Comparative Study of Pair Trading Techniques in Pakistan's Financial and Non-Financial Sector

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ABSTRACT

Purpose:
This study attempts to empirically investigate the pairs trading performance of financial and non-financial firms in Pakistan.

Methodology:
Daily data from 2008 to 2017 were collected for nine years. Cointegration and the distance approach were the major analytical techniques used to evaluate the profitability of pair trading. The financial and non-financial sectors of the Pakistan Stock Exchange were used to build the pairs**.**

Findings:
Results showed that the Top 5 pairs of portfolios exhibited the highest average excess returns of 0.0698 and Jensen's alpha is 0.0947 for the top 5 pairs. All pairs of firms showed significant and positive risk-adjusted performance. In the non-financial sector, the Top 10 pairs of portfolios had the highest average excess returns of 0.0789, and Jensen's alpha under the co-integration method for non-financial firms for all pairs 5, 10, 15, and 20 of the portfolios is also substantial and positive for risk-adjusted performance, with 0.0046, 0.0618, 0.0577, and 0.0493, respectively. Finally, pair trading under both techniques showed profitability. However, the co-integration technique exhibited better performance than the distance method.

Conclusion:
The study concluded that both pair trading techniques, particularly the co-integration technique exhibited profitable pair trading performance that can assist investors and fund managers to earn positive returns on their investments regardless of market direction.

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1. Introduction

It is quite challenging to discover enticing investment opportunities when stock markets are historically high and interest rates are historically low. As a result, more investors are turning to the hedge fund industry in search of gains. The tactics used by these hedge funds are frequently complex and difficult to comprehend, yet they have had great success and produced significant profits by engaging in frequent trades with little risk. Among these quantitative tactics, the pair trading approach is one of the most popular, simple, elegant, straightforward, and still widely employed techniques, despite its age (Jakobsson, E., 2015).

Pair trading is a market-neutral investment method that has grown in popularity as a way to minimize market risk and maximize possible market-neutral profits by using technical and statistical analysis. A pair trading is a trading method in which long and short positions in two distinct securities such as (stocks, currencies, exchange-traded funds, options, commodities, and so on) with high correlation are matched (Plater & Nisar, 2010).

A team of technical and quantitative analysts working for Morgan Stanley, a global investment bank and provider of financial services, invented pairs trading in the middle of the 1980s. Using complex statistical techniques, they created a trading algorithm whose primary objective was to find two groups of assets whose prices show a tendency to move in tandem. According to the Stanley group, the historical correlation of two securities serves as the foundation for a pair's trading strategy (Gatev et al., 1999; Vidyamurthy, 2004; Elliott et al., 2005).

The main factor influencing the profitability of the approach is the need that the securities in a pair's trading to have a high positive correlation. The optimal time to use a pair's trading technique is when the correlation between the two stocks, which is based on historical data, fails to hold a certain level. Investors would try to take a dollar-matched long position in the underperforming asset and sell short the outperforming security when they notice a discrepancy in the correlation. Profit from the convergence occurs if the securities' historical correlation returns. Here it is crucial to note that pair trading is not a risk-free investment technique because making the wrong decisions while placing the long and short positions can lead to a policy failure. Even though securities have a high degree of correlation, there is an additional risk to be considered: the volatility of securities. However, due to its market-neutral properties, pair trading can be used to balance a portfolio in addition to producing profits regardless of market fluctuations (Blázquez & Román, 2018).

The two stages of pair trading methods are known as the "formation phase" in which by using the different methods the pairs are created, and the "trading period," in which the criteria for opening and closing positions among selected pairs describe respectively. Selecting the appropriate strategy is necessary before applying a pair trading strategy. The literature divides pair selection techniques into four categories: time series, cointegration, distance, and stochastic spread method. In his comprehensive analysis of the pair trading literature from 2016, Krauss divided all methods into five primary categories and an additional category he called "alternative approaches." (Krauss, 2016).

These pair trading models have been used in numerous types of research to assess the global feasibility of these strategies. Gatev et al. (2006) examined the profitability and effectiveness of the distance approach, which allowed traders to enter or exit stock pairs

based on differences in relative stock prices. They employed two historical standard deviations as a trading trigger after first calculating the SSD, or distance, between the series of two normalized prices. By connecting the model to the Arbitrage Pricing Theory (APT) Vidyamurthy (2004) describes the cointegration technique. Elliott, van der Hoek, and Malcolm (2005) introduced the time series model, which was afterward regarded as one of the most widely used models. In this model, the spread between paired stocks was represented as a parametric series using the Kalman filter test. Using the stochastic spread technique, Liu and Timmermann (2013) create optimal portfolio strategies. They employed a mean reverting error correction technique to explain the conditional excess return.

The aforementioned techniques are widely used in literature to evaluate the effectiveness of pair trading strategies across developed markets. To the best of our knowledge, there isn't any literature examining how these strategies perform in an emerging and developing stock market like Pakistan. We believe that this phenomenon could have the following basic cause, as compared to other developed financial markets around the world, emerging's stock market still has many restrictions, such as prohibitions on short selling, because of tighter regulations on the financial market. Numerous pair trading strategies are therefore ineffective when applied directly to these emerging stock markets. So Pakistan which is our native country, only a few studies on pair trading have been done in Pakistan; for instance, in the study of Qazi et al. (2015) no trading algorithm was used and only pairings were created from the financial service sector, and commercial banks listed on Karachi stock exchange. Sohail et al., (2020) studied the co-integration approach to calculate the profitability of pair trading by taking the daily data from three industries textiles, chemicals, and banking from 2011 to 2019. Shaukat et al. (2021) used the distance approach to evaluate stock returns from various sectors of the Pakistan Stock Exchange. Sohail et al., (2020) also conducted comparative research on pairs trading by taking the DBSCAN clustering algorithm (machine learning) approach in addition to the typical pair trading technique from 2011 to 2019; the sample included 80 equities from five different sectors: banking, chemicals, cement, textile, food, and personal care items.

There is a considerable risk of poor pair selection, which looked at how different pair selection methods, such as price ratio, co-integration, distance approach, and copulas, performed around the world. According to Huck and Afawubo's (2015) publication, we will compare the two selection procedures to find the best approach to handle this problem. Additionally, there isn't a lot of study in Pakistan comparing the various pair trading tactics. This study concentrates on the issue of contrasting the various pair trading strategies in the Pakistan Stock Exchange. The Distance methodology based on Gatev's work and the cointegration method was used to examine the most profitable pair trading strategy in Pakistan’s financial and non-financial sectors.

2. Literature Review

Pair trading strategy was first used in 1980, and specifically, hedge fund managers particularly used these strategies the most to minimize their market exposure. A comprehensive discussion on pair trading and its origins can be traced back to the literature of Gatev et al. (2006). They looked at the CRSP stocks from 1962 to 2002 without taking transaction costs into account to determine how profitable pair trading strategies were on the US Stock Market. Their research demonstrated a statistically significant excess return of 0.9 percent each month and a risk-adjusted return of 0.76, which fell to between 0.19 and 0.38 percent when market effect, as determined by the bid-ask spread, was taken into consideration. Broussard and Vaihekoski (2012) extend their study and find that pair

trading is lucrative to the illiquid Finnish market even when trade execution is delayed by one day following the trading signal. Jacobs and Weber (2015) investigated the technique's profitability over time for pairs that are difficult to arbitrage or less obvious. Bowen and Hutchinson (2016) identified a pair trading approach was profitable in the market of turmoil using the components of share in the FTSE from 1979 to 2012. They claim that the combination of transaction costs and risk exposure brought on by time variations is a major factor in the UK's abnormal results.

Dos Santos, P. L. (2017) investigated the performance of a distance approach of pairs trading in four European indices: PSI 20 Index, IBEX 35 Index, CAC 40 Index, and DAX 30 Index from 2006 to 2016. The study's findings showed a modest but positive return. Tsoku & Moroke (2018) used correlation analysis and the Engle-Granger cointegration approach from 2010 to 2015 JSE. They used option stocks of 12 financial sector companies; only 18 couples had long-term relationships. Blázquez & Román (2018) investigated five different approaches, found the residual series, and compared the S&P 500 banking sector results from 2008 to 2013. Research findings indicate that cointegration was the most effective technique. Kim, T., and Kim, H. Y. (2019) established an optimum pair-trading method for 50 stocks of the S&P 500 from 1990 to 2018 using deep reinforcement learning. To choose pairings of securities a cointegration test was utilized and compared to a more well-known pairs-trading technique. They found that their proposed model could be trained successfully and outperformed the traditional pairs trading strategy.

Sami Kohvakka (2020) examined the efficiency of distance, cointegration, and copula approaches as ways of signal creation. The data consists of companies listed on OMX Helsinki between 2004 and 2020. The copula strategy appeared to be the weakest in terms of the number of trading alternatives and the average profit per deal. The distance method seems to generate more trustworthy returns when compared to the cointegration strategy. Keshavarz G., & Talebi, H. (2021) examined the significant association between the price returns of stocks listed on the TSX by using distance, cointegration, and copula approaches from September 2016 to February 2019. Their conclusions proved that the copula method of pairing produces the highest level of profitability. Yu, J., & Liu, H. (2022) carried out a comparison of distance, cointegration, Hurst exponent, and HP technique for pair trading throughout the period from 2006 to 2021 of stock listed on the Chinese stock market. Under the full short-selling restriction, all strategies, except the Hurst exponent approach, produce larger returns, with the cointegration method performing the best.

In Pakistan’s context, Qazi et al. (2015) employed the Engle-Granger two-step tests of cointegration on commercial banks and the financial services sector listed on the Karachi Stock Exchange. The findings of this study showed that a linear short/long portfolio may be constructed from equities that are cointegrated and follow stationary dynamics. Sohail, Sindhu, and Imran (2020) used the co-integration method to calculate the profitability of pair trading. Based on daily data from three industries—textiles, chemicals, and banking—from 2011 to 2019, pairings were created. The trading system algorithm uses a variety of parameterizations. The co-integration method yields favorable and substantial returns. Sohail et al. (2020) used the DBSCAN (machine learning) approach in addition to the common pair trading strategy from 2011 to 2019. The sample consists of 80 stocks from five distinct industries: banking, chemicals, cement, textile, food, and personal care products listed on Pakistan Stock Exchange. Machine learning has revealed an astonishing 1.16 percent average excess return with a Sharpe ratio of 2.48. Shaukat, Rehman, and ul Haq (2021) examined the stock returns from several sectors of the Pakistan Stock Exchange from 2009 to 2016. The distance approach is used to swap pairs. Pair trading has

been found to produce strong stock returns of up to 18.48 percent and 27.93 percent annually.

3. Research Methodology

Daily data from 2008 to 2017 of the thirty financial and non-financial firms according to market capitalization. These industries were chosen because of their significance to Pakistan's expansion and development. Two different but most widely statistical techniques cointegration and distance were used to identify the most profitable trading pair under these methods. The basic goal was to compare two distinct approaches to gauge how well certain pair trading strategies perform, thus the distance by Gatev et al., (2006) and cointegration approaches based on the literature were used. The pair trading process was completed in two stages the first stage was the formation stage and the formation period for pairs was one year after that in the second stage half year period stocks would be traded.

3.1. Pair's Selection/Formation under Distance Approach

Under the distance approach following steps are involved in pair formation. In the first step, by using the equation mentioned below we bring the given series of prices to unity by normalizing them. Tfp represents the total no of trading days involved. After normalization when the stock's price is t = 1, 2…Tfp and trading days going towards its closing point then

$$P_t^i = \prod_{t=1}^{t}(1 + r_t^i) \quad (1)$$

In this equation r_t^i represent the stock's daily returns by incorporating the dividend received. Now in the second step, the distance between two stocks is calculated by using the following equation

$$D_{i,j} = \frac{\sum_{t=1}^{Tfp}(P_t^i - P_t^j)2}{Tfp} \quad (2)$$

Now the last step is to arrange and selects the pairs for the portfolio based on minimum distance (Pizzutilo, 2013; Do & Faff, 2010; Perlin, 2009; Engelberg et al., 2008; Gatev et al., 1999, 2006).

3.2. Pair's Selection/Formation under Co-Integration Approach

In the co-integration process, prospect pairs that have the same order of integration are taken into consideration. By using the following equation, the spread among prospect pairs is calculated

$$\Delta P\ R_t^{i,j} = \log(P_t^i - / P_t^j) \quad (3)$$

Then Augmented Dicky Fuller test is used to calculate the mean reversion.

$$\Delta P\ R_t^{i,j} = \beta P R_{t=1}^{i,j} + \varepsilon t \quad (4)$$

The return of spread to mean would be confirmed if the null hypothesis is rejected. The methodology of Johansen co-integration is then used to test cointegration among pairs. As a result, there are a lot of pairings produced and Granger's Causality test is applied to them.

To select the top 20, 15, 10, and 5 pairs portfolios the market factor spread is derived based on the lowest spread (Dunis et al., 2010; Puspaningrum, 2009; Schmidt, 2008; Vidyamurthy, 2004; Hong & Susmel, 2003; Girma & Paulson, 1999).

3.3. Opening a Pair Position

For both methods, the next step is to calculate SSD. Now we assumed a threshold value and when this value goes beyond the calculated SSD of normalized prices, trading of the stocks pair named "trigger" is introduced. Now the trader will purchase underpriced stock and sell the overpriced stocks. Trading will start when /$P_t^i - P_t^j$/>trigger (i, j),
where Trigger (i, j) = n × stdev (i, j)

The number of trading days during the formation period is used to calculate the SSD of normalized prices. That means the standard deviation is (i. j) and it can be measured by the following equation.

$$(i,j) = \sqrt{\frac{1}{Tfp-1}\sum_{t=1}^{Tfp}[\left(P_t^i - P_t^j\right)^2 - D_{i,j}]^2} \quad (5)$$

We set the trigger value n = 2

The trader will close the trading position if no non-positive value is observed.

3.4. Calculation of Return on Pairs Trading

To calculate the return of a portfolio under pair trading techniques the distance method was used, proposed by Gatev et al., (2006). First, the daily returns were calculated with the help of the following equation

$$R_t\,(P^k) = R_t\,(l^k) - R_t\,(S^k) \quad (6)$$

So, if there are subscriptions selected from top 20, 10, 15, and 5 portfolios the daily returns will be determined on an equally weighted basis by using the following equation

$$R_t^{port} = \sum_{k=1}^{Nt} W_t^k\, R_t\,(P^k) \quad (7)$$

Then finally the CAPM was used the model to calculate the risk-adjusted return of the portfolio

$$R_{it} - R_{Ft} = a_i + b_i\,(R_{Mt} - R_{Ft})\,\varepsilon_{it} \quad (8)$$

4. Result and Finding

This section of the paper discussed the comparative results, sample for this paper is composed of 2 sectors of the Pakistan Stock exchange named financial and non-financial. Further, the formation period for both methods is one year, whereas the trading period consists of six months and the trigger value is 2. Daily data was used from 2008 to 2017. The quantitative analysis was performed after the construction of the top 5, 10, 15, and 20 portfolios of pairs.

4.1. Descriptive Analysis

Tables 1 and 2 present the results of descriptive analysis of the financial and non-financial sectors for distance and cointegration methods for the top 5, 10, 15, and 20 portfolios of pairs for comparative study. Table 1 in detail represents the mean, median, and mode values along with the max, min, and standard deviation of data from the central point under the distance method for both sectors, results depicted that both sectors had positive average values which confirmed that the pair trading strategy is profitable for PSX furthermore the highest average returns of 0.0203 are to be observed if portfolio consists of top 10 in the non-financial sector however, the volatility is also max for this top 10 portfolio pairs. Similarly, Table 2 showed mean, median and mode values along with max, min, and standard deviation of data from the central point under the cointegration method for both sectors, results illustrated that again both sectors had positive average values with the highest average returns of 0.0684 if portfolio consists of top 5 pairs in the non-financial sector. These findings are consistent with previous pair trading research in Pakistan, such as (Shaukat et al., 2021; Sohail et al., 2020; Sohail., Sindhu & Imran., 2020; Qazi et al., 2015).

Table.1. Descriptive Analysis under Distance Method

	Financial				**Non-Financial**			
	Top 20	**Top 15**	**Top 10**	**Top 5**	**Top 20**	**Top 15**	**Top 10**	**Top 5**
Formation Period	**1 Year (Collect Daily Data For variable)**							
Trigger Value	2	2	2	2	2	2	2	2
Min. Values	0.0023	0.0035	0.0004	-0.0019	0.0006	0.0043	0.0028	-0.0114
Max. Values	0.0695	0.0753	0.0444	0.0599	0.0623	0.0699	0.0856	0.0772
Avg. Values	0.0132	0.0151	0.0112	0.0068	0.0145	0.0199	0.0203	0.0139
Med. Values	0.0112	0.0121	0.0102	0.0049	0.0165	0.0173	0.0192	0.0122
Std. Deviations	0.0101	0.0113	0.0062	0.0039	0.0121	0.0140	0.0183	0.0109

Source: Author's elaboration

Table.2. Descriptive Analysis of Financial and Non-Financial Sector under Cointegration Method

	Financial				**Non-Financial**			
Formation Period	**Top 20**	**Top 15**	**Top 10**	**Top 5**	**Top 20**	**Top 15**	**Top 10**	**Top 5**
	1 Year (Collect Daily Data For variable)							
Trigger Value	2	2	2	2	2	2	2	2
Min. Values	-0.0189	-0.0121	-0.0663	-0.1139	-0.0014	-0.0067	-0.0072	-0.0383
Max. Values	0.1553	0.1779	0.2689	0.5620	0.3816	0.3109	0.0726	1.5721
Avg. Values	0.0639	0.0467	0.0367	0.0421	0.0540	0.0342	0.0445	0.0684
Med. Values	0.0313	0.0329	0.0146	0.0290	0.0172	0.0199	0.0127	0.0211
Std. Deviations	0.0289	0.0287	0.0481	0.1184	0.0138	0.1042	0.1243	0.1506

Source: Author's own elaboration

4.2. Quantitative Analysis

The t-statistic was used for the analysis of profitability in pair trading methods. The CAPM was also used to observe the risk-adjusted performance of trading portfolios. Based on past studies about pair trading (Shaukat et al., 2021; Sohail et al., 2020; Sohail, Sindhu, and Imran., 2020), Jensen's alpha is a better risk-adjusted measure in capital assets pricing

model, as a result, this study used this to measure the performance. Tables 3 and 4 show the outcomes of pair trading portfolios both in general and risk-adjusted performance of both sectors under two different methods (distance and cointegration method). The table 3 & 4 also include four broader categories of portfolios, each top 5, 10, 15, and 20 pairs of stocks, to examine which broader category yields the maximum amount of profitability for investors. In last table 5 represent the overall comparative analysis of the average annual profit generated by these trading portfolios under distance and cointegration methods.

Table.3. Comparison of Financial and Non-Financial Sector (Distance Method)

	Financial				**Non-Financial**			
	Top 20	**Top 15**	**Top 10**	**Top 5**	**Top 20**	**Top 15**	**Top 10**	**Top 5**
Formation Period	**1 Year (Collect Daily Data For variable)**							
Trigger Value	2	2	2	2	2	2	2	2
Portfolio Average Returns	0.0149	0.0136	0.0116	0.0053	0.0229	0.0211	0.0165	0.0121
Std. Deviations	0.0101	0.0105	0.0052	0.0007	0.0163	0.0151	0.0132	0.0145
t-statistic	7.56	5.32	6.53	6.02	6.23	7.31	7.09	5.55
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Jensen’s alpha	0.0138	0.0126	0.0102	0.0042	0.0249	0.0218	0.0164	0.0131
Standard Error	0.0015	0.0011	0.0008	0.0006	0.0018	0.0014	0.0010	0.0013
t-statistic	7.892	7.653	8.755	6.045	6.665	7.409	7.487	6.876
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Market beta	0.0456	0.0567	0.1541	0.0123	0.0473	0.0378	0.0399	0.0062
Standard Error	0.0215	0.0264	0.0173	0.0157	0.0389	0.0323	0.0276	0.0311
t-statistic	1.8381	2.1256	0.9321	0.6312	1.1497	1.1954	1.4432	0.3461

Source: Author’s own elaboration

Table 3 presented the results of financial and non-financial sectors under the distance method; this method of pair trading strategies produces favorable and substantial outcomes. These findings corroborate and validate the profitability of the pair trading technique in the Pakistan stock exchange. Starting from the left side first four rows present the statistics for the financial sector. To generate maximum profit, the number of pairs must be considered and this is witnessed from the results as the top 20 pairs of portfolios had the highest average excess returns of 0.0149 subsequently 0.0136 for the top 15 pairs of portfolios, 0.0116 for the top 10 pairs of portfolios and 0.0053 for top 5 pairs of portfolios. Jensen's alpha of all pairs of portfolios is also significant and favorable for risk-adjusted performance as for the top-20 pairs of portfolios is 0.0138 subsequently 0.0126 for the top 15 pairs of portfolios, 0.0102 for the top 10 pairs of portfolios and 0.0042 for the top 5 pairs of portfolios of financial firms. Similarly, the next four rows of Table 3 showed the results of non-financial firms. These findings also confirmed that the number of pairs in a portfolio plays a major role in generating profit as the top 20 pairs of portfolios had the highest average excess returns of 0.0229 afterward 0.0211 for the top 15 pairs of portfolios, 0.0165 for the top 10 pairs of portfolios and 0.0121 for top 5 pairs of portfolios. Jensen's alpha of all pairs 5, 10, 15, and 20 of the portfolios in the non-financial firm is also significant and favorable for risk-adjusted performance with 0.0249, 0.0218, 0.0164, and 0.0131 respectively. concludingly, both sectors of the Pakistan stock exchange show favorable significant outcomes under the distance method however the non-financial firms showed the ideal returns. These results are consistent with prior studies of pair trading like (Smith and Xu., 2017; Shaukat et al., 2021; Sohail et al., 2020).

Table.4. Quantitative Analysis of Financial and Non-Financial Sector under Co-Integration Method

	Financial				Non-Financial			
	Top 20	**Top 15**	**Top 10**	**Top 5**	**Top 20**	**Top 15**	**Top 10**	**Top 5**
Formation Period	**1 Year (collect daily data for variable)**							
Trigger Value	2	2	2	2	2	2	2	2
Portfolio Average Returns	0.0521	0.0601	0.0538	0.0698	0.0589	0.0611	0.0789	0.0267
Std. Deviations	0.0411	0.0558	0.0723	0.1329	0.1287	0.3461	0.7821	0.0973
t-statistic	13.4371	9.2455	8.3142	6.9114	5.5668	5.4672	4.5421	3.8539
p-value	0.0001	0.0015	0.0000	0.0001	0.0000	0.0000	0.0001	0.0000
Jensen's alpha	0.0516	0.0607	0.0689	0.0947	0.0493	0.0577	0.0618	0.0046
Standard Error	0.0156	0.0147	0.0196	0.0289	0.0213	0.0345	0.0392	0.0081
t-statistic	4.8293	5.8116	4.1574	4.9579	3.8907	3.0496	2.9835	0.7771
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Market beta	0.9901	1.5691	1.9485	2.5681	2.2345	2.8751	3.3779	2.3562
Standard Error	0.6733	0.7316	0.9815	1.1706	1.1911	2.1381	2.6924	1.1431
t-statistic	3.5697	3.9134	3.3477	3.1074	1.6831	1.9088	1.5876	2.9732

Source: Author's own elaboration

Table 4 explained the results of financial and non-financial sectors under the co-integration method. The co-integration method also generates favorable and significant results. These results substantiate and endorse the profitability of the pair trading technique in the Pakistan stock exchange. The statistics for the financial industry were reported in the first four rows, starting on the left side. The top 5 pairs of portfolios had the highest average excess returns of 0.0698, followed by 0.0601 for the top 15 pairs of portfolios, 0.0521 for the top 20 pairs of portfolios, and 0.0538 for the top 10 pairs of portfolios. Jensen's alpha is 0.0947 for the top 5 pairs of portfolios, 0.0689 for the top 10 pairs of portfolios, 0.0607 for the top 15 pairs of the portfolio, and 0.0516 for the top 20 pairs of a portfolio of financial firms, all of which are significant and positive for risk-adjusted performance.

The findings of non-financial enterprises were shown in the next four rows of Table 4. In the non-financial sector, the Top 10 pairs of portfolios had the highest average excess returns of 0.0789 followed by 0.0611 for the top 15 pairs of portfolios, 0.0589 for the top 20 pairs of portfolios, and 0.0267 for the top 5 pairs of portfolios. Jensen's alpha under the co-integration method for non-financial firms for all pairs 5, 10, 15, and 20 of the portfolios was also substantial and positive for risk-adjusted performance, with 0.0046, 0.0618, 0.0577, and 0.0493, respectively.

Finally, under the co-integration technique, again both sectors of the Pakistan stock exchange show favorable significant outcomes, but non-financial enterprises had comparatively the best returns as in the distance method. These results of pair trading strategies are also authenticating the profitability in accordance with the results of other studies like (Namwong, Yamaka, & Tansuchat., 2019; Sohail, Sindhu & Imran., 2020; Qazi et al., 2015).

The average performance for portfolios using the co-integration and distance approaches is shown in Table 5. According to the individual results shown in the above tables, these two strategies often provide significant and appealing results. Overall, the distance

approach has a highly significant average return of 1.475 percent and a t-statistic of 1.07. Similarly, these results are also highly significant for the co-integration method with an average return of 5.768 percent and a t-statistic of 20.703. However, these outcomes are better than the distance strategy which recommends that pair trading is beneficial in Pakistan, as investors in Pakistan are also earning positive returns similar to those seen in other developing and emerging markets around the world. Market neutrality and mean reversion theory are also reinforced by these findings. The value of the sharp ratio for both methods also reaffirmed the results.

Table.5. Comparison of Distance and Co-Integration Method

	Distance Method	Co-Integration Method
Portfolio Average Returns	0.01475	0.05767
Std. Deviations	0.01074	0.20703
t-statistic	6.45125	7.16727
p-value	0.0000	0.0002
Sharp ratio	0.8935	2.5831

Source: Author's own elaboration

5. Conclusion

The goal of this study was to investigate the idea of pair trading in Pakistan and to compare two different methods to gauge pair trading and its profitability. Data from financial and non-financial firms between 2008 to 2017 was used. The results of pair trading are generally profitable in Pakistan. The overall results of this paper conclude that pair trading by using the co-integration method has better returns as compared to the distance method. Similarly, when compared to the distance technique, the risk-adjusted returns of co-integration were found to be higher. Under both methods sector wise study was also conducted for the top 20, 15, 10, and 5 pairs of portfolios and results are significant and positive for financial and non-financial sectors however in both methods the non-financial sector performs better. The credit crunch of 2008 had a tremendous impact on the financial patterns, market tactics, and operational policies of financial institutions, particularly commercial banks, who were undoubtedly its primary and direct victims. This is the main reason why the financial sectors are not performing up to mark. The sharp ratio is also significant and auspicious for both methods. Market neutrality and mean reversion theory are also reinforced by these findings.

5.1. Policy Implication

Thus, given that the pairs' trading strategy is market-neutral, we can infer that it has the potential to produce higher risk-adjusted returns. It can be an effective investing strategy, especially the cointegration, for both domestic and international investors wishing to invest in Pakistan's stock market due to its potential for making money through short-term trading. The best prospects for pair trading can be found in a variety of markets with varying market situations.

5.2. Limitations and Recommendation

This study also has several limitations, such as the limited sample size and the fact that we merely used PSX. Just two fundamental techniques, co-integration, and distance, were employed. The effects of short sales and transaction costs were also excluded. The use of new methodologies, including the cluster method, time-series, and stochastic spread method, may improve comparisons. Additionally, multiple asset classes, such as

commodities and currencies, may be used to increase profit. In addition to this threshold value, the trigger value should be modified and the formation time should be considered. It is also advised to include different industries to compare the profitability of applying these pair trading strategies.

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