Are simple Pairs Trading Strategies still profitable?

Introduction

Pairs Trading is a well known and one of the earliest statistical arbitrage trading methods. This article will present two rather simple pairs trading strategies, namely the Distance and Cointegration Method and discuss their levels of profitability over time and in the present day.

Intuitively, pairs trading takes advantage of temporary deviations of the prices of two securities relative to each other which otherwise have a strong correlation in prices. When such a deviation is found, one short and one long-position are simultaneously opened: the short-position is opened on the security that is trading higher in comparison to the other security and the long-position is opened on the security that is trading lower. The positions are then closed once the securities trade at their historic value relative to each other. In other words, pairs trading is a mean-reverting strategy, that banks on the fact that the relative prices of pairs will follow historical trends in the mid to long-term with deviations only in the short term. Some of the reasons for this short-term divergence in relative prices could be a large number of shares bought by a single investor or differences in attention-levels of investors regarding one pair specifically or multiple pairs in comparison to one-another. Ways in which to take advantage of these reasons for divergence will be discussed towards the end of the article.

All Pairs Trading Strategies have in common that they are mostly market neutral when excluding transaction costs, as, no matter what the overall direction of the market is, either the long-position or the short-position will always be profitable. The only limit to this market neutrality is a scenario in which pairs don't converge, that is either the two securities diverge even further or both consistently move in the same direction. Furthermore, Pairs Trading is (at least in theory) mostly self-funding as the short-sale returns can be used to open the long position.

The main difference in Pairs Trading Strategies is the way in which pairs a sufficient deviation of price levels is identified. For this article, we will be focusing on two simple Pairs Trading Strategies: The Distance and the Cointegration Method. The structure of these methods was taken from source [1].

The Distance Method

The starting point for both methods is the so-called formation period. In this period, prices of all securities in the specific scope one wants to trade in are analyzed and securities with a particularly high level of correlation in their movements are chosen. This period can be arbitrarily long, but a reasonable time frame would be the 12 months before one wants to start trading.

For the Distance Method, the spread of normalized prices of all combinations of securities is analyzed during the formation period. Then, a number of pairs is chosen (e.g. 20 pairs) which have the least sum of squared spreads over the formation period. Their standard deviation is also noted.

If the spread of these pairs diverges by two or more standard deviations calculated in the formation period, an equally large long and short position is opened on the pair depending on which direction the pair diverged to. If the standard deviation then returns back to zero, the positions are closed. Note that spreads with lower volatility

will have smaller standard deviations, so positions are opened more easily on these pairs meaning they could close with a loss, especially when taking transaction costs into account.

The Cointegration Method

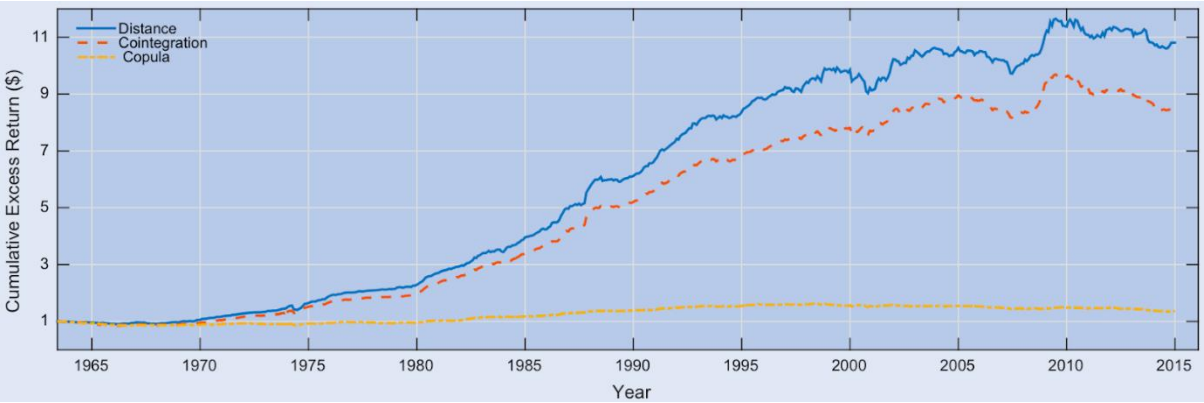
As the name suggests, the Cointegration Method relies on a pair of securities being cointegrated. Let $X_{1,t}$ and $X_{2,t}$ be two non-stationary time series for which their first difference forms a stationary process. If there exists a linear combination of the two time series that is stationary, $X_{1,t}$ and $X_{2,t}$ are cointegrated, in other words, there exists a stationary series u_t and a non-zero β such that $X_{2,t} - \beta X_{1,t} = u_t$. Here, β is the cointegration coefficient and u_t is the cointegration error. This time series has a long-term, mean reverting equilibrium, but short-term deviations can occur, meaning that the evolution of a time series can be shown by $X_{2,t} - X_{2,t-1} = \alpha_{X_2}(X_{2,t-1} - \beta X_{1,t-1}) + \xi_{X_{2,t}}$ and $X_{1,t} - X_{1,t-1} = \alpha_{X_1}(X_{1,t-1} - \beta X_{2,t-1}) + \xi_{X_{1,t}}$ respectively, where $\alpha_{X_2}(X_{2,t-1} - \beta X_{1,t-1})$ is an error correction term (α_{X_2} is the rate of correction) and $\xi_{X_{2,t}}$ is white noise.

The spread of two securities in this framework is given by $e_t = spread_t = X_{2,t} - \beta X_{1,t}$. From this spread, one can calculate the profit (excluding transaction costs) by $(X_{2,t} - X_{2,t-1}) - \beta(X_{1,t} - X_{1,t-1})$ if buying 1 dollar worth of commodity 2 and selling short β dollars worth of commodity 1. Rearranging this equation gives $spread_t - spread_{t-1} = (X_{2,t} - \beta X_{1,t}) - (X_{2,t-1} - \beta X_{1,t-1})$, meaning the profit for a time period is the difference in spreads at the end and start of the period.

Similarly to the Distance Method, in the formation period, all pairs of securities are sorted by the lowest sum of squared spreads and then tested for cointegration. Lastly, a value for β is estimated; this can be done using the Engle-Granger approach for example. In order to determine when a position should be opened, the normalized spread given by $spread_{normalized} = \frac{e-\mu_e}{\sigma_e}$ is used. If $spread_{normalized} \geq +2$, one sells short $\frac{1}{\beta}$ dollars worth of security 2 while buying 1 dollar worth of security 1; conversely, if $spread_{normalized} \leq -2$, one buys 1 dollar worth of security 2 and sells short β dollars worth of security 1. The position is unwound when the spread returns to zero. Note that the threshold for the normalized spread of +2 or -2 is arbitrarily defined.

Profitability of these Methods in the Stock Market

In this section, the profitability of the Distance and Cointegration Method and possible improvements in the criteria for opening a position are discussed. In the analysis of H. Rad et al. return is defined as return on employed capital, which in turn is defined as the "sum of marked-to-market returns on a month's traded pairs divided by the number of pairs that have traded during that month". After accounting for transaction costs, the study finds an average monthly excess return from July 1962 to December 2014 of 0.0038 and 0.0033 for the Distance and Cointegration Method respectively when applying the method on all liquid ordinary shares in the CRSP database of US stocks. The benchmark on which this excess return is based on was not disclosed. However, this excess return has been stagnant or even decreased starting from around 2010, as is shown by this graph:



Source: H. Rad et al.

This decrease in profitability is often attributed to an increase in traders trying to take advantage of these arbitrage opportunities.

When examining the trades themselves, the authors of the study find that only 62.53% of all trades are closed in one month when applying the Distance Method while 61.35% of all trades using the Cointegration Method converge in one month. Moreover, the distribution of returns for both methods have fatter left tails than right tails. This is to be expected, as profits are limited by the difference of spreads when a position is opened and closed which, in turn, is limited by the standard deviation necessary to open a position. However, over 98% of converged trades show positive returns after transaction costs with the Distance Method exhibiting a mean return of 4.26% per trade and 4.37% for the Cointegration Method.

So, while excess returns are decreasing over time, the fact that only about 62% of trades converge could suggest that profitability could be increased. What supports this proposition is the fact that both Pairs Trading Strategies exhibit fatter left tails for trade returns.

This decrease in profitability of simple Pairs Trading Strategies can be combated in two ways: 1. more complex ways in order to identify correlations between securities and discrepancies in their price levels can be utilized or 2. exploiting the drivers behind the profitability of simpler Pairs Trading Strategies. For this article, the second option will be discussed from the point of view of an arbitrageur who wants to increase their Pairs Trading profitability.

In a paper by H. Jacobs and M. Weber (source [2]), the drivers behind the profitability of Pairs Trading using the Distance Method are examined. They find that in situations in which investors are paying little attention to certain securities (in their case stocks), Pairs Trading profits are generally higher. It should be noted that due to the fact that there are differences in the methodology of the two papers in question, this part of the analysis will be purely qualitative.

For one, pairs trading profits are substantially higher in markets with more stocks eligible for trading, so an arbitrageur could exclude small markets (e.g. countries with a below median number of stocks/securities eligible for trading) from their scope of potential pairs. Furthermore, the authors find that stock market size compared to GDP positively correlates with Pairs Trading profits, while average industry market share negatively correlates with profits, so markets of small relative size as well as markets dominated by few players can also be eliminated. The

reason the authors give for these correlations is that investors can only pay attention to a limited amount of securities, so information diffuses less quickly in larger markets or for industries with lower average market share.

Similarly to the analysis of overall trends in profitability, it is also important to look at the characteristics of Pairs Trades themselves. What Jacobs and Weber find is that for positions that are opened in their simple strategy, more than 40% in price discrepancy is attributable to the day of divergence, so some positions might be falsely opened due to some factors that only impact the price of one security rather than both. An explanation that springs into mind immediately is news that pertains to one stock/security such as earnings or dividend announcements or other kinds of firm-specific news. In fact, pairs that are opened on the day of such firm-specific news tend to be less profitable than those pairs that are opened on days without such news. So, days in which one company announces earnings or dividends or where there is an abnormal amount of news for one security could also be excluded from trading.

This price discrepancy however could also be attributable to variations in investor attention as previously alluded to. In addition to average industry market share, the authors also find a number of proxies for investor attention that correlate significantly with Pairs Trading profits. Those proxies that can be implemented in a strategy that correlate with higher profits include high sentiment, high volatility and a high number of searches in Google, meaning trading activity should be decreased in times of low sentiment and volatility or when a firm/security is not searched for often on Google.

On an unrelated note, the fatter left tails for distributions of Pairs Trading profits can be slimmed down by using stop-trades, so pairs don't continue to diverge past a certain point.

Of course, this way of eliminating many potential pairs could also have negative impacts on profitability. Firstly, eligible pairs could have a higher sum of squared spreads during the formation period and secondly, less trades could take place, meaning either capital might not be fully invested at all times which increases opportunity cost or trades are less diversified, increasing overall risk. However, additional research is necessary in order to come to a conclusion on this topic.

[1] Rad, H., Low, R. K. Y., & Faff, R. (2016). *The profitability of pairs trading strategies: distance, cointegration and copula methods.*

[2] Jacobs, H., & Weber, M. (2015). *On the determinants of pairs trading profitability.*

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