



Improving Sharpe by hedging Australian 10y bond futures with Treasuries

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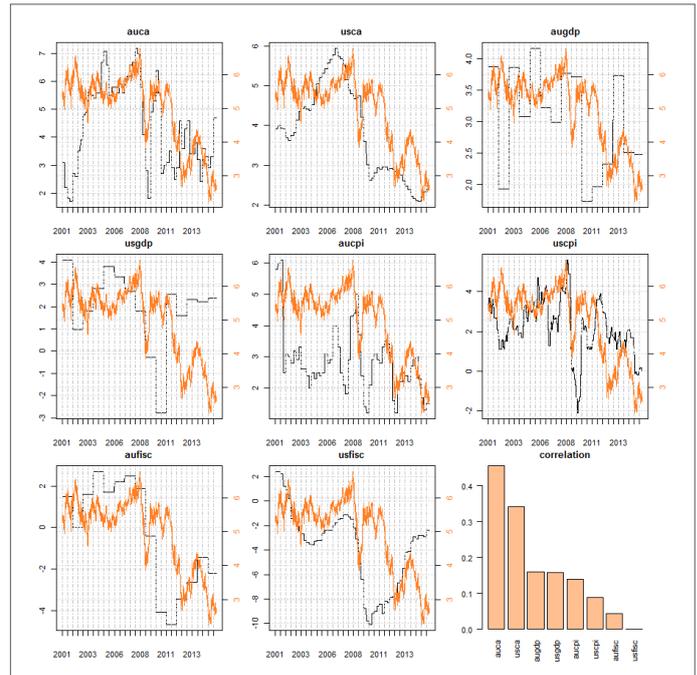
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Traders are constantly seeking opportunities in securities that are differentiated from the highly correlated markets of the US and Europe. Australian bond futures offer this potential, by providing exposure to the economies of the Pacific timezone. The country is a large raw materials exporter to the manufacturing economies of Asia, which in turn have become the engine of production for a large segment of the US economy. Through these economic links, it is unsurprising that there is some correlation between Australian government bonds and Treasuries, commodities or other asset classes. However with the judicious use of liquid hedges, investors can not only isolate the uncorrelated, purely idiosyncratic exposures to the ebbs and flows of the Australian and Asian economies, but also design entry and exit timing strategies that may provide a higher Sharpe ratio than a purely passive strategy.

The aim of this note is to provide a pedagogical introduction to the techniques traders and investors can use to access Australian bond futures returns while minimising risk seepage from other markets, to show how timing can be optimised for a high quality of entry and levels, and to give some concrete examples of currently relevant trade ideas.

Macro risk

First let us survey the correlations of Australian bonds to macro factors in Australia and the US:

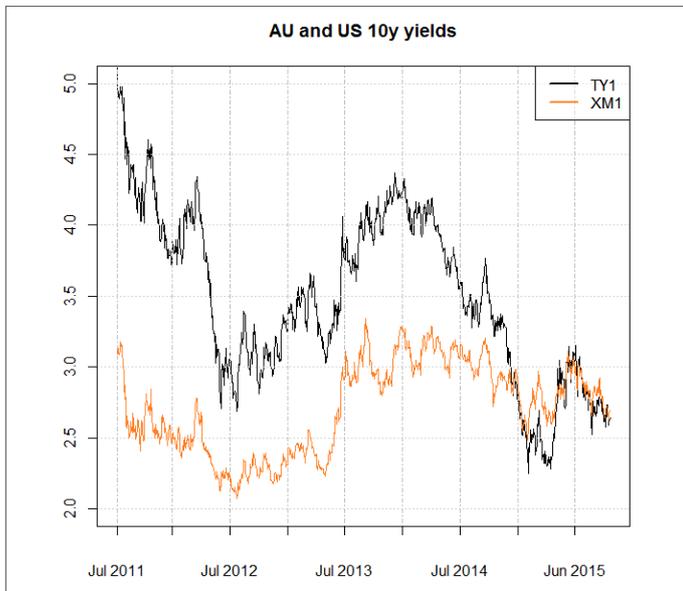


The charts show that the highest correlations are to the current account deficits, which explain between one third and two fifths of Australian yields over the past 15 years. Next come GDP numbers, distantly followed by CPI at below 10%, and fiscal numbers at almost zero. In other words, issuance and inflation, traditional drivers of bond yields, do not seem to play a large part, and instead the current account, highly correlated to economic activity, plays an important role. Note that in the charts above the CA numbers have been inverted for easier comparison, that is, high bond yields are associated with high current account deficits. Still it is worth noting that no single variable explains more than half of the series, and indeed, even with multivariate regressions (not shown here) it is difficult to get much over 50% correlation against the 8 factors shown above. Since these variables are not tradable directly, the analysis is for context only.

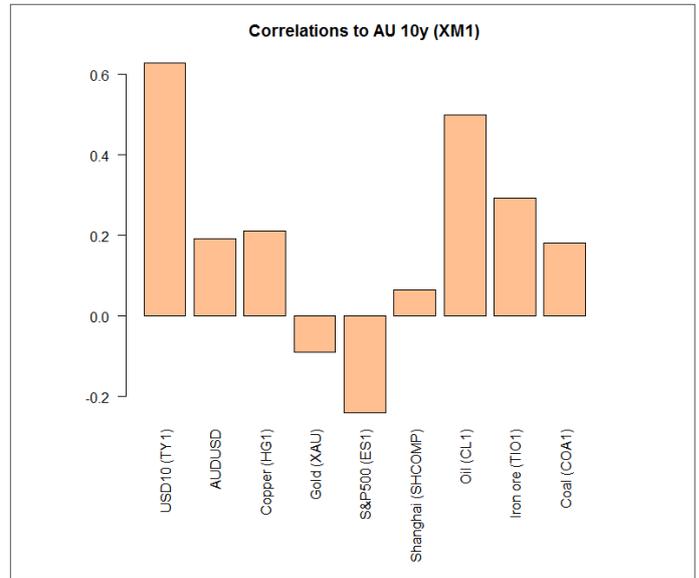
Market risk correlations

Having briefly surveyed some basic econometric correlations, we now move to the core of this analysis, and that is to extract market factors from Australian bond yields, with the objective of optimizing risk. We will consider 9 variables which have a bearing on the Australian economy, namely, US Treasury 10y yields, the AUDUSD exchange rate, the prices of copper, gold, oil, iron ore and coal, and the S&P and Chinese stock markets. Most are represented by futures contracts, as can be seen in the chart legends. We do not include Australian stocks in our hedging basket as we wish to maintain as much Australia risk as possible.

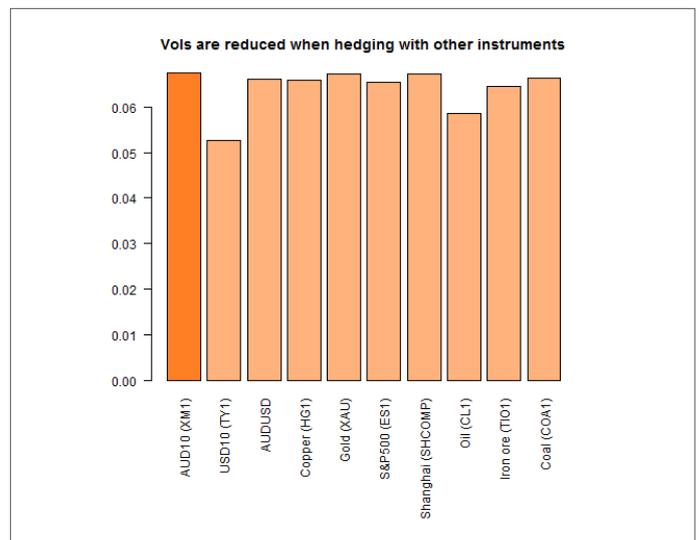
First, let's consider the Australian 10y yield compared with the corresponding Treasury:



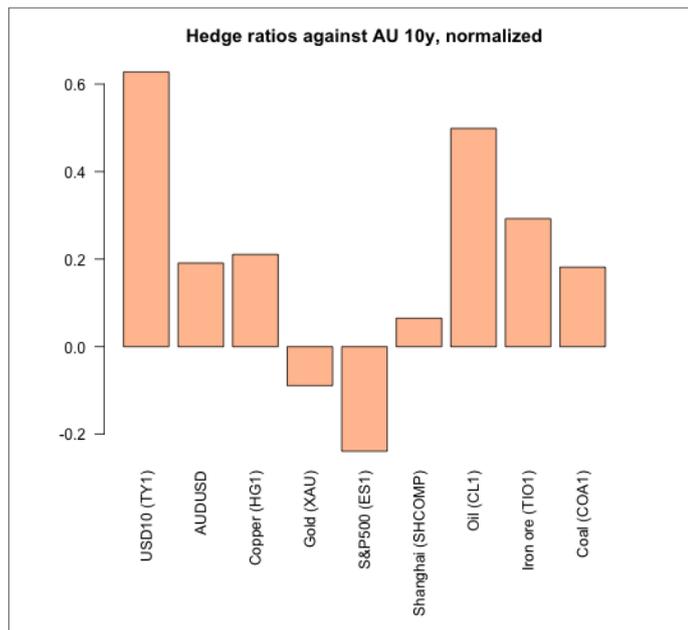
It is clear that while there has been a trend tightening of Australian yields to US yields, there are visible intra-day and intra-month correlations. In other words, there is a large amount of risk in Treasuries which is imported into Australian government bonds, such that the investor in Australia is indirectly an investor in the US. Here are the correlations to US 10y and to other markets: make for some slow profit growth since real GDP will expand by (optimistically) 2.5-3.0% over the next few years, and inflation is not likely to exceed 2%, if it even gets that high. As such, the most one can hope for in terms of profit growth is probably not more than 5% per annum for the next several years.



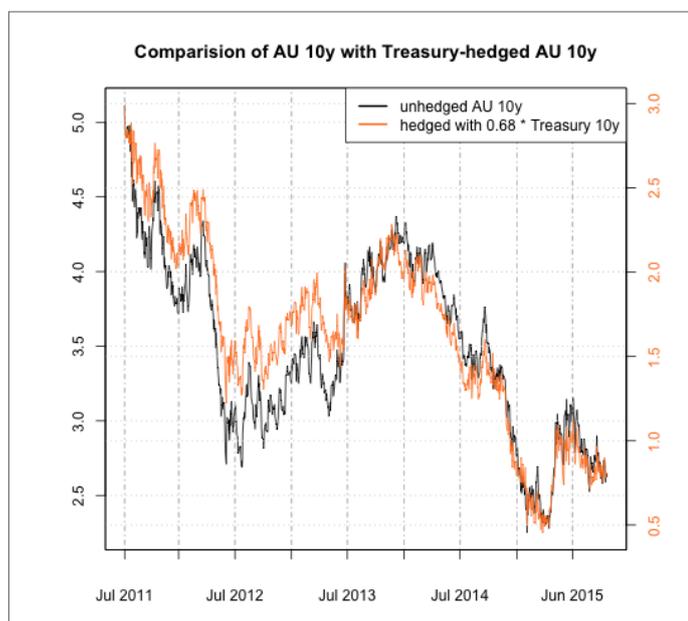
The highest degree of correlation is to Treasuries, and to base commodities (Oil in particular), whereas the currency and equities feature less strongly. If our objective is to trade pure Australian risk, we will have to reduce some of these correlations, so as not to be simultaneously trading other markets when we buy or sell XM1. We do this by performing a "regression hedge", that is, we obtain the ratio of one security versus another which minimises the difference between the two. It extracts all common factors (correlation) such that only the pure idiosyncratic risk of the target variable is left. Let's perform this for all of the series in our set, show the hedge ratio, and examine the volatility of the residual returns (the volatility of the resulting regression-weighted spread).



Unsurprisingly, the variables with the highest correlations, when used as hedges, reduce the volatility the most. The resulting hedge ratios are as follows:



...and the resulting series obtained when selling 0.68 units of Treasury 10s for each unit of Australia purchased, is as follows:

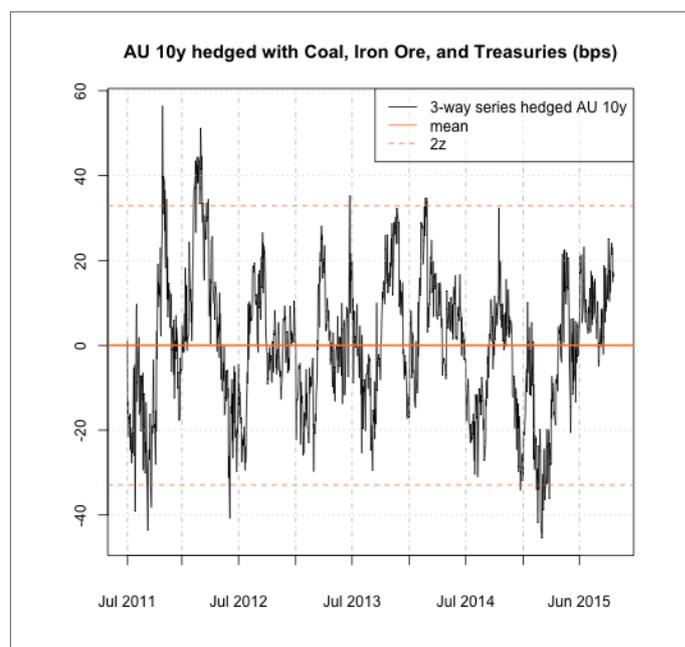


In the chart above, the hedged exposure (orange) clearly has a lower lower beta than the black, unhedged series, and would allow an investor to take 22% larger position in Australia for an equal amount of volatility risk. It would mean selling 0.68 units of DV01 in TY1 for each 1.00 units of DV01 (obviously in the same currency) purchased in XM1.

Turbo boosting the hedge

While the above method produces an optimized and pure AU 10y returns exposure, which will typically be useful for longer term investors, it is somewhat uninteresting to higher frequency traders. The reason is that while we have reduced VaR due to Treasuries, we have not produced any entry timing indicators. Both series in the above chart still display trending behaviour, rather than mean reversion, and indeed, both look quite similar (even if one is optimised). Trending behaviour is not unfavourable - for macro traders this is what they seek - but it does not exhibit the same predictability displayed by mean reversion.

To construct a mean-reverting series, we will have to go further, towards multivariate techniques of series regression. Series regression will not consider returns, but will minimise the distance of the shapes of the entire series considered as a whole. As such, while it will also minimise returns volatility to some degree (though less effectively than the above), it will mainly take into account variable trend similarities. To understand the difference, a search for "correlation vs co-integration" on the Internet will be useful, with the canonical lay explanation for co-integration involving "a drunk man and his dog", where both exhibit random short-term walks away from each other (ie uncorrelated), but inevitably mean revert to the same location (ie their paths are similar over time). Herewith an example, which we have constructed using three hedge variables, found using an exhaustive data search:



We have constructed a series which is almost perfectly mean reverting ("stationary") which very rarely moves outside of its 2 standard deviation bands, and has behaved in this way for over 4 years. Regularly and very profitably "Topping and tailing" such a series becomes much easier, as any move above 30bps or below -30 bps has a high chance of retracement. Clearly though, the hedging becomes more complicated. In the above case, for every for every 100 USD (we converted bps to percentages) of DVO1 in the AU 10y (XM1 - handle 2.69), one must sell 1.234 USD DVO1 in the US 10y (TY1 - handle 2.70), sell 0.0090 USD per point in Iron ore (TIO1 - handle 53.9), and sell 0.0151 USD per point in Coal (COA1 - handle 52). Currently, at +16 bps above the hedge series, AU 10y futures appear somewhat cheap on this analysis versus the other three securities, with 3 times more room to move lower than to move higher, if historic patterns are to be believed, but because of the normal distribution of the series, this does not translate into 3x more likelihood of moving lower. The historic likelihood is closer to 2:1 - still attractive. It is clear that AU 10y bonds are good value here, but the mean reversion will not yet be strong enough until we approach +30.

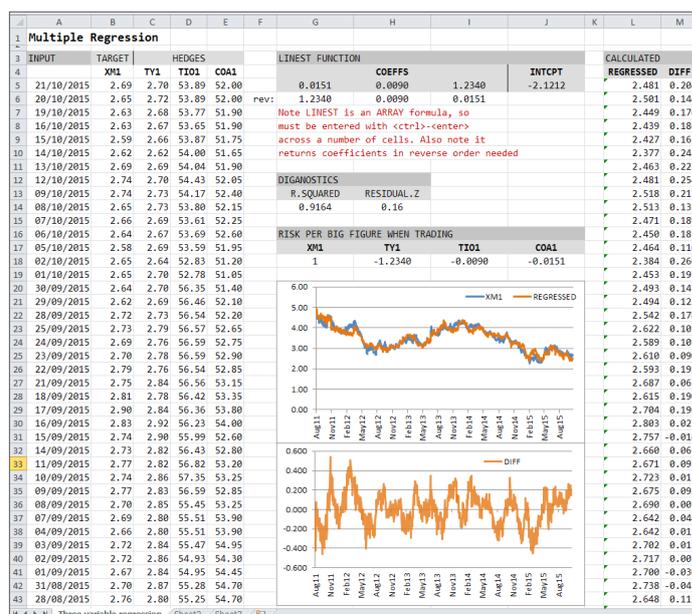
It is important to re-iterate that the three variables we have used (US 10y, Coal, Iron Ore) were not found by chance. All combinations of single, double, and triple-factor regressions were considered until the best was found, and this must usually be performed in a programming language rather than a spreadsheet (see below), as the latter is limited in the dimensionality of problems it is able efficiently to address, whereas programming languages, unconstrained by a 2-dimensional paradigm, may pursue much deeper analyses.

ADDENDUM1: How to calculate regression hedge ratios

The principal of regression hedging, if imagining two series plotted on a chart, is to minimize the average vertical distance between them (though it is made slightly more complex by the fact that the "distance" is actually the square of the distance, so giving more importance to points that are far apart). By doing so, we minimize the P&L of being short one, and long the other.

Single-series regression can easily be performed in Microsoft Excel using the SLOPE function, and the LINEST function for multiple series as above. The slope output in the former case provides the regression ratio for 1 unit of the target ("dependent") variable, keeping in mind that that software does not make any distinction between yields or prices, or whatever other units the series are represented in. It will be up to the investor, at trading time, to ensure that the dollar-per-unit exposure in the two series is consistent with the units used in the regression. In the case of LINEST, its output is more complex because it includes a number of diagnostics in addition to the multiple slopes (= hedge ratios), but the objective is the same: to hedge one variable with a combination of other variables.

Herewith an example of LINEST - hedging the AU 10 with UST 10, Iron Ore, and Coal. This spreadsheet is available on request at thomas.browne@itcmarkets.com.



Please note that the spreadsheet above does a multivariate regression, providing weights on UST10, TIO1 and COA1 which accurately track XM1, the AU 10y. However it is by no means guaranteed that the weights will not change over time, so investors should always consider more advanced techniques such as rolling window regression, and cross validation, before blindly following a strategy such as that shown above (even it remains an excellent starting point). Still, it is clear that the speed of the (relatively small) divergences is high compared to trend, so it is likely, in this case, that P&L will be positive even in the event of trend shifts. The key on strategies such as these is conservative profit taking (IE, not waiting for complete mean reversion, but simply clipping the tops and tails), and frequent trading.

Also note that while Microsoft Excel is capable of finding hedge ratios for series that have already been identified, the above example assumes a large search has already been performed to find which combination of series does a good job of hedging in the first place. As mentioned already, for this type of analysis, a spreadsheet is usually not sufficient, and a full programming language is needed. The idea is that multiple candidates are input, and the best candidates are selected. This note used the R programming language, a library named "leaps", and a function within it which does exhaustive regression searches, named "regsubsets". Equivalents exist, in the authors experience, in Python, Matlab, Scala and C, amongst others. Please contact thomas.browne@itcmarkets.com for more information on how to put these techniques into your workflow.

ADDENDUM 2: Basic background information on USTs 10y futures and Aussie 10y futures

Conventions for USTs 10y futures on CME (price based, 1/32nd, as yield drop, duration of position accelerates and therefore price increase accelerates). Cheapest to deliver basket.

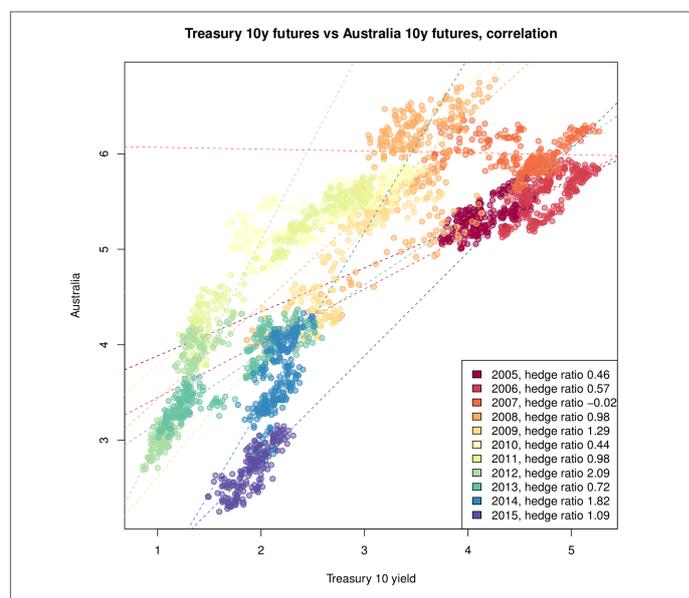
Conventions for Aussie 10Y futures on ASX (quoted as 100-yield, yield based, as yields drop price increases but tick value increase). Delivery basket: Cash settled

It must be noted that the contracts are traded in their respective country currencies, and that therefore, as P&L accumulates, so does exposure to AUDUSD.

ADDENDUM3: Long term history of the AU 10y and UST 10y spreads.

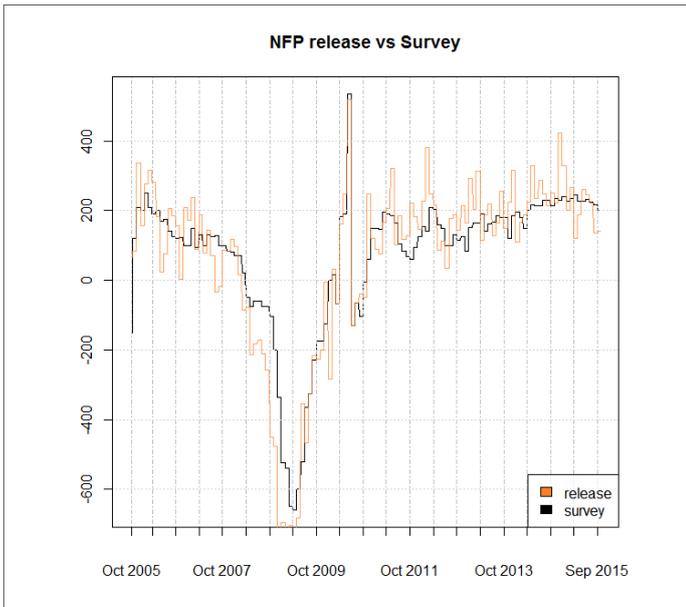
One of the issues mentioned above is the stability of hedge ratios. In the chart below, we colour each of the past 11 years differently, and pass a regression line through them, in a univariate (US 10y - only) version of the trivariate hedge discussed above.

We note that there is quite a lot of variation in the regression lines slopes (hedge ratios), but we pointed out above that as long as the regressions evolve in a continuous way, the volatility of mean-reverting divergence will mean P&L will be protected, as long as the investor takes profits relatively early - we suggest 1.25z from the mean. The only case where the regression differs significantly is during the crisis years, at which time a flat regression line indicates a correlation which broke down completely. In such scenarios of event-wise paradigm shifts, typically z-scores will reach very high numbers, often into the teens (reflecting market breakdown), and the judicious investor will be stopping out positions as soon as it becomes apparent that residuals are no longer normally distributed (that is, above 4). Even considering high slippage, such a strategy will usually contain losses to only a few month's worth of the usual profits. For detailed backtests, please contact the authors.

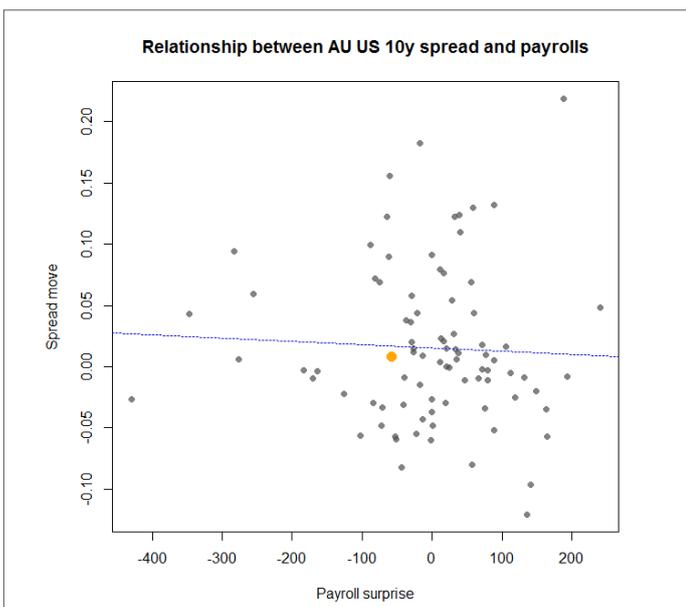


ADDENDUM 4: Sensitivity of the AU US 10y spread to payrolls.

For completeness of the analysis, we examine whether or not AU 10y futures are sensitive to payroll surprises. To do this, we take 10 years data of the difference between the actual payroll number, and the survey number for that day, shown here.



We take the difference between these two, that is, the magnitude of the surprise, and we regress it against opening and closing spread levels of the AU 10y over US 10y spread:





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