

# Research of Multi-Stock Pairs Trading Strategy Based on Co-integration

Feiyu Gu\*

Ernst & Young, Beijing 100006, China.

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**Abstract:** Many institutional investors and hedge funds have utilized pairs trading as an important branch of market neutral approach. Traditional pairs trading, in general, is limited to two similar stocks and relies heavily on stock price information; however, there is a danger of non-convergence. The major goal of this study is to use standard pair trading to expand the trading technique from a limited two-stock portfolio to a multiple-stock portfolio and profit from differential pricing. As a result, we suggest a multi-stock pair trading strategy based on co-integration, in which long and short trades are executed when trading signals are triggered in order to generate excess returns.

**Keywords:** Pair Trading; Co-Integration Connection; Multi-Stock; Statistical Arbitrage

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## 1. Introduction

Pair trading constitutes a crucial facet of market-neutral strategies, originally instituted in the mid-1980s by Nunzio Tartaglia and his team at Morgan Stanley (Vidyamurthy, 2004). This strategy hinges upon the identification of highly correlated pairs of stocks or similar securities. Presuming the correlation remains robust over time, any observed divergence in the trends between the two may present arbitrage opportunities, as this divergence is expected to rectify itself in due course (Elliott et al., 2005; Vidyamurthy, 2004).

The widespread application and significant role of pair trading in financial trading strategy implementation can be attributed to several key reasons. Foremost among these is the market neutrality of pair trading income, indicating its independence from market performance. Additionally, the strategy is characterized by relatively minimal volatility in returns and consistent stability in yield (Vidyamurthy, 2004).

## 2. Economic Hypothesis

Pairs trading strategy is a type of statistical arbitrage and based on the idea that stocks in similar companies should have similar values and its core idea is the mean reversion of the stock price in academic literature. (Vidyamurthy, G. 2011) According to this assumption, stocks with similar characteristics should generate similar cash flows and carry similar risks. Because the two fundamental criteria that influence the value of an investment are cash flows and risk, two companies that are similar in both areas should be equal in value. Stocks in the same sector have similar risk factors, as a result of similar businesses, external policies, and market influence, and their market prices are frequently associated. As a result, finding companies that can be paired in similar industries is easier, and the risk of industry rotation is reduced. Meanwhile, if matched portfolios have a cointegration connection, the projected return rate of an arbitrage operation may be larger. (cf. Vidyamurthy 2004)

## 3. Implementation

The first step is to choose securities. Traditional pairs trading depended mostly on stock price information and was limited to two homogeneous assets. We introduce a cointegration-based multi-stock pair trading strategy. We consider two companies to be similar if they belong to the same industry classification, have similar leverage, and have a high correlation between their stock returns of larger than 0.6. To calculate the correlation, we chose the banking sector from the Chinese stock market and used daily returns over a period

of time. Only pairs with a correlation of larger than 0.6 are kept, indicating that they are highly correlated. This pairs trading method can also be applied to other stock market sectors such as new energy, real estate, semiconductors, and so on. (Weiming, G 2018)

The second step is to test for cointegration and determine the coefficient. cointegration testing is a two-step process that involves evaluating the linear relationship and measuring the degree of mean reversion of the residual. The most common cointegration is between two stock time series, however any linear combination of time sequences can be thought of as a new time series. To begin, a stationarity test of each stock in the stock pool's price sequence and first-order difference sequence is performed during the sample period to guarantee that all stocks are integrated of order one. Then the ordinary least squares (OLS) method is used to estimate the cointegration regression equation. The following estimation equation can be obtained:  $x_t^n = a_0 + a_1 x_t^1 + \dots + a_n x_t^n + \varepsilon_t$ . Where  $a_0, a_1$  and...  $a_n$  are cointegration coefficients, ADF test is commonly used to judge whether  $\varepsilon_t$  is stable. (Vidyamurthy.G,2011, page 104-117) (Moura, C. E,2016)

The third step is to identify trading signals. According to Cointegration equation above, define the sequence of  $Spread_t = x_t^n - a_1 x_t^1 - \dots - a_n x_t^n - a_0$ , Let A represent the set of stocks with negative ratio coefficient, B represents the set of stocks whose ratio coefficient is positive. A threshold  $\lambda\sigma$  is set to determine the trigger point of the trade, where  $\sigma$  is the standard deviation of the spread series in a previous period of time, and  $\lambda$  is a fixed constant. If  $Spread_t > \lambda\sigma$  then we short stocks in A and long stocks in B. When  $Spread_t < -\lambda\sigma$  then we short stocks in B and long stocks in A. When  $Spread_t$  falls back to the 0 axis, close all the positions.

The position sizes for both long and short positions are \$1.5 million. We'll keep these stocks for the following month until the present pairs are liquidated, at which point we'll repeat the process.

## 4. Risks

The following are the primary risks associated with pair trading: (1) The most significant danger of pairs trading is that if the price differential between the two stocks chosen does not revert, we will be forced to accept a loss on the trade. The cause for the price gap not reverting could be due to fundamental features of the two equities altering or investors over-speculating. Setting a stop loss barrier is one technique to mitigate risk; (2) another danger is that if basic characteristics of a firm undergo significant change, the pair relationship may vanish over time. If we fail to notice this move, we may suffer an unanticipated loss in pairs trading. To prevent this danger, the ideal approach for pairs trading is to update pairs dynamically. (Moura, C. E, 2016)

## 5. Liquidity and Capital Considerations

China's capital market is becoming increasingly open. Quota requirements for foreign qualified investors to invest in domestic securities, for example, have been eliminated, and barriers to entry for QFII and RQFII have been reduced. Therefore, the Chinese market is more accessible to foreign capital.

Our trading strategy is implemented in the banking sector of the Chinese stock market. The listed banking industry which consists of 43 banks, is currently a heavily weighted sector, accounting for 12% of the stock market capitalization. The trading equities we've picked to trade are all large-cap stocks with substantial daily turnover and a big market capitalization. They have a daily turnover of more than 10 billion yuan in stock market, indicating that they are quite liquid. This trading method can also be applied to other industries such as new energy, real estate, semiconductors, and others, resulting in a low liquidity cost during the trading process.

Our recommended trading approach is to hold a \$1.5 million position each portfolio, but there are numerous alternative methods to increase the strategy's profitability. For example, we can not only trade at the end of each month, but we can also initiate new positions every day and then close out positions initiated a month earlier each day. Let's imagine there are 20 trading days every month, which would increase the strategy's portfolio size from \$1.5 million to \$30 million. If we have 30 tradable portfolios per month on average, we'll have a total long position of \$900 million and a short position of the same size in our portfolio.

## 6. Analysis of Strategy Prospects

Banking stocks listed in China market was selected to verify the effectiveness of multi-stock pairs trading strategy. We used the transaction data from January 7, 2014, to January 7, 2015 as samples to conduct correlation tests. Finally, six stocks were selected to

meet the requirements: Bank of Ningbo, Shanghai Pudong Development Bank, Huaxia Bank, Minsheng Bank, Bank of Nanjing, Industrial Bank, these bank stocks conform to first-order integration and  $\varepsilon_t$  is a stationary series in the sample period. (Table 1)

Table 1 The correlation coefficient between bank stocks

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Banking stocks	NingBo Banking	Pufa Banking	Huaxia Banking	Minsheng Banking	Nanjing Banking	Xingye Banking
NingBo Banking	1	0.976	0.964	0.892	0.992	0.985
Pufa Banking	0.976	1	0.985	0.94	0.958	0.982
Huaxia Banking	0.964	0.985	1	0.959	0.935	0.984
Minsheng Banking	0.892	0.94	0.959	1	0.862	0.933
Nanjing Banking	0.992	0.958	0.935	0.862	1	0.924
Xingye Banking	0.958	0.982	0.984	0.933	0.924	1

We simulate the strategy during the period from January 8, 2015, to January 8, 2017, the results reveal that using a multi-stock pairs trading strategy can earn you roughly 5% extra annual returns. Furthermore, the strategy's annual maximum retracement is around 26.67, and its annualized Sharpe ratio is about 0.99. This indicates that by employing this method, the maximum call back may be greatly reduced, and the Sharpe ratio can be significantly improved. It can be inferred that a multi-stock pairs trading strategy based on cointegration can significantly improve the profitability and stability of pairs trading. (Lei, Yin, 2018)

Table 2 Multi - stock paired trading versus holding risks

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	2 $\sigma$	3 $\sigma$	4 $\sigma$	Keep Holding
Return rate	26.46%	25.54%	23.86%	15.88%
Maximum retracement	24.78%	26.43%	28.82%	39.85%
Annual Sharpe ratio	1.16	1.05	0.98	0.77
Excess return rate	10.58%	9.66%	7.98%	
Average annual excess return	5.29%	4.83%	3.99%	

## 7. Conclusion

The results reveal that using a multi-stock pairs trading strategy can earn you roughly 15% extra annual returns. Furthermore, the strategy's annual maximum retracement is 32, and its annualized Sharpe ratio is 1.1. This indicates that by employing this method, the maximum callback may be greatly reduced, and the Sharpe ratio can be significantly improved. It can be inferred that a multi-stock pairs trading strategy based on co-integration can significantly improve the profitability and stability of pairs trading.

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