Pairs Trading, Technical Analysis and Data Snooping: Mean Reversion vs. Momentum

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This article examines the performance of technical rules applied to the commodity arbitrage (pairs-trading) investment strategy using daily data from 1990 to 2016. Adopting the false discovery rate method to control for data snooping bias and exercising 18,412 technical trading rules, significant predictability and excess profitability are observed. An out-of-sample analysis is performed to cross-validate the results in different sub-periods. The main finding is that whilst the performance of pairs-trading based on technical analysis exhibits a downward trend over the sample period, the opportunity for significant pairs-trading excess profitability remains.

Introduction

Pairs trading is a relative-value arbitrage strategy that matches a long position with a short position in a pair of highly correlated instruments. This 35-year-old trading approach remains popular among hedge funds as well as investment managers.

This paper investigates the excess profitability of pairs trading on daily data including spreads on *commodities* from January 1990 to December 2016, while considering a "universe" of *technical trading rules* (TTRs). The excess returns from technical analysis have shrunk over time, but transaction costs do not fully neutralize them: break-even transaction costs exceed conservative historical estimates of actual transaction costs. The authors also examine the time-varying excess returns of technical analysis on pairs trading in an out-of-sample (OOS) framework. Generally, the results suggest a decay in profitability in recent years; however, portfolios of significant pairs-trading rules on commodity pairs can still achieve attractive Sharpe ratios. Overall the findings are consistent with those of Gatev *et al*. (2006) in suggesting that simple mean reversion is *not* the only factor behind the significant profits but also momentum.

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Relevance of the Research Question

Technical analysis is widely employed by innovative classes of investors, such as hedge fund managers, as a strategy that is deemed to capture higher performance, lower risk and superior market-timing ability than other strategies (Smith *et al*., 2016). It is important to conduct a comprehensive and robust investigation of its merits since it is quite easy to confuse "luck" with true "skill"; namely, classical statistical inference focusing on single hypothesis testing of each (of multiple) trading rules can easily lead to false rejections or the so-called *p*-hacking phenomenon (see Harvey, 2017). The present study seeks to fill this gap in the context of commodity-pairs technical trading.

Technical Trading Rules Universe and Data-Snooping-Bias Control

Seven main families of TTRs based on past price data of the computed pairs are considered. Those classes of rules are categorized as *momentum* and *mean-reverting* rules. The momentum rules include: *filter rules*, *moving averages*, *support and resistance rules* and *channel breakouts*. The mean-reverting rules include: *relative strength indicators, Bollinger bands*, and c*ommodity channel index rules*. For each family, numerous parameterizations are employed (e.g., delay-period filters, holding-period filters, and fixed local maximum/minimum values), summing up to about 18,000 rules.

An appropriate investigation of significant profitability of a "universe" of TTRs requires controlling for data snooping bias. This paper adopts the *false discovery rate* (FDR) test of Barras *et al*. (2010) which estimates the proportion of false discoveries among strategies performing better or worse than the benchmark (e.g., risk-free rate), while displaying genuine performance under a specific threshold. The method assesses multiple strategies concurrently in a cross-section structure using the Sharpe ratio. The popularity of the FDR lies in the fact that by tolerating a certain, usually small, amount of Type I error, the FDR has more power to detect significantly profitable strategies.

The full-sample historical sample performance of TTRs on commodities pairs indicates that all commodity pairs are significantly predictable at the 1% or 5% nominal level, namely the Brent-WTI, platinum-gold, platinum-palladium, and corn-ethanol pairs. The Brent-WTI pair (or spread) seems to be the most predictable pair with 563 TTRs producing positive performance, while in terms of economic magnitude, the best-performing rule yields an outstanding mean excess return of 17.6% per annum and a healthy Sharpe ratio of 1.20. For the rest of commodities, the number of significantly predictive rules, range from 6 to 12, while the best-performing rules generate very promising annualized mean excess returns varying from 2.03% to 8.57%, with Sharpe ratios from 0.45 to 0.61.

To conduct the OOS analysis of pairs-trading performance the authors divide the full sample period into five sub-periods and adopt a 70-30 split for the in-sample versus OOS years in each of them. Then they construct FDR equally-weighted portfolios of each pair's significant rules based on in-sample performance and evaluate them in the OOS periods. The Brent-WTI crude oil pair seems again the most promising, yielding positive Sharpe ratios above 1 for the first two OOS periods (i.e., 1997 and 2001). For the platinum-gold pair, the TTRs reach their highest Sharpe ratio of 1.83 during 2011 which then fall back to 0.60 on average during 2016. For the platinum-palladium and corn-ethanol pairs, the significant TTRs yield positive performance for the majority of OOS subperiods, but the Sharpe ratios are smaller in

magnitude, generally below 1. The findings confirm the diversification benefits of the FDR method in enabling a portfolio of pairs-trading rules with significant profitability and relatively small downside risk.

Following what is common practice among *contrarian* pair-traders, the authors examine the OOS performance of specific contrarian TTRs, setting the lookback period equal to the half-life of an optimal mean-reverting strategy. In this context, the most promising results are obtained by trading the Brent-WTI crude oil spread, albeit its returns also decay to zero after reaching the third post-sample year.

Another popular pairs trading technique the authors considered is based on information from the *cointegrating* relation (i.e., long run co-movement) of the two assets to dynamically create hedge ratios. Here the Brent-WTI pair shows a consistently positive performance for all OOS years except one (2011) reaching its highest level in the last year (2016) with a very attractive Sharpe ratio of 2.02.

The final OOS simulation conducted in the paper is for an integrated market portfolio for all commodity pairs based on the TTRs selected, which are in-sample significant in terms of Sharpe ratio according to the FDR method for every pair. Its performance is compared with identical integrated portfolios constructed under the half-time, mean-reverting significant rules as well as with similar ones based on the significant rules identified using the dynamic hedging technique. The integrated commodities portfolio achieves a very healthy performance across all OOS years, yielding mostly Sharpe ratios of up to 1.73 and an average *compounded annual growth rate* (CAGR) of 2.24%. The analogous commodities portfolio constructed under the half-time of mean-reversion criterion yields attractive performance at least during the first two OOS years; in 1996 and 2001 the corresponding Sharpe ratios (0.86 and 1.05) and CAGRs (4.32% and 7.80%) indicate some good arbitrage opportunities, which subsequently decay. Finally, the commodities' portfolio performance based on pairs constructed under the dynamic hedging reveals similar evidence with the ones employing no hedging. The commodities' portfolio again outperforms during the first two post-sample periods with Sharpe ratios ranging from 1.01 to 1.82 and CAGRs from 2.42% to 5.58%, which then decay 0.20% and 0.11% over the recent period.

Conclusions

A hedge fund trading strategy based on the assumption of price *cointegration* in an efficient market is investigated in order to anticipate potentially profitable commodity-pair spreads. For this purpose, a large universe of technical trading rules is examined over a long sample period while adopting a robust multiple hypothesis testing method that attempts to shield the findings from data mining biases. The empirical evidence provided in this paper suggests that technical trading still has predictive power for most of the spreads considered, as it is able to yield attractive Sharpe ratios that remain significant after conservative transaction costs. An out-of-sample trading simulation exercise reveals that although the excess profitability of technical pairs-trading has gradually shrunk in recent years, some commodity pairs still exhibit attractive performance.

Endnotes

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Keywords

Pairs trading, technical analysis, data snooping, market efficiency.