " " "  "*" "*"  "*" " "
```
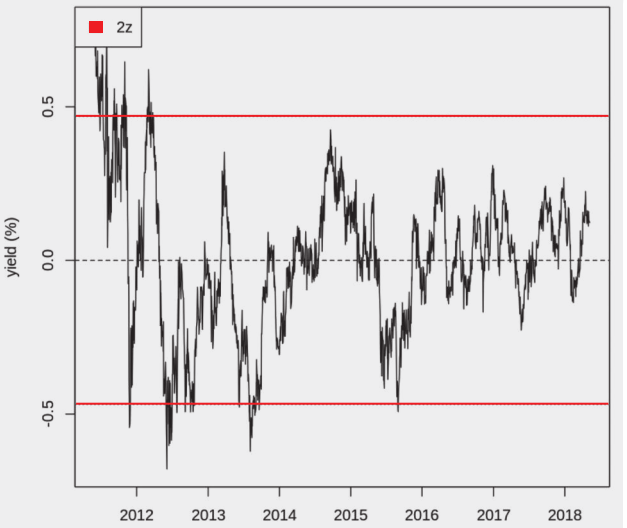
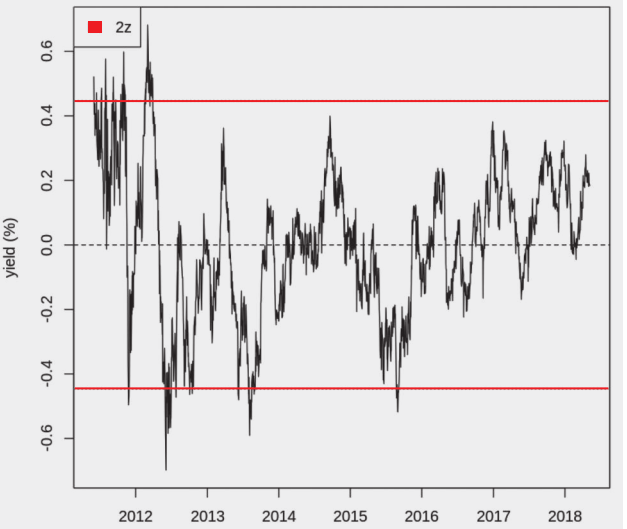

Here we see that Bunds are (perhaps surprisingly) also the best hedge for Australia 3s. However, it is a combination of Schatz and Bunds, which provide the best two-variable hedge. Here are the corresponding residuals charts:

Australia 3 vs Bund residuals



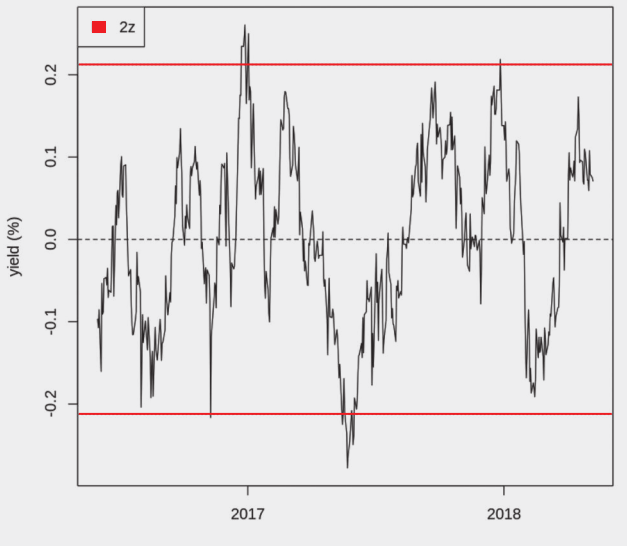
Australia 3 vs Bund + Schatz residuals



We note decent, if not perfect, stationarity, with not much to be gained from adding Schatz, since the above two charts are very similar. In the interests of minimizing transaction costs, it is better to use only one hedge, in this case Bunds.

Here is the short-term sample, which is very encouraging in terms of mean reversion:

Australia 3 vs Bund residuals, 2y sample

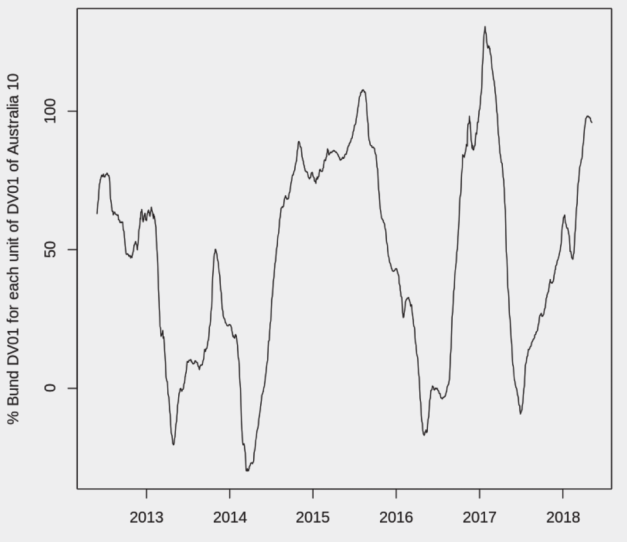


What are the hedge ratios?

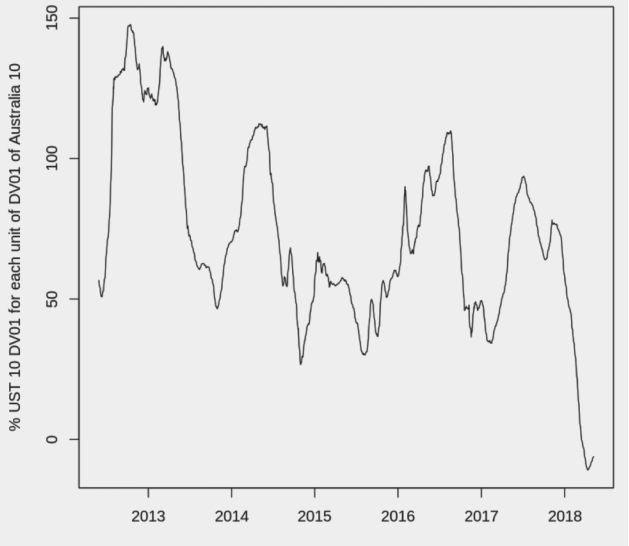
We have ascertained that hedging Australia 10s with two variables, or Australia 3s with one (Bunds + Treasury 10s, and Bunds alone, respectively), can transform a noisily trending series which is difficult to trade, into a spread trade with clear limits which offers the potential to "top and tail", thereby generating much better sharpe ratios. However, we have not broached the question of what the hedge ratios are. Again it is regression, which will provide us with the answer, but there will be a slight complication which we will discuss.

We must now examine the stability of the hedge ratios. Using the ASX10s example, we note the following:

Bund share of historic ratio to spread trade against Australia 3

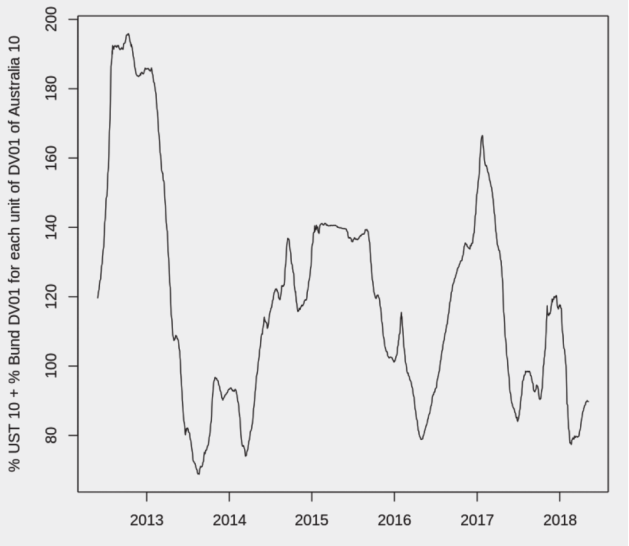


US Treasury 10 share of historic ratio to hedge Australia 10



The above two charts represent the rolling 2y-optimal ratio of Bunds and US Treasury 10s to use when hedging Australia 10s. A single unit of DV01 of Australia 10s, will require somewhere between –0.4 and 1.3 units DV01 of Bunds, and –0.1 to 1.5 units of US Treasury 10s. We note the sum of weights of Bunds and Treasury 10s can also reach far above 1. In other words, we may have quite a lot of delta in our position.

Sum of Bund 10 and UST 10 ratios



So how to determine the best hedge ratio? In practice, using the average of the previous two years is acceptable, because the volatility of the hedged series is higher than any small mishedge, and so the sharpe ratio of the trade will be dominated by the mean reversion. However, this is not guaranteed to be the case at all times, particularly during times of regime change. The recommendation is for investors not to trade relative value during periods when

there are likely to be changes in the global policy paradigm, which usually last 3–6 months. Instead, it is suggested to trade relative value during the intervening periods, which usually last a much longer 3–5 years. Herewith, the current best hedge ratios for the series described above:

Output of R "linear model" regression function for determining hedge ratios:
(commands in red, output in black)

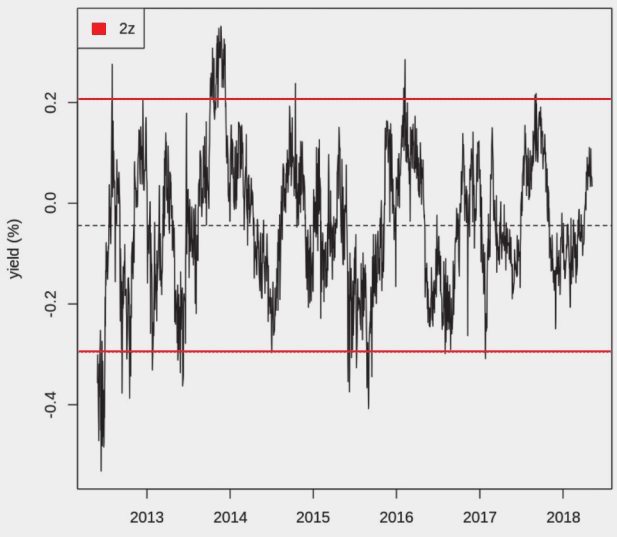
```
lm(AU10 ~ DE10 + US10, data = rx2y)$coefficients
(Intercept)
1.413
DE10
0.488
US10
0.431

lm(AU3 ~ DE10, data = rx2y)$coefficients
(Intercept)
1.609
DE10
0.89
```

The intercepts can be ignored, but currently, for each unit of DV01 of Australia 10s, one should sell 0.488 DV01 of Bunds and 0.431 of US Treasury 10s. Similarly, for each unit of DV01 of Australia 3s, one should sell 0.89 units of DV01 of Bunds.

Dynamic hedging improves stationarity further

Finally, let us look at the best series of them all, a weekly rebalanced hedge residual of Australia 10s vs Bunds plus US Treasury 10s.

Dynamic ratio ASX 10 vs Eurex Bund 10 + US Treasury 10

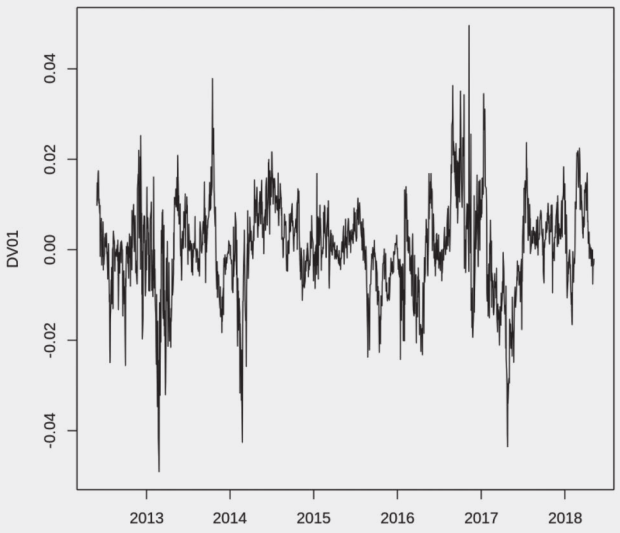


This is a very stationary series, with very few overshoots above and below the 2-z bars.

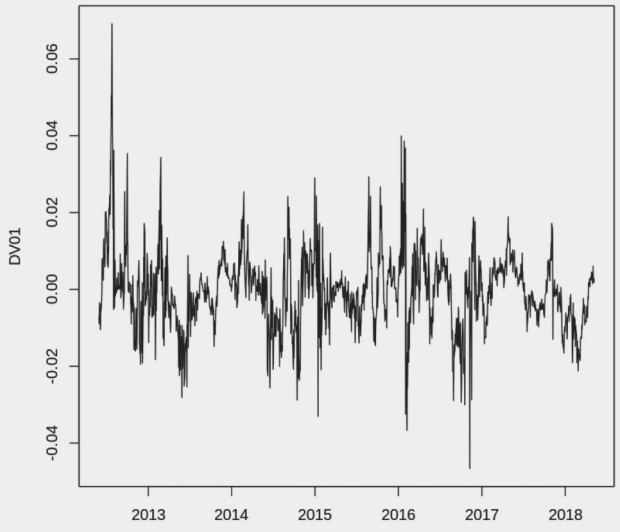
One can get far with static hedges, for the reason described above, namely the fact that the residuals are much more volatile than any mishedges. However, by minimizing mishedges, that is rebalancing every week, one can create a very attractive and tradable series indeed.

Dynamic hedging obviously incurs transaction charges, but these need not be large, as is indicated by the small size of the rebalancing:

Bund DV01 per day hedge ratio change



US Treasury 10 DV01 per day hedge ratio change



The daily hedge change means are 0.008k DV01 per day for the Bund, and 0.007k DV01 per day of the US Treasury 10s. Thus, we have a mean of 0.015k DV01 per day of hedge

ratio reweighting per day, or 0.075k per week in the worst case (i.e. 7.5% of the ASX position size). This is a small enough number that we can be comfortable that dynamic hedging is not costly.

Summary

We have shown that a simple relative value strategy can significantly improve the mean reversion, and therefore alpha generation characteristics of the Australia 3y and 10y bond futures. Using Eurex 10y Bund futures and US 10y Treasury futures, one can spread trade Australian bonds at opportune time when their regression residuals reach near or above 2 z-scores from the mean. Dynamic hedging can improve mean-reversion even further, though during periods where monetary policy paradigm shifts are less likely, static spread trading can still be very effective.

Further Information

The above analysis has been performed by Thomas Browne, a professional fixed income quantitative analyst working with the CRVM ("Computational Relative Value Matrix") suite of fixed income relative value trading tools. For further information, or for updates on hedge ratios, please contact thomas@crvm.io or +44 20 3463 4983.

Appendix

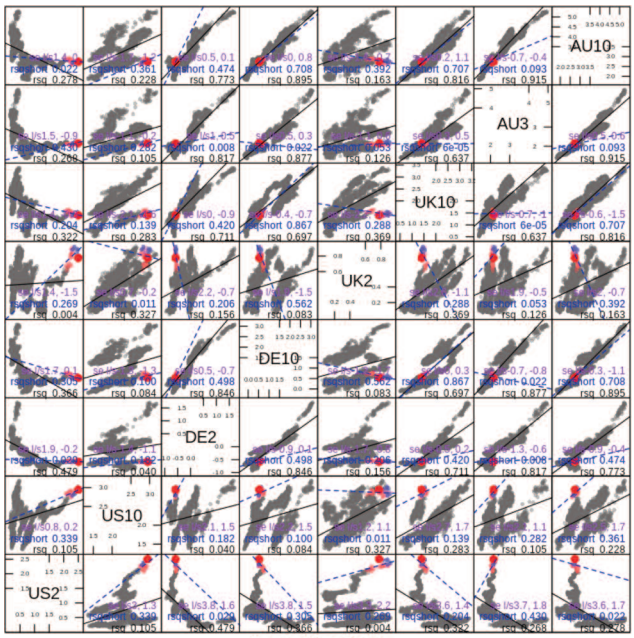
What is Australia correlated to?

In the field of data analysis, it is always a good idea to try to see a picture of our data before delving into formulae. Here then, is a matrix of regressions of the 2y (or 3y in Australia's case) and the 10y for the US, Germany, the UK and Australia fixed income. The way the chart should be read is as follows: the columns represent the "independent" variable of the regression and the rows represent the dependent variable. Thus, for example, the top-left corner represents how ASX 10s trade with respects to US Treasury 2s.

The legend codes are as follows:

US2	The US Treasury 2y yield
US10	The US Treasury 10y yield
AU3	Australian 3y bond yield
AU10	Australian 10y bond yield
DE2	Schatz (German 2y) yield
DE10	Bund (German 10y) yield
UK2	UK 2y generic yield
UK10	UK 10y generic yield

Regression of all series against each other



Scatter Plot Matrix

Immediately, we note that Australia 10s are well correlated to Bund 10s, Schatz, and UK10s (top row). Similarly, Australia 3s are well correlated only to Schatz and Bunds. The rest of the second row is not compelling. The point of the above chart is not to find the best hedges but only to ensure that we have some correlations, in order to validate the candidate set of possible hedge instruments in other countries.