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Has equity pairs trading had its day?

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Spain

- **Strategy based on expectation of mean reversion is similar stocks**
- **To make it manageable, limit combinations using various filters**
- **The standardised ratio of prices is used to calculate spreads**
- **Several parameters must be set to gauge performance and exit/entry**
- **Over two-thirds of our possible trades proved profitable**
- **Losing trades generate far bigger losses than the profits winners generate**
- **Conclusion: simple pairs trading approach is modestly profitable, but impractical**

Shares that share a sub-industry are what it's all about. Photo: iStock

By Mads Koefoed

Pairs trading is by no means a new phenomenon to traders. In fact, it has been around since the 1980s at least, and has evolved in several directions to account for the increased competition. The simplicity of a classic equity pair trade, however, ensures that it is still in use to this day. This strategy attempts to capture a reversion to the mean of the spread between the prices of two equities – typically equities which are perceived to be quite similar, such as operating in the same (sub-) industry and potentially also limited to the same geographical region(s).

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well more than 100,000 pair combinations possible in the US S&P 500 index, we will make the following restrictions:

- Only US companies represented in the **S&P 500 index** are included.
- The two companies in a pair must be in the same sub-industry.
- Trading starts on January 1, 2003 and runs until September 2015. No new trades are initiated in the last 63 days of the period (63 days being the default look-back window).
- We use daily close prices, no intraday trading for now.
- No costs at all are included.
- There is no rebalancing of the two positions for the duration of a trade.
- The gross exposure is 100% when a trade is initiated (i.e. 50% for each leg).

These restrictions are sensible as they allow us to decrease the number of combinations dramatically to 1,395 and is in any case how many market participants search for suitable pairs.

Video

Morning Call: Softer dollar boosts commodities, stocks

#SaxoStrats

Today's edition of the Saxo Morning Call features the SaxoStrats team discussing the continuing weakness of the US dollar as commodity prices recover ground and in the wake of key US equity indices hitting all-time highs Thursday.

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look-back window is 63 trading days, which is approximately a quarter of a trading year.

The resulting series of Z-scores can then be used as a basis for trading decisions. As an example, if the last value of the series breached -2 then this can be deemed an outsized move and we would therefore expect the ratio to revert towards the zero mean, that is, to a value larger than -2. In this case we should go long the equity used as the numerator in the ratio calculation and go short the equity used as the denominator. The number of shares to buy and sell short respectively are determined by the mean of the ratio calculated above.

Example: Say Coca-Cola (KO) trades at $48 and Pepsico (PEP) trades at $80. The ratio is thus $48 / $80 = 0.6. Let us further say that the mean of this ratio over the last 63 days is 0.5 and the standard deviation is 0.05, then the z-score is given by: (0.6 - 0.5) / 0.05 = 2. KO thus looks expensive compared to PEP so we short two shares of KO for every share bought in PEP, betting on the ratio (0.6) moving closer towards the 63-day mean (0.5). When this happens we exit the positions. (*The ratio and the Bollinger Bands® around the ratio are both readily available tools in the SaxoTrader toolbox. A z-score can also be constructed directly.)*

Chart: Coca-Cola (KO:xnys) and Pepsico (PEP:xnys)

Source: SaxoTrader

When to enter and when to exit

There are several parameters that need to be set to allow us to gauge the performance of the selected pairs, including when to enter a position as outlined above. In sum, we need to assign values to:

- The entry value. We use the same value of both sides with the default being 2 (so -2 and 2 respectively).
- The exit value. We use 0.
- The stop value. Infinite, implying that trades are allowed to run until exit is reached. This can result in trades being active for a considerable period of time as we will see below. *(An implementation of stops can be found below as well.)*
- Correlation* threshold. We use 0.8. *(We will investigate cointegration in a later post.)*
- The rolling look-back window. We use 63 trading days. A longer window ensures more stable estimates of the mean and standard deviation, but it also reacts more slowly to changes in the two share prices.

Barely alive

The strategy outlined above is back-tested from January 2003 and 12½ years forward. From the 1,395 pairs available to us 28,997 trades were completed with an average profit of 0.15% and a standard deviation of 5.53%. We have 19,788 winners for a win ratio of 68.2%. This tells us that we have plenty of profitable trades (a tad more than two out of three), but the losing trades generate far bigger losses than the profitable trades generate profits on average. When we take into account that the average trade lasts 39 trading days, roughly two calendar months, it implies that you can experience very large and long drawdown periods.

Trades	63,947	60,582	28,997	16,250	8,172
Winners	42,121	40,820	19,788	11,224	5,541
Losers	21,826	19,762	9,209	5,026	2,631
Win ratio (%)	65.87	67.38	68.24	69.07	67.80
Mean (%)	0.11	0.14	0.15	-0.03	-0.66
Standard deviation (%)	2.71	3.51	5.53	8.25	12.18
Sharpe ratio (risk-free rate: 0%)	0.04	0.04	0.03	0.00	-0.05
Length (days, average)	9	15	39	71	135
Max drawdown (%, average)	-1.86	-2.70	-4.77	-6.96	-10.42

Source: Saxo Bank. Note: All other parameters are set to default values.

Overall, the message is clearly that performance deteriorates as the look-back window widens. Not only are returns lower, but the standard deviations and average holding periods also increase. With look-back windows of less than 63 days returns decline somewhat, but we have lower standard deviations and holding periods. Something which is also evident from the higher Sharpe ratio (without a risk-free rate).

The highest return is achieved with a look-back window of 63 days at 0.15%, but this is before all costs and it is therefore doubtful whether investors can get any performance from simply pursuing a strategy as it is outlined above. So far it does indeed looks like pairs trading is hardly a valid strategy – at least as specified above.

Adding a stop-loss to the mix

The preliminary results are not encouraging, but we still have plenty of parameters to investigate so we postpone a final judgment for now. So far we have only altered the look-back window and found that it did not improve our results materially. A look-back window of 63 days was in fact the most profitable at 0.15% per trade, but risk-adjusted a shorter window was a tad better.

But what about changing the entry point, that is the value of our z-score? And even more interesting from a risk-management point of view, can adding a stop help performance? First, we vary the entry value (on both sides) in increments of 1 from 1 to 5 (remember, 2 was the default value):

Entry (Z-score)	1	2	3	4	5
Trades	55,941	28,997	8,924	1,586	257
Winners	40,637	19,788	5,785	987	146
Losers	15,304	9,209	3,139	599	111
Win ratio (%)	72.64	68.24	64.83	62.23	56.81
Mean (%)	0.10	0.15	0.27	0.64	1.19
Standard deviation (%)	4.91	5.53	6.00	7.37	8.72
Sharpe ratio (risk-free rate: 0%)	0.02	0.03	0.05	0.09	0.14
Length (days, average)	30	39	45	51	54
Max drawdown (%, average)	-3.87	-4.77	-5.61	-6.84	-7.44

Source: Saxo Bank. Note: All other parameters are set to default values.

The results are clear-cut, waiting until the (standardised) ratio is farther away from zero is more profitable. Not only are the per-trade profits higher, but there are few trades too so it becomes more manageable as well. Note that the average holding period increases from 39 in the default scenario to as much as 54 when the entry (z-score) level is 5. While it is generally better to wait for a larger misalignment in the ratio is occur, it takes nearly a month longer on average for a pair to revert to zero.

Now, what about those stops! To investigate this we introduce a simple stop where the trade is exited if the (absolute) z-score value climbs above a preset value, e.g. 3. If a trade in a particular pair is stopped out, we refrain from re-entering a position in this pair until the z-score has touched 0 as otherwise we could potentially be re-entering a trending spread over and over again.

Stop (Z-score)	3	4	5	None
Trades	28,294	28,865	28,976	28,997
Winners	15,666	19,308	19,744	19,788
Losers	12,628	9,557	9,232	9,209
Win ratio (%)	55.37	68.24	68.14	68.24
Mean (%)	0.06	0.10	0.12	0.15
Standard deviation (%)	6.47	7.07	7.19	5.53
Sharpe ratio (risk-free rate: 0%)	0.01	0.01	0.02	0.03
Length (days, average)	24	35	38	39
Max drawdown (%, average)	-3.31	-4.47	-4.72	-4.77

Source: Saxo Bank. Note: All other parameters are set to default values.

relatively large losses. The mean drawdown is, on the other hand, lower at -3.3% when we use a stop of 3 compared to the base case where the drawdown is -4.8%. Unsurprisingly, the average trade length also reduces with the aggressiveness of our stop (i.e. the lower the stop). Still, the mean return is not appetising at all.

Correlation: Does it matter?

Our investigation up until now has operated with a minimum correlation requirement of 0.8, that is to say, the rolling (63-day) correlation between the two price series in a pair must be correlated* at this level at least. But does it make any difference whether the price correlation is, say, 0.5 or 0.8? Let's find out:

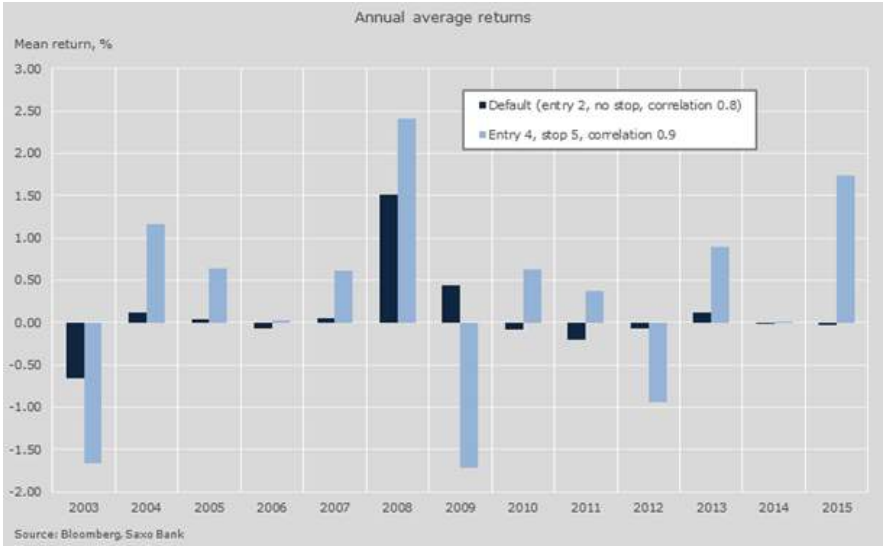
Price correlation	0.5	0.6	0.7	0.8	0.9
Trades	44,836	41,581	36,783	28,997	15,696
Winners	30,034	27,947	24,850	19,788	10,942
Losers	14,802	13,634	11,933	9,209	4,754
Win ratio (%)	66.99	67.21	67.56	68.24	69.71
Mean (%)	0.07	0.08	0.10	0.15	0.28
Standard deviation (%)	5.87	5.79	5.71	5.53	5.27
Sharpe ratio (risk-free rate: 0%)	0.01	0.01	0.02	0.03	0.05
Length (days, average)	40	40	39	39	37
Max drawdown (%, average)	-5.09	-5.02	-4.94	-4.77	-4.50

Source: Saxo Bank. Note: All other parameters are set to default values.

Just as a larger entry level generates higher profits so too does a higher correlation. We have more profitable trades – the win ratio increases to 69.7% when the correlation threshold is 0.9 – on fewer trades. The average trade yields 0.28% compared with our base result of 0.15%. Furthermore on a risk-adjusted basis the performance also increases to 0.05 from 0.03. The max drawdown also declines modestly and the average holding period drops as the correlation requirement is raised. A combination of a higher entry level and a high correlation threshold, but without a stop, looks best – or should we say least poor – at the moment.

What about the time element?

We have found the simple pairs trading approach to be modestly profitable, but not necessarily practical. However, we have solely been concerned with averages across time so far, ignoring this element entirely. As is evident from the chart below, you ignore this aspect at your own peril, as pairs trading (again, as carried out in this post, at least) is clearly was clearly strongest during 2008. Since then average profits have come down markedly, in particular for our default strategy. But a strategy with a higher entry level (4), a stop (5) and a higher correlation threshold (0.9) also fails to deliver stable returns, though they are as we have seen larger on average.



The verdict: Unfeasible, as it stands

Pairs trading is arguably still alive, but the returns are not great and they vary quite a bit across

sample testing involved and what worked in this particular period might not work going forward.

In an upcoming post we will broaden our investigation to include the also very common approach of linear regression. We will also add a couple of exit strategies, such as a fixed exit level (other than 0 as used in this post) and an exit based on the speed of mean reversion. Stay tuned!

** We use price correlation as it is often used in a simple, classic setup, which is what we want to emulate in this article. Whether one should use either the correlation of returns or cointegration instead is not relevant to this particular post.*

– Edited by Clare MacCarthy

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