Understanding the Risks in and Rewards for Pairs Trading

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1. Background and aims of project

Pairs-trading is a popular investment strategy among hedge funds and investment banks. It is executed across a formation horizon $(T-t)$ and trading horizon $(K-T)$. During $(T-t)$, pairwise stocks i and j are identified, matched and ranked based on how closely their historical prices p_t^i and p_t^j move together over time. During $(K-T)$, once the pricing gap $|p_t^i - p_t^j| = s_t$ exceeds a given threshold ε, a zero-cost long-short position is opened by short selling the winner and buying the loser. If s_t displays mean-reversion, this implies positive expected profits from pairs-trading.

Although widely used, pairs-trading remains elusive since it has not drawn nearly as much academic attention as contrarian trading. The latter involves ranking stocks based on past returns, then short sell 'winners' and buy 'losers' to profit from short term overreaction. If prices systematically overreact, this implies positive expected profits from contrarian trading.

Lo and MacKinlay (1990) pose the reverse question, "If contrarian profits are robust, does it imply prices systematically overreact?" They highlight delayed reaction between winner and loser stocks as another source of contrarian profits. If such lead-lag effect is systematic, then buying (selling) stock j subsequent to an increase (decrease) in stock i generates contrarian profits, even without overreaction. They find half of contrarian profit is generated by such lead-lag effects.

Jegadeesh and Titman (1995) suggest that such lead-lag effects must be associated with common factors and not idiosyncratic news. They argue that while overreaction to idiosyncratic news will generate contrarian profits, overreaction to common factors may increase or decrease contrarian profits. Using a factor model based decomposition of contrarian profits, they find that most of it is driven by overreaction to idiosyncratic news.

Our project has two objectives. First, develop a pairs-trading price formation model to obtain a closed-form solution for s_t. Given that pairs-trading profitability depends on σ_{s_t}, a variance decomposition of s_t should provide a better understanding of the risks in and the rewards for pairs-trading. We demonstrate this using unrestricted matching from the entire population of NYSE and NASDAQ firms on the CRSP daily database. Second, investigate potential impact on the sources of pairs-trading profit by imposing various matching restrictions according to investment styles e.g. SIC code, size, leverage, index/non-index, growth/value etc.

2. Significance and innovation

Pairs-trading has at least a 20 year history on Wall Street. There are several reasons for its popularity. First, it is simple to understand and execute. And since it does not normally evoke frequent intraday trading, pairs-trading can be cost-feasibly automated. Second, cashflow and/or financial ratio based valuation models, which are potentially subjected to huge error margins, are not required. In pairs-trading, valuation is relative and the position is often near market-neutral. Lastly, it has sufficient flexibility to accommodate various investment styles e.g. pairs matched within sectors, size, index/non-index, growth/value etc.

Ironically, while contrarian trading has received ample academic attention, pairs-trading has been branded statistical arbitrage. To our knowledge, Elliott et al (2005) and Gatev et al (2006) are the only recent studies on pairs-trading. Market microstructure research highlights the relevance of short run dynamics in returns/size/direction and duration effects on subsequent price formation. In doing so, it has transformed technical analysis from an art to a science.

Significance: We pursue a similar path to shed some academic light on pairs-trading, which can be fundamentally related to 'near' law-of-one-price, relative valuation, cointegration and mean-reversion. In doing so, we offer funds managers and investment bankers a better understanding of the risks in and the rewards for pairs-trading.

Innovation: Our pairs-trading model is a variant of a cross-market price formation model that encapsulates own-market, cross-market and error correction dynamics. This allows us to incorporate overreaction (own dynamics), lead-lag effect (cross dynamics) and cointegration into our model. In addition, we can easily allow pairwise stocks to possess common factor structure(s) in their return generating processes. The model description and empirical demonstration from unrestricted matching forms the basis of our 1st academic paper. If our model decomposes pairs-trading profit into various components, we can easily analyze potential shifts in the sources of pairs-trading profitability when various matching restrictions are imposed during $(T-t)$. In addition, we attempt to improve on existing pairs-trading technology. E.g. Gatev etc (2006) match stocks based on minimizing the sum of squared historical daily pricing gap $\sum_{t=1}^{T} s_t^2$, which measures the 'closeness' between two normalized price series, including reinvested dividends. This criterion appears paradoxical since potential profitability during $(K-T)$ is driven by σ_{s_t}. We explore an alternative dual criteria, which is to min $E(s_t)$ and max σ_{s_t}. We benchmark this against the Gatev etc (2006) criterion, and explore the performance between the two as pairwise portfolio size increases. These considerations form the basis of our 2nd academic paper.

3. Description of approach

Following Gatev et al (2006), set $(T-t) = 12$ months and $(K-T) = 6$ months to progress through the overall sample based on an 18-month moving window. During $(T-t)$, distill from the population all stocks that do not trade for one day or more and/or cannot be short-sold. This makes actual trading more realistic. Next, exhaustively match stocks based on $\sum_{t=1}^{T} s_t^2$. At the end of $(T-t)$, pairwise stocks are identified, matched and ranked from lowest to highest $\sum_{t=1}^{T} s_t^2$. We consider only the top 100 ranked pairs, which are partitioned into Pairs 1-5, 6-20, 20-40,…,80-100 to contrast results across different segments of the ranking scale. The opening trigger is $s_{T+k} > \varepsilon$, and since matching is based on a historical standard deviation measure in

$\sum_{t=1}^{T} s_t^2$, ε should conform to a similar measure for consistency. Denote the opening trigger as $s_{T+k} > \varepsilon = 2 \times \sqrt{\sum_{t=1}^{T} s_t^2 / T}$ i.e. when s_{T+k} exceed two historical standard deviations. The position will be closed when p_t^i and p_t^j subsequently intercept. If not, the position will close out at the end of $(K-T)$.

Consider the following:

1. Matched firms are likely to possess increasingly similar characteristics at the top end of the ranking scale. This implies that pairs-trading profits at the top end are more likely driven by overreaction to idiosyncratic news rather than delayed reaction to common factors.
2. Imposing more matching restrictions during $(T-t)$ leads to more similar matched pairwise stocks. As such, profits are more likely driven by overreaction to idiosyncratic news.
3. During $(K-T)$, $s_t > \varepsilon$ can be triggered by p_t^i and p_t^j are moving in either the same or in opposite directions. Condition $s_t > \varepsilon$ on the sign $[\pm,\pm]$ of the cumulative returns $\sum_{k=1}^{K} r_{T+k}^i$ and $\sum_{k=1}^{K} r_{T+k}^j$. If $s_t > \varepsilon \,|\, [+,+]$ or $[-,-]$, p_t^i and p_t^j are moving in the same direction, such that profitability is likely driven by delayed reaction in the 'follower' stock. If $s_t > \varepsilon \,|\, [+,-]$ or $[-,+]$, p_t^i and p_t^j are moving in opposite directions, such that profitability is likely driven by overreaction to idiosyncratic news by either or both stocks.

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If contrarian profit is mainly driven by overreaction to idiosyncratic news in accordance with Jegadeesh and Titman (1995), then a pairs-trading strategy that i) imposes restricted matching, ii) only considers top ranking pairs, and iii) only open positions conditional on p_t^i and p_t^j moving in opposite directions, should dominate unrestricted and unconditional pairs-trading, ceteris paribus. This investigation forms the basis of the 2nd academic paper from this project.

Reference:

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