Pairs-Trading in the Asian ADR Market

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Abstract

In this paper, we study pairs-trading strategies for 64 Asian shares listed in their local markets and listed in the U.S. as ADRs. Given that all pairs are cointegrated, they are logical choice for pairs-trading. We find that pairs-trading in this market delivers significant profits. The results are robust to different profit measures and different holding periods. For example, for a conservative investor willing to wait for a one-year period, before closing the portfolio pairs-trading positions, pairs-trading delivers annualized profits over 33%.

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Abstract

In this paper, we study pairs-trading strategies for 64 Asian shares listed in their local markets and listed in the U.S. as ADRs. Given that all pairs are cointegrated, they are logical choice for pairs-trading. We find that pairs-trading in this market delivers significant profits. The results are robust to different profit measures and different holding periods. For example, for a conservative investor willing to wait for a one-year period, before closing the portfolio pairs-trading positions, pairs-trading delivers annualized profits over 33%.

I. Introduction

Pairs-trading is an old portfolio management technique based on a classic hedge: a manager looks at stocks in pairs, buying the one she expects to perform best and selling short the one she expects to underperform. The concept has been generalized to accommodate long and short portfolios with different performance expectations. In the 1980s, hedge funds popularized pairs-trading.[1] According to Lowenstein (2000), LTCM lost $ 286 million during the 1998 Russian financial crisis.

The pairs-trading strategy, also known as "statistical arbitrage" and loosely based on the "Law of One Price", is very simple: find two stocks whose prices have moved together historically. When the spread between them widens, short the winner and buy the loser. If the joint distribution of the two stocks is stationary, prices will converge and the arbitrageur will profit. "Pairs-trading" has recently been the subject of academic interest. Gatev, Goetzmann and Rouwenhorst (1999) present evidence that this simple trading strategy produced statistically significant excess returns for the period 1963-1997. Zebedee (2001) analyzes the impact of pairs-trading at the microstructure level within the airline industry.

Finding pairs that are highly correlated over time is the key to the success of this strategy. A natural pair to study is ADRs trading in the U.S. and their underlying foreign assets. Since ADRs represent warehouse receipts for foreign underlying shares that have been deposited in a custodian bank on behalf of U.S. investors, ADRs and their

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[1] Today, market participants in London can buy an Equity Contract for Difference (ECD), which is an agreement (made between two parties) to exchange, at the closing of the contract, the difference between the opening and closing prices, multiplied by the number of shares detailed in the contract.

underlying shares should have a high correlation. The Law of One Price in the case of ADRs and their underlying shares has a very strong intuitive appeal.

Kato, Linn and Schallheim (1991) and Wahab, Lashgari, and Cohn (1992) studied arbitrage opportunities in the ADR market, and found very little evidence for profitable opportunities in the ADR market. In particular, Wahab et al. (1992) follow an implicit pairs trading strategy with two portfolios: an ADR portfolio and an underlying shares portfolio. They sell the "winner" (portfolio with the highest returns over a period of two weeks) and buy the "loser" (the portfolio with lowest returns over the same two-week period). They found limited profits for their pairs trading strategy, and they attributed their small profits (around 4%) to transaction costs and data limitations. That is, pairs trading using ADRs do not seem to be profitable.

Our paper is related to the substantial body of literature documenting mean reversion in stock returns in the short-run. DeBondt and Thaler (1985, 1987) and Jegadeesh and Titman (1993) document that long-term past losers outperform long-term past winners over the subsequent three to five years. Jegadeesh (1990) and Lehman (1990) document short-term stock return reversals.

The paper is organized as follows: Section I is the introduction. In Section II we discuss the formation of pairs and some methodological issues. In Section III, we describe the data and provide univariate statistics for each pair considered. Section IV contains the results. Finally, section V is the conclusions.

II. Pairs-trading in the ADR market

Since some Asian markets have short-selling restrictions, the "pairs trading" strategy is restricted to buying the underlying shares and selling the ADRs. That is, the strategy we analyze takes the ADR as the "winner" and the underlying as the "looser". When the price difference (expressed in U.S. dollars) between an ADR and its underlying share is bigger than κ_o ($\kappa_o > 0$), then we short the ADR shares and go long an equal number of the underlying shares. Let P_{ADR} represent the price of the ADR and P_F represent the price, expressed in USD, of the underlying foreign share. Then, we open an ADR position and its corresponding foreign share position when:

$$P_{ADR,t} - P_{F,t+j} > \kappa_o,$$

where j=0 if the long position in Asian market is established first, and j=1 if the short position in the U.S. market is established first.

Then, we unwind our positions the first time that the spread between the given ADR and its underlying shares is smaller than κ_c ($\kappa_0 > \kappa_c$). That is, we reverse the ADR position and its corresponding foreign share position when:

$$P_{ADR,t+j} - P_{F,t+k} < \kappa_c,$$

where j=k if the long position in Asian market is closed first, and j=k+1 if the short position in the U.S. market is closed first. Thus, we bet on the convergence of the ADR price and the underlying share price.

Since Asian markets are not open when the U.S. market is open, the pair, sometimes, cannot be formed. Overnight, the spread may reverse (say, $\kappa_c \le 0$) and then, the long position is not established. In this case, our short ADR position will be closed the next trading day.

The pairs-trading strategy is related to the error correction model, where the ADR price and the underlying share price are cointegrated. In this context, the pairs-trading strategy implies a long-run relation between the ADR price and the underlying share price. Moreover, if the cointegrating vector is one, which implies we short one share, and go long one share, the long-run spread should be zero.

The determination of κ_o and κ_c is ad-hoc. Gatev et al. (1999) use two historical standard deviations to determine κ_o. Then, they select κ_c to be non-positive –i.e., κ_c is implicitly set non-negative, because the positions are closed when the spread reverses for the first time. Wahab et. al. (1992) automatically close their positions after two weeks, without setting a-priori values for κ_o and κ_c. Note that the selection of κ_o and κ_c can be different for different agents. Individuals with higher risk-aversion individuals might a higher κ_o. Similarly individual with higher risk-aversion might also select a higher κ_c.

Note that our strategy involves two open positions: a short position of α ADR shares in the U.S. market and a long position of α underlying shares in the Asian market. We are not matching amount of dollar, but quantities of shares. Thus, our net investment is usually never zero. In the terminology of hedge funds, our strategy is beta-neutral, not dollar-neutral, since we are not matching dollar amounts in our long and short positions.

Pairs-trading in our context has some risks, and, therefore, it is not an arbitrage strategy in the strict sense of the definition of arbitrage. First, Asian markets and the U.S. market have no overlap in trading hours. Thus, it takes more than three hours to establish the long position, at which time the spread between the ADR price and the underlying share price might have already been reduced to zero. Second, exchange rates can fluctuate widely and, thus, exchange rate risk can affect the convergence of the spread.

Third, some underlying shares might not be very liquid, and, therefore, establishing the long position in the Asian markets might not be possible.

Pairs-trading involves different cash flows. As mentioned above, sometimes we open a short position in the U.S., but the spread completely reverses overnight and no long position is established in Asian markets. In this case only one cash flow will be taken into account. When pairs are formed, we aggregate the net cash flows for the different pair over a holding period. At the end of the holding period, say 3 months, we closed all the open positions and, then, calculate the returns for all our portfolio of pairs formed during that period. We consider three holding periods: 3 months, 6 months, and 12 months. Note that at the end of the holding period, we force ourselves to close all positions –even those that might be profitable in a couple of days-, therefore, as the holding period increases, the returns for the pairs trading strategy should increase.

Measuring returns for each pair might be complicated. From a frictionless arbitrage point of view, the net investment sometimes is negative. If a pair is formed, we tend to have a negative net investment, since we usually sell the ADR (the "winner") and buy the underlying (the "loser"). However, pairs-trading is not frictionless. To establish a short position in the U.S., investors need a to open a margin account, which requires a 50% collateral deposit for a given open position. In general, investors do not have available the proceeds of the short sale. Therefore, transferring the short sale proceeds to Asian markets is not possible. Thus, investors need capital to establish the long position in the underlying local shares.

Taking the above considerations into account, we consider several measures of return. First, we use the simplest measure of returns, which we called *return on nominal*

capital exposed in each market (the sum of the returns values of our U.S. short and long Asian positions). That is:

$$\sum_{i=1}^{N}\left(\frac{FS_{i,t+j}-FB_{i,t+1}}{FS_{i,t+1}}+\frac{US_{i,t}-UB_{i,t+k}}{US_{i,t}}\right)\frac{1}{N},,\qquad(1)$$

where j=k if the long position in Asian market is closed first, and j=k+1 if the short position in the U.S. market is closed first. FS_i represents the USD proceeds from sale of a foreign share i, FB_i represents the USD cost of a purchase of a foreign share i, US_i represents the USD proceeds from a sale of the corresponding ADR share i, and UB_i represents the USD cost of the purchase of the corresponding ADR share i.

Second, we use a more realistic measure, which we called *return on overall capital exposed* (the sum of the return in each market, divided by the overall capital exposed). That is:

$$\sum_{i=1}^{N}\left(\frac{FS_{i,t+j}-FB_{i,t+1}+US_{i,t}-UB_{i,t+k}}{FS_{i,t+1}+US_{i,t}}\right)\frac{1}{N}.\qquad(2)$$

Third, we use a more aggressive measure, where we assume the trading in the U.S. short position is done using the margin account, we called this measure *return on actual capital exposed* (the capital needed to trade on margin in the U.S. plus the investment in the foreign market). That is:

$$\sum_{i=1}^{N}\left(\frac{FS_{i,t+j}-FB_{i,t+1}+US_{i,t}-UB_{i,t+k}}{FS_{i,t+1}+0.5US_{i,t}}\right)\frac{1}{N}.\qquad(3)$$

Note that this third period is clearly more aggressive than the second measure.

III. Data

Our database consists of daily closing and opening prices for pairs of ADRs and their underlying shares for the period starting in the first quarter of 1991 and ending in the last quarter of 2000. We use 64 ADRs trading in the U.S. from Asian nine different markets. The underlying shares come from Hong Kong, India, Indonesia, Israel, Japan, Korea, Phillipines, Thailand, and Taiwan.

Table 1 presents summary statistics for our sample. All the pairs of ADR and their underlying shares are cointegrated using the ADF test.

IV. Results

Table 2 presents the annualized mean returns and other statistics of the ADR pair-trading strategy for the three different holding periods: 3 months, 6 months, and 12 months. For all our measures, and for all the holding periods, the pair-trading profits are positive and significant. For example, for the 3-mo holding period, the numbers of pairs trading positions with postive returns is 1073 out of 1315. That is, 82% of the positions show the expected convergence of ADR prices and underlying local price. We find that the second measure, the return on nominal capital exposed is the most conservative measure, with the lowest annualized mean and median returns. The most aggresive measure is the first measure, the return on nominal capital exposed in each market. As expected, we also find that as the holding period increase, so do the profits. Consider the most conservative measure, the nominal capital exposed measure. For this measure, the annualized return increases from 8.5% to 33.8% just by increasing the holding period

from 3 months to 12 months. As pointed out above, the pairs trading strategy is not without risk. Note that we have, in our portfolio, very extreme observations.

Next, we want to study if the observed portfolio returns in Table 2 can be explained by risk factors. Thus, we regress the pairs trading portfolio returns against several risk factors. We include the three Fama and French (1993) factors (SMB, HML, and excess U.S. market returns). We also include, following Griffin (2002), who makes a case for domestic factors in international markets, the local market return (LMR) and changes in the value of the local currency against the USD (EXR). The results are presented in Table 3 for the different measures and holding periods.

In each case, we estimate the following four-factor regression model:

$$R_{p,t} = a_p + \beta_p (R_{m,t} - R_{f,t}) + s_p\ SMB_t + h_p\ HML_t + l_p\ LMR_t + x_p\ EXR_t + e_{p,t} \quad (1)$$

where $R_{p,t}$ represents the calendar time portfolio of pairs-trading securities, and $R_{f,t}$ is the return of the one-month Treasury Bill. The four independent variables are the excess return on the U.S. market portfolio $(R_{m,t} - R_{f,t})$, the difference between the returns of value-weighted portfolios of small and big firm stocks (SMB_t), the difference in returns of value-weighted portfolios of high and low book-to-market stocks (HML_t), the local market return (LMR_t) and changes in the value of the local currency against the USD (EXR_t).

Table 3 reports the results for the 3-mo and 6-mo holding periods (the 12-mo holding period we do not have enough observations to report sensible results) for the equally-weighted portfolio. We report OLS results, but GLS results provide similar results. We find that in all cases, the portfolio profits are still significant even after controlling for the above mentioned five risk factors. We also estimate a one-way panel

data regression to check the robustness of our results. A common intercept, in this case is not significant, but we find that for the 3-mo period holding between 11to 15 intercepts are signifcantly positive out of 63 individual intercepts, while the others are found not to be statistically significant.

V. Conclusions

In this paper, we study pairs-trading strategies for 64 Asian shares listed in their local markets and listed in the U.S. as ADRs. The underlying shares come from Hong Kong, India, Indonesia, Israel, Japan, Korea, Phillipines, Thailand, and Taiwan. All the pairs are cointegrated, making them a logical choice for pairs-trading. We find that pairs-trading in this market delivers significant profits. The results are robust to different profit measures and different holding periods. For example, for a conservative investor willing to wait for a one-year period, before closing the portfolio pairs-trading positions, pairs-trading delivers annualized profits over 33%.

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Table 1. Summary Statistic

[Missing]

Table 2. Overall Profits

Overall Profits calculated according to our measures of principal invested.
Sample period: 1991.I-2000.IV

Number of Arbitrage Positions: 1,315
Number of Positions with Positive Returns: 1073.

	Mean	p-value	SD	Max/Min (%)	Median	Sign Test (p-value)
Holding Period: 3 Months **Number of Arbitrage Position: 1315**						
Nominal Capital Exposed in each Market	0.170 (19.60)	0.0001	0.315	2.26/-3.11	0.129	347,125 (0.0001)
Nominal Capital Exposed	0.085 (15.95)	0.0001	0.193	1.16/-3.79	0.066	343,928 (0.0001)
Actual Capital Exposed	.115 (15.26)	0.0001	0.272	1.57/-5.67	0.089	344,408 (.0001)
Holding Period: 6 Months **Number of Arbitrage Position: 672**						
Nominal Capital Exposed in each Market	0.361 (19.65)	0.0001	0.477	3.20/-2.87	0.509	99,967 (0.0001)
Nominal Capital Exposed	0.177 (13.78)	0.0001	0.333	1.85/-5.10	0.265	97,661 (0.0001)
Actual Capital Exposed	.239 (13.10)	0.0001	0.472	2.53/-7.60	0.358	97,762 (.0001)
Holding Period: 12 Months **Number of Arbitrage Position: 347**						
Nominal Capital Exposed in each Market	0.694 (15.20)	0.0001	0.851	4.50/-4.91	0.532	26,930 (0.0001)
Nominal Capital Exposed	0.338 (10.33)	0.0001	0.609	3.08/-7.37	0.266	26,401 (0.0001)
Actual Capital Exposed	.456 (9.81)	0.0001	0.865	4.60/-10.84	0.359	26,443 (.0001)

Note: T-statistics in parenthesis

Table 3. Abnormal Returns

This Table reports the result from this regression:

$$R_{p,t} = a_p + \beta_p (R_{m,t} - R_{f,t}) + s_p\,SMB_t + h_p\,HML_t + l_p\,LMR_t + x_p\,EXR_t + e_{p,t} \quad (1)$$

where $R_{p,t}$ represents the calendar time portfolio of pairs-trading securities, and $R_{f,t}$ is the return of the one-month Treasury Bill. The four independent variables are the excess return on the U.S. market portfolio ($R_{m,t} - R_{f,t}$), the difference between the returns of value-weighted portfolios of small and big firm stocks (SMB_t), the difference in returns of value-weighted portfolios of high and low book-to-market stocks (HML_t), the local market return (LMR_t) and changes in the value of the local currency against the USD (EXR_t).

	α_p (standard error)	Adj R^2
3-mo Portfolio		
First Measure	0.16523 (0.01619)*	-0.0224
Second Measure	0.08432 (0.00889)*	0.0206
Third Measure	0.11426 (0.01247)*	0.0184
6-mo Portfolio		
First Measure	0.36872 (0.03310)*	0.0854
Second Measure	0.18505 (0.01777)*	0.0962
Third Measure	0.24992 (0.02473)*	0.0982

Notes: * significant at the 5% level