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Which Pairs of Stocks should we Trade? Selection of Pairs for Statistical Arbitrage and Pairs Trading in Karachi Stock Exchange

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Pairs Trading refers to a statistical arbitrage approach devised to take advantage from short term fluctuations simultaneously depicted by two stocks from long run equilibrium position. In this study a technique has been designed for the selection of pairs for pairs trading strategy. Engle-Granger 2-step Cointegration approach has been applied for identifying the trading pairs. The data employed in this study comprised of daily stock prices of Commercial Banks and Financial Services Sector. Restricted pairs have been formed out of highly liquid log share price series of 22 Commercial Banks and 19 Financial Services companies listed on Karachi Stock Exchange. Sample time period extended from November 2, 2009 to June 28, 2013 having total 911 observations for each share prices series incorporated in the study. Out of 231 pairs of commercial banks 25 were found cointegrated whereas 40 cointegrated pairs were identified among 156 pairs formed in Financial Services Sector. Furthermore a Cointegration relationship was estimated by regressing one stock price series on another, whereas the order of regression is accessed through Granger Causality Test. The mean reverting residual of Cointegration regression is modeled through the Vector Error Correction Model in order to assess the speed of adjustment coefficient for the statistical arbitrage opportunity. The findings of the study depict that the cointegrated stocks can be combined linearly in a long/short portfolio having stationary dynamics. Although for the given strategy profitability has not been assessed in this study yet the VECM results for residual series show significant deviations around the mean which identify the statistical arbitrage opportunity and ensure profitability of the pairs trading strategy.

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1. INTRODUCTION

The concept of statistical arbitrage emerged from the notion of predictability and long-term relationship in stock returns, which has been further support by the recent advent of the idea of mean reversion. The idea of mean reversion in stock prices supports predictability and works against the concept of efficient market hypothesis according to which stock prices exhibit a random walk and cannot be forecasted. A mean reverting

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time series, on the contrary can be forecasted using historical data [Charles and Darné (2009); Gupta and Basu (2007)]. Furthermore literature also reported the role of mean reversion for portfolio allocation and asset management. Over the past decade, the hedge funds and investment banks have capitalised on statistical arbitrage opportunities using mean reverting portfolios. Simplest of such portfolios is a two-asset portfolio in case of pairs trading [Pole (2007); Vidyamurthy (2004)].

Pairs trading strategy was initiated by Nunzio Tartaglias while working with Morgan and Stanley during the era of 1980s. It has been adopted by hedge funds as a statistical arbitrage technique. The idea emerged from the fact that certain securities depicted daily correlated returns over a long period of time. Therefore trading strategies were developed in order to capitalise upon these statistical arbitrage opportunities evolving due to the market inefficiencies [Lo and MacKinlay (1988); Khandani and Lo (2007); Lo and Mackinlay (1997); Gatev, *et al.* (2006); Guidolin, *et al.* (2009)]. In pairs trading, pairs are formed of those stocks, which had shown similar price movements historically. When the selected pair depicts divergence between the price movements, it is assumed to be temporary and is capitalised upon through opening long/short positions simultaneously. The strategy aspires that these short-term fluctuations will converge over the period of time under the effect of long run equilibrium relationship between the two stocks.

Traditionally stocks are allocated in a portfolio on the basis of correlation or other non-parametric techniques. In this study Cointegration based trading pairs have been developed. The existence of a cointegrating association provided a base for developing a certain linear combination between the cointegrated trading pairs and as a result the portfolio developed is a stationary process. Any deviation depicted by stock price series from the equilibrium is regarded as mispricing. Hence the stock price series are expected to return to zero from these short term mispricing deviations. The effect of mispricing makes one stock appear as undervalued and the other as overvalued and creates a statistical arbitrage opportunity for pair traders. Therefore in pair trading a two stock portfolio is developed through taking a long position in an undervalued stock and a short position in an overvalued stock. A portfolio maintaining a value below its equilibrium position creates a prospect for opening a long position however it is closed when the portfolio value returns back to its likely mean position. Whereas a short position is opened in the portfolio when its value is above its equilibrium value and is closed out when the portfolio value falls close to the estimated mean. Such short-term mis-pricing moments make the portfolio profitable under the pairs trading strategy.

Which pairs of stocks should we trade? This is a critical question, imperative for the traders to address, in order to avoid trading with the mismatched pairs which may make the pairs trading strategy unprofitable. Therefore the primary objective of this study is to select a trading pair based on the co-movement of two stock price series in the long run and the speed of adjustment of the disequilibrium term. Engle-Granger (EG) Test for Cointegration has been applied to identify the long run equilibrium relationship between two stocks. The EG approach to Cointegration will help in assessing whether the relationship between two stocks in a pair is spurious or not. A Cointegration relationship is estimated by regressing one stock price series on another, whereas the order of regression is accessed through Granger Causality Test. The stationary residual series of the cointegrating regression depicts the mean reverting behaviour of a trading pair. Consequently, the Vector Error Correction Model (VECM) has been employed to model the stationary residual series. The residual series contains significant information pertaining to co-movement between the trading pairs. For instance the 'speed of adjustment' coefficients in the VECM describe how quickly the system reverts to its mean after observing a short-term deviation and also identifies which stock in a pair performs the error correction function.

In order to achieve the above mentioned objectives the rest of the study has been organised into following sections. Section 2 postulates a brief overview of academic literature pertaining to pairs trading strategy. Section 3 explains the methodology adopted in the study for describing pairs trading strategy. Section 4 specifies the empirical results and Section 5 provides discussion and conclusion of the empirical study.

2. LITERATURE REVIEW

Since long the pairs trading strategy has fascinated the practitioners as well as the academicians. Kawasaki, *et al.* (2003) analysed the profitability of taking both long and short positions simultaneously in a pair of stocks that yields a stationary spread series. The long/short investment strategies proved to be profitable. Kawasaki, *et al.* (2003) did not present the idea of pairs trading formally however the underlying concept remained same. Nath (2003) proposed a simple yet profitable pairs trading strategy based on Cointegration analysis, in the large and highly liquid secondary market of US treasury securities while accounting for finance and transaction cost. Hong and Susmel (2003) further tested the pairs trading strategy based on Cointegration analysis for 64 Asian shares listed in their local markets as well as in the US markets as American Depository Receipt (ADR). The findings of the study revealed significant pairs trading profits in the US ARD market. Elliot, *et al.* (2005) extended the concept of pairs trading and asserted that the Pairs trading strategy works through making a market neutral portfolio with zero beta and is referred to as spread. This spread is further modelled as mean reverting process using the Gaussian Markov Chain model. On the basis of the simulated data, the findings of the study revealed that the methodology proposed by Elliot, *et al.* (2005) has the ability to generate profits from the financial time series data which is found out to be out of equilibrium. Andrade, *et al.* (2005) introduced the effect of uninformed demand shocks in the pairs trading strategy in the Taiwanese stock market revealing significant excess returns.

The literature pertaining to pairs trading is pioneered by Gatev, *et al.* (2006). Under the pairs trading strategy proposed by Gatev, *et al.* (2006) pairs were selected on the basis of the distance approach and using the identified pairs long and short positions were taken on the basis of preset criteria. The strategy yielded annualised returns of 11 percent and the findings of the study also suggested that the pair trading strategy is a profitable option for those investors who are exposed to smaller transaction costs and can execute short sale activities. Do, *et al.* (2006) followed the pairs trading strategy proposed by Gatev, *et al.* (2006) and introduced the stochastic spread approach for the formation of restricted pairs. The findings of Do, *et al.* (2006) reported stable performance results and also confirmed the mean reversion behaviour observed under the stochastic residual spread approach. Lin, *et al.* (2006) also extended the work of Gatev, *et al.* (2006) through replacing the distance approach with

Cointegration analysis during the pair formation period. Papadakis and Wysocki (2007) attempted to test the impact of accounting information events (i.e. earnings announcements and analyst's earnings forecasts) on the profitability of the pairs trading strategy proposed by Gatev, *et al.* (2006) and inferred that the stock prices drift, due to the earnings announcements and the analyst's earnings forecasts, is a significant factor affecting the profitability of the pairs trading strategy. Later Bock and Mestel (2009) attempted to execute the traditional pairs trading strategy through apply the trading rules.

The idea of pairs trading further evolved with the work of Engelberg, *et al.* (2009) for whom the primary motivation was to understand and identify those factors that cause the pairs to diverge. Certain factors identified by Engelberg, *et al.* (2009), that might affect the convergence and divergence patterns in stock prices, included liquidity of the stocks in a pair, information diffusions, horizon risk and divergence risk. The results suggested that the profits from the pairs trading strategy are short lived and are directly related to the information pertaining to the constituent firms in a pair. Engelberg, *et al.* (2009), asserted that the identification of a lead lag relationship between stocks due to a common information event depicts a strong lacking in the unconditional pairs trading strategy proposed by Gatev, *et al.* (2006) which works without referring to the events leading to the changes in the prices of stocks in a pair.

Huck, *et al.* (2009) introduced combined forecast approach and Multi criteria decision methods for pair selection and depicted promising results and categorised the proposed methodology as a powerful tool for pair's selection. Perlin (2009) tested the pairs trading strategy in the Brazilian stock market with high frequency data and discovered that the pairs trading strategy is profitable and market neutral in the Brazilian market and generates best results for the high frequency daily data. The concept of high frequency pairs trading was further supported by Bowen, *et al.* (2010) confirming that higher profits from the strategy are generated during the first hour of the trading. Bianchi, *et al*. (2009) tested the pairs trading strategy in the commodity futures market and the findings of the study revealed statistically significant excess returns. Bolgün, *et al.* (2010) and Yuksel, *et al.* (2010) tested the pairs trading strategy proposed by Gatev, *et al.* (2006) in the Istanbul Stock Exchange and revealed that the profitability from pairs trading is highly sensitive to transaction restrictions and transaction commissions.

Do and Faff (2010) extended the pairs trading strategy proposed by Gatev, *et al.* (2006) and suggested that the pairs trading strategy performs well during the turbulent times in the market i.e. it is profitable in the bearish markets. Mori and Ziobrowski (2011) further asserted that only the market trends are not important for explaining divergence patterns and the profitability of pairs trading rather the market characteristics and dynamics also play a significant role. Do and Faff (2012) once again tested the pairs trading strategy proposed by Gatev, *et al.* (2006) while assessing the impact of transaction cost on the profitability of pairs trading strategy. The empirical results exhibited that the pairs trading strategy remains profitable even after controlling for the trading costs however the level of profit decreases. These findings were further supported by Pizzutilo (2013) while testing the effectiveness of the pairs trading strategy for the individual investors under the existence of the relevant constraints in the form of restriction to short selling and trading costs. Furthermore Huck (2013) also tested the sensitivity of the pairs trading strategy to the length of the formation period and signified that the large abnormal positive returns are generated when long formation periods are employed.

Hong, *et al.* (2012) revealed a positive performance of the pairs trading strategy in the Korean stock market whereas Broussard and Vaihekoski (2012) described excess positive returns from the pairs trading strategy in the Finish market. Mashele, *et al.* (2013) also affirmed that the investment strategy based on pairs trading is successful in the Johannesburg stock exchange. Caldeira and Moura (2013) claimed that the pairs trading strategy based on Cointegration remains profitable in the Brazilian market even during the times of financial crisis and thus generate consistent profits.

Several techniques have been reported in the literature for the implementation of pairs trading strategy. The four most commonly reported techniques include the non-parametric distance approach [Gatev, *et al.* (1999); Nath (2003)], the stochastic spread method [Elliot, *et al.* (2005)], the stochastic residual spread method [Do, *et al.* (2006)] and the Cointegration method [Vidyamurthy (2004)].

The significance and power of the Cointegration technique can be inferred from the fact that it allows for the application of estimation models like Ordinary Least Square and Maximum Likelihood to non-stationary time series. Regardless of its vast applicability, the use of Cointegration technique in the field of investment analysis and portfolio management is still limited. This limited use of Cointegration in investment strategies is attributable to massive use of a standardised correlation analysis for asset returns. Correlation analysis technique works for stationary variables, which in turn entails prior de-trending of stock prices and financial time series data which is normally integrated of order one or higher. As a result all inferences are based on returns [Damghani, *et al.* (2012)]. Due to the de-trending procedure valuable information is lost from the differenced time series [Johansen (2011)]. Likewise if time series included in a system are integrated of different orders then different orders of differencing are needed to make the variables stationary. Therefore inferences made on the basis of correlation analysis fail to incorporate important information pertaining to the time series understudy.

The Cointegration approach for pairs trading is significantly adopted and favoured in the literature due to its simplicity and ability to avoid the problem of model mis-specification and to identify mean reversion in price series [Broussard and Vaihekoski (2012); Gutierrez and Tse (2011); Puspaningrum, Lin, and Gulati (2010); Chiu and Wong (2012)]. In order to benefit from the positive features of Cointegration approach this study also strives to adopt the Cointegration approach in order to form and select pairs for pairs trading strategy in Karachi Stock Exchange while using Engle Granger Cointegration methodology. Literature concludes pairs trading as an efficient arbitrage opportunity emerged through statistical transformations however this arbitrage opportunity can only be materialised through the correct selection of pairs possessing long term equilibrium. The next section elaborates the methodology adopted to assess the long run equilibrium relationship between stocks included in a pair and their mean reversion behaviour imperative for a successful pairs trading strategy.

3. DATA COLLECTION AND METHODOLOGY

This study utilised daily stock prices of 22 Commercial banks and 19 Financial Services companies listed on the Karachi Stock Exchange (KSE). The daily data of stock prices has been retrieved from *Business Recorder*. Since it is imperative for pairs trading that the stocks remain actively traded and liquid, therefore only those stocks were included in the study, which depicted high turnover and active trading. Out of the 23 listed commercial banks and 40 listed financial services companies, 22 banks and 19 financial services companies were included in the study solely on the basis of high turnover and active trading [Do and Faff (2010)]. The issue of stale prices and restricted trading became a reason for stocks exclusion from the study. See Appendix I for the list of companies included in the study.

The sample time period consists of daily stock returns collected over a period extending from November 2, 2009 to June 28, 2013 having total 911 observations for each time series incorporated in the study. This study is based upon restricted trading pairs, which refers to pair formation of stocks from the same industry or sector [Kawasaki, *et al.* (2003)]. There are several reasons attributable to opting for restricted pairs trading. Pairs trading, by virtue of its construction is largely perceived as a market neutral strategy in which portfolios are deliberately constructed to hold zero beta and inhibit the systematic risk. In such neutralised portfolios profits are generated by the long and short positions solely due to the convergence of residual spread in the form of mean reversion. Therefore stocks in a pair have been selected from the same sector with an assumption that they would be affected by similar systematic risk factors and resultantly the portfolios developed would have a zero beta. In this study 231 restricted pairs have been developed using 22 sampled Commercial Banks (see Table 3 in Appendix III) and 171 pairs have been developed using 19 financial services companies however 15 pairs were dropped due to the Stationarity issues and for the rest of the analysis 156 pairs have been considered (see Table 4 in Appendix III). The formula employed for developing stock pairs is given below,

$$No.of\ Stock\ Pairs = \frac{N^2-N}{2},$$ N is the number of sample Companies.

Another reason supporting the formation of restricted pairs is the theoretical justification for a cointegrating relationship existing between the two stocks of the same sector. Although Cointegration alone provides fundamental basis for the formation of a trading strategy yet in case of restricted pairs this statistical relationship is also justified by the fact that the two stocks are affected by similar fundamental factors in the long run. Therefore a cointegrating relationship found in-sample would be expected to prevail in the long run out-of-sample as well. However a cointegrating relationship between two randomly selected stocks would possess no economic and theoretical justification along with any surety to prevail in the long run. Consequently the study worked with two sectors being commercial banks and financial services sector as described above. Trading pairs made in each sector are handled separately.

As mentioned earlier, the objective of the study is to identify trading pairs on the basis of a long run equilibrium relationship between two stocks in a pair and the speed of adjustment of the disequilibrium term. On the basis of the set objective, the methodology has been divided in to four subsections. For testing long run equilibrium relationship Engle-Granger (EG) approach to Cointegration has been discussed in subsection 3.1. Later in subsection 3.2., Granger Causality test has been discussed in detail due to its ability to provide an insight into the dynamics of a cointegrating relationship for cointegrated pair of stocks. A uni-directional Granger Causality test describes which stock informationally leads another stock in a trading pair. In subsection 3.3., a cointegrating equation and a residual spread has been established on the basis of uni-directional Granger Causality output. In subsection 3.4., for estimating the short run relationship between the cointegrated share prices series, Vector Error Correction Model has been discussed in detail.

3.1. Engle Granger (EG) 2-step Approach to Cointegration

A simple approach to Cointegration has been proposed by Engle and Granger (1987) in order to estimate a long run equilibrium relationship between two non-stationary time series. If a linear combination of two non-stationary time series is stationary then the two series exhibit a long run equilibrium relationship. For two series to be cointegrated it is imperative that they must be integrated of same order. Alexander (2008) asserted that although the OLS estimators are normally employed for stationary time series yet it can also be applied to non-stationary time series in case the cointegrating regression residual is a stationary process [Greene (2002)]. EG approach to Cointegration is a two step process illustrated below.

Step 1: Cointegrating Regression

For testing Cointegration, it is imperative for the two series to be non-stationary and integrated of same order. Hence the Augmented Dickey-Fuller test (ADF) applied to the log price series as a test of Stationarity in which appropriate lag length is determined using Aikaike's Information Criterion (AIC). If any of the log prices series is reported to be stationary i.e. I(0) by the ADF test, such a series is excluded from the analysis. This exclusion is attributable to the fact that Cointegration of a stationary and a non-stationary series results in a spurious regression with non-stationary residual series [Greene (2002)]. Hence if x_t and y_t are I(1) processes, then a long run relationship is estimated between log of x_t and log of $y_t$using the OLS estimator.

$$y_t = \beta_o + \beta_1 x_t + e_t \qquad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (3.1)$$

In the Equation 1, β_o is a constant and β_1 is the Cointegration coefficient. The residual series of the cointegrating regression is tested for Stationarity in step 2.

Step 2: Testing Stationarity of Residual Series

In this step ADF test is employed to verify the Stationarity of the estimated residual series $\hat{e_t}$ retrieved from Equation 1 in step 1 of the EG approach, described through the Equation 2 below.

$$\hat{e_t} = y_t - \beta_o - \beta_1 x_t \qquad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (3.2)$$

According to the EG approach, the estimated residual series has to be stationary for the x_t and $y_t$to be cointegrated.

The Equation 3.2 depicts a portfolio consisting of 1 Long unit of stock y_t for every β_1 short units of stock x_t and the portfolio has an equilibrium value of e_t. The deviations from the equilibrium value are represented by $\hat{e_t}$, which is a stationary process ensuring mean reversion in portfolio value. In case the two variables are not cointegrated then the resulting regression provides spurious results and $\hat{e_t}$ is not a stationary process.

3.2. Granger Causality Test

In the EG approach ordering of variables can emerge as an issue. For instance if log prices of y_t are regressed on log prices of x_t, then a different residual series is generated which is further tested for stationarity. In case of pairs trading strategy the ordering issue can be resolved through the Granger Causality test. Moreover the use of Granger Causality test also allows for assessing the lead-lag relationship between two stocks [Greene (2002)].

Granger causality test under bivariate (x, y) setting can be expressed as under,

$$y_t = \beta_o + \beta_1 y_{t-1} + \cdots + \beta_i y_{t-i} + \alpha_1 x_{t-1} + \cdots + \alpha_i x_{t-i} + e_t \quad \ldots \quad \ldots \quad (3.3)$$

$$x_t = \beta_o + \beta_1 x_{t-1} + \cdots + \beta_i x_{t-i} + \alpha_1 y_{t-1} + \cdots + \alpha_i y_{t-i} + e_t \quad \ldots \quad \ldots \quad (3.4)$$

This analysis provides two tests; first test examines a null hypothesis that the x does not granger causes y and the second tests examines that y does not granger causes x. If the first null hypothesis is rejected and the second is accepted, it can be inferred that x granger causes y indicating uni-directional causality from x to y. This also depicts that x informationally leads y [Greene (2002)]. However in case if both the hypotheses are rejected then there is a bi-directional causality between x and y but if both the hypotheses are accepted there are no evidence of causality between x and y.

3.3. Cointegrating Directional Regression and Testing Residual Spread for Stationarity

After assessing the direction of causality through the Uni-directional Granger Causality test, the issue pertaining to ordering of variables in cointegrating regression is resolved and allows the researchers to estimate a cointegrating directional regression as given in Equation 3.1 if null hypothesis of Equation 3.3 is rejected in Granger Causality test [Greene (2002)]. As mentioned under the EG approach to Cointegration, estimated residual spread series is tested for Stationarity using ADF test.

3.4. Vector Error Correction Model (VECM)

According to the Granger Representation Theorem, when the two time series are cointegrated, the Vector Autoregressive model (VAR) is mis-specified [Greene (2002)]. The mis-specification problem can be treated through incorporating the previous disequilibrium term in the VAR model as an explanatory variable and thus the model becomes well-specified and is termed as Vector Error Correction model (VECM). VECM allows for modelling the dynamics of one time series as a function of its own lags, lags of its cointegrated pair and the error correction component. The error correction component determines the speed of adjustment of time series from a short run deviation to its equilibrium position [Gujarati (2003)]. After obtaining the disequilibrium term from Equation 3.1, the VECM is applied to the two cointegrated log return series Δy_t and Δx_t.

$$\Delta y_t = \alpha_1 + \gamma_1 e_{t-1} + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3.5)$$

$$\Delta x_t = \alpha_2 + \gamma_2 e_{t-1} + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3.6)$$

In the Equation 3.5 and Equation 3.6, e_{t-1} is the lag of disequilibrium term obtained from Equation 3.2 above. α_1 and α_2 are constant terms whereas γ_1 and γ_2 are the speed of adjustment coefficients.

$$\Delta y_t = \alpha_1 + \sum_{i=1}^{m} \beta_{11}^{i} \Delta x_{t-i} + \sum_{i=1}^{m} \beta_{12}^{i} \Delta y_{t-i} + \gamma_1 e_{t-1} + \varepsilon_{it} \quad \dots \quad \dots \quad (3.7)$$

$$\Delta x_t = \alpha_2 + \sum_{i=1}^{m} \beta_{21}^{i} \Delta x_{t-i} + \sum_{i=1}^{m} \beta_{22}^{i} \Delta y_{t-i} + \gamma_2 e_{t-1} + \varepsilon_{it} \quad \dots \quad \dots \quad (3.8)$$

Both the Equations 3.7 and 3.8 have been estimated through OLS while including the lags of the dependent and independent variables in order to avoid autocorrelation problem. From the Equations 3.7 and 3.8, the values of γ_1 and γ_2 can be retrieved which can be termed as speed of adjustment coefficients [Gujarati (2003)]. The size and sign of the speed of adjustment coefficients are the two critical characteristics. In VECM, it is imperative that either one of the two or both coefficients must be statistically different from zero. When both the statistically significant speed of adjustment coefficients depict opposite sign, it can be inferred that the two cointegrated time series will move in opposite direction to resume equilibrium [Gujarati (2003)]. However if the two depict same sign, then both series will exhibit convergence in the same direction, with one moving faster than the other one.

The size of the speed of adjustment coefficient indicates that the larger the size of the speed of adjustment coefficient the faster will be the response of the dependent variable towards the deviation from the long run equilibrium. Large values of speed of adjustment coefficients also indicate highly stationary disequilibrium term. However in case these coefficients have small values it can be concluded that the dependent variable either does not responds or responds very slowly to the short term deviations [Gujarati (2003)].

Here the size and sign of the speed of adjustment coefficients depict the mean reversion and convergence characteristics of two cointegrated time series in a pair. Therefore for pairs trading profitability it is imperative that the speed of adjustment coefficients must be significant having the right sign and a large size.

On the basis of the methodology devised above, empirical results of the study have been illustrated in the next section.

4. EMPIRICAL RESULTS

This section pertains to the empirical testing of the trading pairs selection idea presented in the preceding sections and the interpretation of results. Table 1 (Appendix I) contains a List of companies included in the study pertaining to Commercial Banks and the Financial Services sector. For each company given in Table 1, a symbol is also given as quoted in Karachi Stock Exchange. Later in the analysis, these companies will be referred to using these symbols. Subsequent subsections depict application of the methodology devised in Section 3.

4.1. Cointegration Results

Cointegration analysis strives to work with non-stationary time series data in order to assess long run equilibrium relationship. Therefore for Cointegration analysis, the sample time series have to be non-stationary. Table 2 in Appendix II, provides the summary of ADF test for the entire log share price series incorporated in the study related to commercial banks and financial services sector. Table 2 provides the tau-statistic for the ADF test in levels along with the relevant p-values given in parenthesis. According to the ADF test results for all the understudy log share price series, all the series are non-stationary being I(1) except for two series in Financial Services Sector. Hence overall the null hypothesis of unit root cannot be rejected, on the basis of the ADF test results all the series qualify for Cointegration analysis under the EG two step approach.

In this study, Long run relationship has been assessed through EG Cointegration approach for all the potential trading pairs in Commercial Banks and Financial Service Sector listed on the Karachi Stock Exchange. In the EG two step approach, the Stationarity of the residual series, estimated through the OLS regression, when applied to two non-stationary log share price series, has been tested. Table 5 and Table 6 in Appendix IV contains the result of EG Cointegration tests for Commercial Banks and Financial Services Sector respectively. For each trading pair EG Cointegrating regression estimated residual series has been tested for Stationarity using the ADF test and the p-values have been reported. In Commercial Banks Sector out of the 231 potential trading pairs 60 pairs were found out to be cointegrated as reported in Table 5. P-values reported in Table 5 indicate the rejection of unit root null hypothesis. Similarly Table 6 reports the EG Cointegration rest results for Financial Services Sector indicating that out of 156 potential trading pairs 77 were found out to be cointegrated as the p-values reported in Table 6 rejected the unit root null hypothesis at the significance level of 1 percent, 5 percent and 10 percent.

For all the cointegrated pairs, revealed in both Commercial Banks and Financial Services Sector, a long run equilibrium relationship can be inferred as meaningful and statistically significant. In order to assess the direction of causality or the order of cointegrating regression for all the cointegrated pairs in Commercial Banks and Financial Services Sector granger causality results have been reported in the next sub section.

4.2. Results of Granger Causality Test

For 60 cointegrated pairs in Commercial Banks sector and 77 cointegrated pairs in Financial Services Sector granger causality has been tested in this sub section. This will provide an insight into the dynamics of the cointegrated pairs through describing which share price series in a cointegrated pairs informationally leads the other series. Table 7 and Table 8 in Appendix V provide pair-wise granger causality test results for each cointegrated pairs in Commercial Banks and Financial Services Sector respectively. For every trading pair two null hypotheses have been tested and reported along with the p-values in Table 7 and Table 8. The acceptance or rejection of the null hypothesis determines the direction of causality in each trading pair.

For instance, in Commercial Bank Sector pair-wise granger causality test results for BAFL/BOK depict bi-directional causality as both the null hypotheses have been rejected. Same is found out to be true for ABL/UBL pair. However in case of HBL/HMB pair, both the null hypotheses have been accepted indicating no causal relationship between the two return series.

Analysing the granger causality results (see Table 7) for ABL/BOK pair, it can be inferred that BOK granger causes ABL whereas ABL does not granger causes BOK. Such inferences are based on the p-values of both the null hypotheses. This is an evidence of unidirectional causality exhibiting that BOK leads ABL. Similarly in Financial Services Sector unidirectional causality has been reported in FDIBL/FCSC pair for which the null hypothesis stating that FDIBL does not granger causes FCSC is accepted as its p-value > 0.05. However null hypothesis stating FCSC does not granger causes FDIBL is rejected with the p-value < 0.05. This is again an evidence of unidirectional causality.

Out of the 60 cointegrated pairs in Commercial Bank Sector 25 pairs reported unidirectional causality. Similarly in Financial Services Sector 40 pairs reported unidirectional causality. Since in this study, the idea is to form a long/short two asset portfolio with one asset leading the other, therefore only the pairs demonstrating unidirectional causality have been considered for further analysis. 35 pairs from Commercial Bank Sector and 37 pairs from Financial Services Sector have been excluded from the analysis either due to no causality or bi-directional causality.

4.3. Estimation of Directional Regression and Residual Spread Stationarity

After identifying the direction of causality, in this section cointegrating direction regression equation has been estimated and the estimated residual series is tested for stationarity. This step of the methodology strives to confirm the long term equilibrium relationship between the trading pairs depicting unidirectional causality. Since it is a cointegrating regression, OLS estimator has been applied on two non-stationary log share price series for which the stationarity of the estimated residual series has been ensured through the ADF test. Table 9 and Table 10 contain cointegrating directional regression results for commercial banks and financial services sector respectively.

Continuing the BAHL/FABL pair from the Commercial Banks Sector, the cointegrating coefficient estimated through the cointegrating regression is 0.5812 (see Table 9 in Appendix VI). The cointegrating coefficient is significant and can be interpreted as the number of units of FABL held short for every one unit of ABL held long so that the resulting portfolio is mean reverting. The value of the portfolio is given by [C+e_t] exhibiting an equilibrium value of 23.61016 (see Table 9 in Appendix VI). Fluctuations in the portfolio value around its equilibrium value are governed by the deviations in e_t. Here it can be inferred that the behaviour of e_t dictates the behaviour of the total portfolio value. For a meaningfully cointegrated pair of share price series, it is critical for e_t to be stationary as only then the dynamic behaviour of e_t will depict strong levels of mean reversion. Stationarity of e_t ensuring mean reversion is a necessary condition for a successful pairs trading strategy. Table 9 also provides the ADF test statistics along with its p-value for residual series estimated through the cointegrating regression of BAHL/FABL pair. For BAHL/FABL pair residual series, the unit root null hypothesis has been rejected at the significance level of 5 percent hence confirming the existence of a long run equilibrium relationship between BAHL/FABL. Similarly in the Financial Services Sector, the cointegrating regression for FDIBL/FCSC pair exhibits a cointegrating coefficient of 0.1910 indicating the number of FCSC units to be held short for every one unit of FDIBL held long. The portfolio has an equilibrium value of 0.9069 and any deviations in the equilibrium value are governed by deviations in e_t as the estimated residual series is reported to be stationary and mean reverting on the basis of the ADF test results.

The strong evidences of long term equilibrium relationship and mean reversion revealed by the results of the cointegrating directional regression lead the discussion towards estimating error correction model in order to understand the short term dynamics of the cointegrated variables.

4.4. Validation Short Term Deviations through VECM

In this subsection, the error component has been modelled using Vector Error Correction Model (VECM) for which the results are given in Table 11 and Table 12 for Commercial Banks and Financial Services sector respectively. For VECM, log differences of stock prices have been employed. Table 11 and Table 12 also include Long run β Coefficient and its [t-statistic] for each cointegrated pair. Speed of Adjustment Coefficients $\gamma 1$ and $\gamma 2$ are also given along with their [t-statistic].

The VECM results for Commercial Banks Sector indicate that at least one of the speed of adjustment coefficients is statistically significant confirming the existence of cointegrating relationship as reported in the previous subsection. VECM results for BAHL/FABL pair, of Commercial Banks, depict a significant long run β coefficient confirming the granger causality results and indicating that FABL granger causes BAHL. Furthermore for BAHL/FABL pair, both the speed of adjustment coefficients is statistically significant having opposite signs. This indicates that both the stocks in the pair respond towards the exogenous shocks to restore the equilibrium position of the portfolio however their response is opposite to each other. Similarly for ABL/BOK, both the speed of adjustment coefficients is significant having same signs (see Table 11 in Appendix VII). According to the reported results $\gamma 1$ (–0.0599) and $\gamma 2$ (–0.0025) is significant at 5 percent. For ABL/BOK pair speed of adjustment coefficients depict same sign which indicates that in response to a shock, ABL and BOK move in the same direction however ABL moves faster than BOK on the basis of larger size of its $\gamma 1$ coefficient in order to restore the equilibrium. Considering the case of NBP/BAHL pair, there is a significant long run β coefficient confirming the granger causality results and indicating that BAHL leads NBP and confirms the long term equilibrium relationship. For NBP/BAHL pair, one speed of adjustment coefficient is found out to be significant ($\gamma 1$=-6.13575) indicating that in case of disequilibrium and short term shocks NBP responds to restore the equilibrium.

Considering KASBSL/JSIL pair from the Financial Services Sector, the VECM results in Table 12 report a significant long term β coefficient confirming the cointegrating relationship however none of the speed of adjustment coefficients are statistically different from zero. In this case it can be inferred that although KASBSL and JSIL report a long run equilibrium relationship yet there is no term in the model that responds to restore the model to some equilibrium level after experiencing short term deviations. For such pairs in pairs trading mean reversion is not possible.

Therefore on the basis of the VECM results it can be recommended that only those cointegrated pairs must be traded for which either one or both speed of adjustment coefficients are significant having correct signs and are large enough to generate faster response for restoring equilibrium after short term shocks.

5. CONCLUSION

In this study an attempt has been made to answer a primary question in pairs trading strategy being; which pairs of stocks should we trade? In order to answer this question, the study has focused on cointegration analysis for ensuring mean reversion in the selected pairs. For a successful pairs trading strategy it is imperative that a trading pair must depict long run equilibrium relationship as well as short run relationship ensuring mean reversion. Here mean reversion is imperative due to the fact that if any divergence from equilibrium position creates an arbitrage opportunity and a trade is opened, then there must be convergence in order to restore the equilibrium and close the trade to earn arbitrage profits. This can only be achieved with pairs that depict a long run equilibrium relationship as well as also respond to the short term deviations due to exogenous shocks.

The focus of the study remained Commercial Banks and Financial Services Sector in Karachi Stock Exchange and formed 231 restricted pairs in Commercial Banks sector and 156 restricted pairs were formed in Financial Services sector. The alternate hypothesis of long run equilibrium relationship between stocks in pair is found out to be true for 60 pairs in Commercial Banks sector and for 77 pairs in Financial Services sector under the EG 2 step Cointegration approach. In order to further confirm the cointegration relationship, direction of causality has also been assessed through Granger Causality test revealing 25 trading pairs in Commercial Banks demonstrating unidirectional causality whereas 40 pairs depicted unidirectional causality in Financial Services sector. For all the cointegrating pairs, a long run directional regression has been estimated and the regression residuals have been tested for stationarity in order confirm the long run equilibrium relationship. Later for all the cointegrating pairs, the residual is modeled through employing the VECM in order to ensure that at least one of the two speed of adjustment coefficients is significant so that mean reversion can be expected in a pair. The methodology for pairs selection proposed in this study works through forming restricted pairs of highly liquid stocks and ensures the existence of long term as well as short term equilibrium relationship between stocks in a pair. In doing so this methodology responds to a major risk factor in pairs trading being absence of co movement or long run relationship between stocks in a pair. The pairs formed under this methodology depict long run relationship as well as short term corrections to the random shocks experienced and are capable of executing a profitable pairs trading strategy.

The scope of this study has remained limited to proposing and empirically testing the pairs selection technique within the context of Karachi Stock Exchange. The scope of the study did not include assessing the profitability of pairs trading in Karachi Stock Exchange which should be the next research endeavour. Future research attempts can be made through expanding the scope to other sectors of Karachi Stock Exchange. Further the proposed pair's selection technique should be employed for pairs trading in Karachi Stock Exchange.

6. PRACTICAL IMPLICATION OF THE STUDY

This study focuses upon a comprehensive application of pairs trading strategy within the context of Pakistan. The pairs trading strategy as a hedge fund strategy is new to the emerging equity market of Pakistan. Through this research the application of pairs trading investment strategy in Pakistan will help in broadening the investment horizon of the local investors. Although short selling is not allowed in Pakistan which is the primary assumption of the pairs trading strategy yet it can be based on the assumption that the stocks can be sold short. Therefore this study tends to challenge the restricted short selling policy in the equity market of Pakistan.

APPENDIX I

Table 1

List of Companies

Table 1 contains a List of companies included in the study pertaining to Commercial Banks and the Financial Services sector. For each company given in the Table 1, a symbol is also given as quoted in Karachi Stock Exchange. Later in the analysis, these companies will be referred to using these symbols

Commercial Banks		Financial Services Sector	
Symbol	Company Name	Symbol	Company Name
ABL	Allied Bank Limited	AHL	Arif Habib Limited
AKBL	Askari Bank Limited	DEL	Dawood Equities Limited
BAFL	Bank Al-Falah Limited	ESBL	Escorts Investment Bank Limited
BAHL	Bank Al-Habib Limited	FCSC	First Capital Securities Corporation Limited
BOK	Bank Of Khyber Limited	FDIBL	First Dawood Investment Bank Limited
BOP	Bank Of Punjab Limited	FNEL	First National Equities Limited
BIPL	Bankislami Pakistan Limited	GRYL	Grays Leasing Limited
FABL	Faysal Bank Limited	IGIBL	IGI Investment Bank Limited
HBL	Habib Bank Limited	JSGCL	JS Global Capital Limited
HMB	Habib Metropolitan Bank Limited	JSIL	JS Investments Limited
JSBL	JS Bank Limited	JSCL	Jahangir Siddiqui Company Limited
KASBB	KASB Bank Limited	KASBSL	KASB Securities Limited
MCB	MCB Bank Limited	MCBAH	MCB-ARIF Habib Savings & Investments Ltd
MEBL	Meezan Bank Limited	OLPL	Orix Leasing Pakistan Limited
NIB	NIB Bank Limited	PASL	Pervez Ahmed Securities Limited
NBP	National Bank of Pakistan	SPLC	Saudi Pak Leasing Company Limited
SBL	Samba Bank Limited	SIBL	Security Investment Bank Limited
SILK	Silkbank Limited	SCLL	Standard Chartered Leasing Limited
SNBL	Soneri Bank Limited	TRIBL	Trust Investment Bank Limited
SCBPL	Standard Chartered Bank Limited		
SMBL	Summit Bank Limited		
UBL	United Bank Limited		

APPENDIX II

Table 2

Augmented Dickey Fuller (ADF) Test Results for Log Price Series

Table 2 contains ADF test results of log prices in order to ensure that the price series qualifies the condition of non-Stationarity for the Cointegration analysis. Table 2 provides the tau-statistic for the ADF test along with the relevant p-values given in parenthesis

Commercial Banks		Financial Services Sector	
Symbol	tau-Statistic (p-value)	Symbol	tau-Statistic (p-value)
ABL	–0.12981 (0.22445)	AHL	–1.79456 (0.3837)
AKBL	–2.07698 (0.2542)	DEL	–1.97609 (0.2977)
BAFL	–1.11167 (0.7136)	ESBL	–1.81009 (0.376)
BAHL	–1.41394 (0.51052)	FCSC	–2.38769 (0.1452)
BOK	–1.4434 (0.5624)	FDIBL	–2.23861 (0.1926)
BOP	–1.79736 (0.3823)	FNEL	–1.7598 (0.401)
BIPL	–1.09327 (0.7208)	GRYL	–1.92371 (0.3216)
FABL	–1.68157 (0.4407)	IGIBL	–2.36111 (0.153)
HBL	–1.01707 (0.33335)	JSGCL	–2.33763 (0.1601)
HMB	–2.44617 (0.1291)	JSIL	–2.36966 (0.1505)
JSBL	–1.50221 (0.5327)	JSCL	–2.14956 (0.2253)
KASBB	–2.22589 (0.1971)	KASBSL	–2.38842 (0.145)
MCB	–2.29299 (0.1743)	MCBAH	–2.72558 (0.06965***)
MEBL	–1.36619 (0.6005)	OLPL	0.170826 (0.9708)
NIB	–1.5681 (0.499)	PASL	–1.72358 (0.4193)
NBP	–2.04519 (0.2675)	SPLC	–0.928116 (0.7799)
SBL	–2.03015 (0.2739)	SIBL	–0.750174 (0.8322)
SILK	–2.27314 (0.1808)	SCLL	–2.25135 (0.1882)
SNBL	–2.5003 (0.1153)	TRIBL	–2.72648 (0.0695***)
SCBPL	–0.0529857 (0.9526)		
SMBL	–1.92746 (0.3198)		
UBL	–0.512045 (0.8866)		

* Significant at 1 percent, **Significant at 5 percent, ***Significant at 10 percent.

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APPENDIX III

Table 3

List of Trading Pairs for Commercial Banks

Table 3 provides a list of pairs for Commercial Banks Sector. Using 22 sampled Commercial Banks, 231 pairs have been formed employing the following formula $No.of\ Stock\ Pairs = (N^2 - N)/2$, N is the number of sampled Commercial Banks. Relevant symbols have been used to represent a specific Commercial Bank in a pair.

1	BAFL/BAHL	31	BAHL/KASBB	61	AKBL/BOK	91	BOK/UBL	121	BIPL/SBL	151	HBL/SCBPL	181	KASBB/SBL	211	NIB/SBL
2	BAFL/ABL	32	BAHL/MCB	62	AKBL/BOP	92	BOK/SMBL	122	BIPL/UBL	152	HBL/SILK	182	KASBB/UBL	212	NIB/UBL
3	BAFL/AKBL	33	BAHL/MEBL	63	AKBL/BIPL	93	BOK/SCBPL	123	BIPL/SMBL	153	HBL/SNBL	183	KASBB/SMBL	213	NIB/SMBL
4	BAFL/BOK	34	BAHL/NBP	64	AKBL/FABL	94	BOK/SILK	124	BIPL/SCBPL	154	HMB/JSBL	184	KASBB/SCBPL	214	NIB/SCBPL
5	BAFL/BOP	35	BAHL/NIB	65	AKBL/HBL	95	BOK/SNBL	125	BIPL/SILK	155	HMB/KASBB	185	KASBB/SILK	215	NIB/SILK
6	BAFL/BIPL	36	BAHL/SBL	66	AKBL/HMB	96	BOP/BIPL	126	BIPL/SNBL	156	HMB/MCB	186	KASBB/SNBL	216	NIB/SNBL
7	BAFL/FABL	37	BAHL/UBL	67	AKBL/JSBL	97	BOP/FABL	127	FABL/HBL	157	HMB/MEBL	187	MCB/MEBL	217	SBL/UBL
8	BAFL/HBL	38	BAHL/SMBL	68	AKBL/KASBB	98	BOP/HBL	128	FABL/HMB	158	HMB/NBP	188	MCB/NBP	218	SBL/SMBL
9	BAFL/HMB	39	BAHL/SCBPL	69	AKBL/MCB	99	BOP/HMB	129	FABL/JSBL	159	HMB/NIB	189	MCB/NIB	219	SBL/SCBPL
10	BAFL/JSBL	40	BAHL/SILK	70	AKBL/MEBL	100	BOP/JSBL	130	FABL/KASBB	160	HMB/SBL	190	MCB/SBL	220	SBL/SILK
11	BAFL/KASBB	41	BAHL/SNBL	71	AKBL/NBP	101	BOP/KASBB	131	FABL/MCB	161	HMB/UBL	191	MCB/UBL	221	SBL/SNBL
12	BAFL/MCB	42	ABL/AKBL	72	AKBL/NIB	102	BOP/MCB	132	FABL/MEBL	162	HMB/SMBL	192	MCB/SMBL	222	UBL/SMBL
13	BAFL/MEBL	43	ABL/BOK	73	AKBL/SBL	103	BOP/MEBL	133	FABL/NBP	163	HMB/SCBPL	193	MCB/SCBPL	223	UBL/SCBPL
14	BAFL/NBP	44	ABL/BOP	74	AKBL/UBL	104	BOP/NBP	134	FABL/NIB	164	HMB/SILK	194	MCB/SILK	224	UBL/SILK
15	BAFL/NIB	45	ABL/BIPL	75	AKBL/SMBL	105	BOP/NIB	135	FABL/SBL	165	HMB/SNBL	195	MCB/SNBL	225	UBL/SNBL
16	BAFL/SBL	46	ABL/FABL	76	AKBL/SCBPL	106	BOP/SBL	136	FABL/UBL	166	JSBL/KASBB	196	MEBL/NBP	226	SMBL/SCBPL
17	BAFL/UBL	47	ABL/HBL	77	AKBL/SILK	107	BOP/UBL	137	FABL/SMBL	167	JSBL/MCB	197	MEBL/NIB	227	SMBL/SILK
18	BAFL/SMBL	48	ABL/HMB	78	AKBL/SNBL	108	BOP/SMBL	138	FABL/SCBPL	168	JSBL/MEBL	198	MEBL/SBL	228	SMBL/SNBL
19	BAFL/SCBPL	49	ABL/JSBL	79	BOK/BOP	109	BOP/SCBPL	139	FABL/SILK	169	JSBL/NBP	199	MEBL/UBL	229	SCBPL/SILK
20	BAFL/SILK	50	ABL/KASBB	80	BOK/BIPL	110	BOP/SILK	140	FABL/SNBL	170	JSBL/NIB	200	MEBL/SMBL	230	SCBPL/SNBL
21	BAFL/SNBL	51	ABL/MCB	81	BOK/FABL	111	BOP/SNBL	141	HBL/HMB	171	JSBL/SBL	201	MEBL/SCBPL	231	SILK/SNBL
22	BAHL/ABL	52	ABL/MEBL	82	BOK/HBL	112	BIPL/FABL	142	HBL/JSBL	172	JSBL/UBL	202	MEBL/SILK		
23	BAHL/AKBL	53	ABL/NBP	83	BOK/HMB	113	BIPL/HBL	143	HBL/KASBB	173	JSBL/SMBL	203	MEBL/SNBL		
24	BAHL/BOK	54	ABL/NIB	84	BOK/JSBL	114	BIPL/HMB	144	HBL/MCB	174	JSBL/SCBPL	204	NBP/NIB		
25	BAHL/BOP	55	ABL/SBL	85	BOK/KASBB	115	BIPL/JSBL	145	HBL/MEBL	175	JSBL/SILK	205	NBP/SBL		
26	BAHL/BIPL	56	ABL/UBL	86	BOK/MCB	116	BIPL/KASBB	146	HBL/NBP	176	JSBL/SNBL	206	NBP/UBL		
27	BAHL/FABL	57	ABL/SMBL	87	BOK/MEBL	117	BIPL/MCB	147	HBL/NIB	177	KASBB/MCB	207	NBP/SMBL		
28	BAHL/HBL	58	ABL/SCBPL	88	BOK/NBP	118	BIPL/MEBL	148	HBL/SBL	178	KASBB/MEBL	208	NBP/SCBPL		
29	BAHL/HMB	59	ABL/SILK	89	BOK/NIB	119	BIPL/NBP	149	HBL/UBL	179	KASBB/NBP	209	NBP/SILK		
30	BAHL/JSBL	60	ABL/SNBL	90	BOK/SBL	120	BIPL/NIB	150	HBL/SMBL	180	KASBB/NIB	210	NBP/SNBL		

Table 4

List of Trading Pairs for Financial Services Sector

Table 4 provides a list of pairs for Financial Sector. Using 19 sampled Financial Services companies, 156 pairs have been formed employing the following formula,

$No. of\ Stock\ Pairs = \frac{N^2 - N}{2}$, N is the number of sampled Financial Services Companies. Relevant symbols have been used to represent a specific Financial Services Company in a pair.

1	FDIBL/AHL	31	DEL/ESBL	61	GRYL/FCSC	91	JSCL/SPLC	121	JSIL/SPLC		
2	FDIBL/DEL	32	DEL/GRYL	62	GRYL/JSIL	92	JSCL/SIBL	122	JSIL/SIBL		
3	FDIBL/IGIBL	33	DEL/IGIBL	63	GRYL/JSGCL	93	JSCL/TRIBL	123	JSIL/TRIBL		
4	FDIBL/JSCL	34	DEL/JSCL	64	GRYL/KASBSL	94	FNEL/FCSC	124	JSGCL/KASBSL		
5	FDIBL/FNEL	35	DEL/FNEL	65	GRYL/OLPL	95	FNEL/JSIL	125	JSGCL/MCBAH		
6	FDIBL/FCSC	36	DEL/FCSC	66	GRYL/PASL	96	FNEL/JSGCL	126	JSGCL/OLPL		
7	FDIBL/JSIL	37	DEL/JSIL	67	GRYL/SCLL	97	FNEL/KASBSL	127	JSGCL/PASL		
8	FDIBL/JSGCL	38	DEL/JSGCL	68	GRYL/SPLC	98	FNEL/MCBAH	128	JSGCL/SCLL		
9	FDIBL/KASBSL	39	DEL/KASBSL	69	IGIBL/JSCL	99	FNEL/OLPL	129	JSGCL/SPLC		
10	FDIBL/OLPL	40	DEL/MCBAH	70	IGIBL/FNEL	100	FNEL/PASL	130	JSGCL/SIBL	151	PASL/TRIBL
11	FDIBL/PASL	41	DEL/OLPL	71	IGIBL/FCSC	101	FNEL/SCLL	131	JSGCL/TRIBL	152	SCLL/SPLC
12	FDIBL/SCLL	42	DEL/PASL	72	IGIBL/JSIL	102	FNEL/SPLC	132	KASBSL/MCBAH	153	SCLL/SIBL
13	FDIBL/SPLC	43	DEL/SCLL	73	IGIBL/JSGCL	103	FNEL/SIBL	133	KASBSL/OLPL	154	SCLL/TRIBL
14	AHL/DEL	44	DEL/SPLC	74	IGIBL/KASBSL	104	FNEL/TRIBL	134	KASBSL/PASL	155	SPLC/SIBL
15	AHL/ESBL	45	DEL/SIBL	75	IGIBL/MCBAH	105	FCSC/JSIL	135	KASBSL/SCLL	156	SPLC/TRIBL
16	AHL/GRYL	46	DEL/TRIBL	76	IGIBL/OLPL	106	FCSC/JSGCL	136	KASBSL/SPLC		
17	AHL/IGIBL	47	ESBL/IGIBL	77	IGIBL/PASL	107	FCSC/KASBSL	137	KASBSL/SIBL		
18	AHL/JSCL	48	ESBL/JSCL	78	IGIBL/SCLL	108	FCSC/MCBAH	138	KASBSL/TRIBL		
19	AHL/FNEL	49	ESBL/FNEL	79	IGIBL/SPLC	109	FCSC/OLPL	139	MCBAH/OLPL		
20	AHL/FCSC	50	ESBL/FCSC	80	IGIBL/SIBL	110	FCSC/PASL	140	MCBAH/PASL		
21	AHL/JSIL	51	ESBL/JSIL	81	IGIBL/TRIBL	111	FCSC/SCLL	141	MCBAH/SCLL		
22	AHL/JSGCL	52	ESBL/JSGCL	82	JSCL/FNEL	112	FCSC/SPLC	142	MCBAH/SPLC		
23	AHL/KASBSL	53	ESBL/KASBSL	83	JSCL/FCSC	113	FCSC/SIBL	143	OLPL/PASL		
24	AHL/MCBAH	54	ESBL/OLPL	84	JSCL/JSIL	114	FCSC/TRIBL	144	OLPL/SCLL		
25	AHL/OLPL	55	ESBL/PASL	85	JSCL/JSGCL	115	JSIL/JSGCL	145	OLPL/SPLC		
26	AHL/PASL	56	ESBL/SCLL	86	JSCL/KASBSL	116	JSIL/KASBSL	146	OLPL/SIBL		
27	AHL/SCLL	57	ESBL/SPLC	87	JSCL/MCBAH	117	JSIL/MCBAH	147	OLPL/TRIBL		
28	AHL/SPLC	58	GRYL/IGIBL	88	JSCL/OLPL	118	JSIL/OLPL	148	PASL/SCLL		
29	AHL/SIBL	59	GRYL/JSCL	89	JSCL/PASL	119	JSIL/PASL	149	PASL/SPLC		
30	AHL/TRIBL	60	GRYL/FNEL	90	JSCL/SCLL	120	JSIL/SCLL	150	PASL/SIBL		

APPENDIX IV

Table 5

Cointegration Results for Commercial Banks

Table 5 contains the Engle-Granger (EG) Cointegration test results for Commercial Banks. For each trading pairs, Engle-Granger Cointegrating Regression error has been tested for Stationarity using the ADF test and the p-values have been reported in the table below

	Trading Pairs	EG (p-value)		Trading Pairs	EG (p-value)		Trading Pairs	EG (p-value)		Trading Pairs	EG (p-value)
1	BAFL/BOK	0.008789*	19	ABL/MEBL	0.02807**	39	FABL/SMBL	0.09897***	57	MEBL/UBL	0.0918***
2	BAFL/MEBL	0.02299**	20	ABL/SBL	0.9959***	40	FABL/SILK	0.01807*	56	NBP/SILK	0.09046***
3	BAHL/AKBL	0.04425**	21	ABL/UBL	0.08923***	41	HBL/HMB	0.05596**	57	NIB/SNBL	0.0697***
4	BAHL/BOP	0.06455***	22	ABL/SCBPL	0.04085**	42	HBL/JSBL	0.06623***	58	SBL/SNBL	0.01072**
5	BAHL/BIPL	0.0918***	23	AKBL/KASBB	0.08669***	43	HBL/KASBB	0.06546***	59	UBL/SCBPL	0.000009841*
6	BAHL/FABL	0.002668*	24	AKBL/NIB	0.02887**	44	HBL/MCB	0.09504***	60	SMBL/SILK	0.003712*
7	BAHL/HMB	0.0003476*	25	AKBL/SBL	0.05104***	45	HBL/MEBL	0.06476***			
8	BAHL/KASBB	0.0411**	26	AKBL/SNBL	0.08551***	46	HBL/NBP	0.08939***			
9	BAHL/MEBL	0.0358**	27	BOK/BIPL	0.02936**	47	HBL/NIB	0.06438***			
10	BAHL/NBP	0.001183*	28	BOK/MEBL	0.001175*	48	HBL/SMBL	0.07491***			
11	BAHL/NIB	0.02914**	29	BOK/SCBPL	0.01992*	49	HMB/NBP	0.01724**			
12	BAHL/SMBL	0.04305**	30	BOP/KASBB	0.004174*	50	HMB/SILK	0.05437***			
13	BAHL/SCBPL	0.04955**	31	BOP/NIB	0.009164*	51	KASBB/NIB	0.001719*			
14	BAHL/SILK	0.02161**	32	BOP/SBL	0.02544**	52	KASBB/SBL	0.0724***			
15	BAHL/SNBL	0.0681***	33	BOP/SNBL	0.07581***	53	KASBB/SILK	0.08409***			
16	ABL/BOK	0.02138**	34	BIPL/JSBL	0.01882*	54	KASBB/SNBL	0.04456**			
17	ABL/BIPL	0.0274**	35	BIPL/MEBL	0.05611**						
18	ABL/JSBL	0.03491**	36	FABL/HMB	0.00924*						
			37	FABL/NBP	0.0007933*						
			38	FABL/NIB	0.04268**						

* Significant at 1 percent, **Significant at 5 percent, ***Significant at 10 percent.

Table 6

Cointegration Results for Financial Services Sector

Table 6 contains the Engle-Granger (EG) Cointegration test results for Financial Services Sector. For each trading pairs, Engle-Granger Cointegrating Regression error has been tested for Stationarity using the ADF test and the p-values have been reported in the table below.

Trading Pairs	EG p-value	Trading Pairs	EG p-value	Trading Pairs	EG p-value	Trading Pairs	EG p-value	Trading Pairs	EG p-value
1 FDIBL/AHL	0.0056*	19 DEL/JSCL	0.00001903*	35 GRYL/IGIBL	0.00064*	53 IGIBL/TRIBL	0.09656***	71 MCBAH/SPLC	0.08559***
2 FDIBL/DEL	0.0000*	20 DEL/FNEL	0.03626**	36 GRYL/JSCL	0.00080*	54 JSCL/JSIL	0.0026*	72 OLPL/SCLL	0.00000*
3 FDIBL/IGIBL	9.147e-05*	21 DEL/FCSC	0.00000*	37 GRYL/FNEL	0.0001*	55 JSCL/JSGCL	0.0384**	73 PASL/SPLC	0.03601**
4 FDIBL/JSCL	0.001359*	22 DEL/JSIL	0.0001*	38 GRYL/FCSC	0.00066*	56 JSCL/KASBSL	0.03866**	74 PASL/SIBL	0.02605**
5 FDIBL/FNEL	0.02285**	23 DEL/JSGCL	0.00000*	39 GRYL/JSIL	0.00076*	57 FCSC/JSGCL	0.006474*	75 PASL/TRIBL	0.0587***
6 FDIBL/FCSC	0.0001264*	24 DEL/KASBSL	0.00000*	40 GRYL/JSGCL	0.00082*	58 FCSC/KASBSL	0.01155*	76 SCLL/SIBL	0.07853***
7 FDIBL/JSIL	0.001275*	25 DEL/PASL	0.00000*	41 GRYL/KASBSL	0.00044*	59 FCSC/PASL	0.06795***	77 SPLC/SIBL	0.00051*
8 FDIBL/JSGCL	0.001362*	26 DEL/SIBL	0.02753**	42 GRYL/OLPL	0.00038*	60 FCSC/SIBL	0.09751***		
9 FDIBL/KASBSL	0.00007*	27 DEL/TRIBL	0.0009031*	43 GRYL/PASL	0.00048*	61 FCSC/TRIBL	0.0001118*		
10 FDIBL/PASL	0.00011*	28 ESBL/JSCL	0.00248*	44 GRYL/SCLL	0.00064*	62 JSIL/JSGCL	0.04554**		
11 FDIBL/SCLL	0.06495***	29 ESBL/FNEL	0.03565**	45 GRYL/SPLC	0.00000*	63 JSIL/KASBSL	0.02953**		
12 FDIBL/SPLC	0.00976*	30 ESBL/FCSC	0.0001*	46 IGIBL/JSCL	0.00163*	64 JSGCL/KASBSL	0.03947**		
13 AHL/DEL	0.00074*	31 ESBL/JSGCL	0.00053*	47 IGIBL/FNEL	0.08451***	65 JSGCL/PASL	0.07957***		
14 AHL/ESBL	0.05041***	32 ESBL/KASBSL	0.00006*	48 IGIBL/FCSC	0.02687**	66 JSGCL/TRIBL	0.03619**		
15 AHL/FCSC	0.05804***	33 ESBL/OLPL	0.07936***	49 IGIBL/JSIL	0.0005128*	67 KASBSL/SPLC	0.04196**		
16 AHL/KASBSL	0.08265*	34 ESBL/PASL	0.00001*	50 IGIBL/JSGCL	0.02714**	68 KASBSL/SIBL	0.03391**		
17 DEL/ESBL	0.00002*			51 IGIBL/KASBSL	0.009774*	69 KASBSL/TRIBL	0.007249*		
18 DEL/IGIBL	0.00005*			52 IGIBL/SIBL	0.05003***	70 MCBAH/SCLL	0.04695**		

* Significant at 1 percent, **Significant at 5 percent, ***Significant at 10 percent.

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Appendix V

Table 7

Pair-wise Granger Causality Test Results for Commercial Banks

Table 7 provides pair-wise Granger Causality Test Results, for each cointegrated trading pair of Commercial Banks identified in Table 5. For every trading pair two null hypotheses have been given along with their p-values. The acceptance or rejection of the null hypothesis determines the direction of causality in each trading pair.

	Trading Pairs	Direction of Causality (Null Hypothesis)	p-value	Direction of Causality (Null Hypothesis)	p-value
1	BAFL/BOK	BAFL does not Granger Cause BOK	0.045**	BOK does not Granger Cause BAFL	0.005*
2	BAFL/MEBL	MEBL does not Granger Cause BAFL	0.007*	BAFL does not Granger Cause MEBL	0.049**
3	BAHL/AKBL	AKBL does not Granger Cause BAHL	0.392	BAHL does not Granger Cause AKBL	0.643
4	BAHL/BOP	BOP does not Granger Cause BAHL	0.159	BAHL does not Granger Cause BOP	0.509
5	BAHL/BIPL	BIPL does not Granger Cause BAHL	0.738	BAHL does not Granger Cause BIPL	0.551
6	BAHL/FABL	FABL does not Granger Cause BAHL	0.005*	BAHL does not Granger Cause FABL	0.933
7	BAHL/HMB	BAHL does not Granger Cause HMB	0.369	HMB does not Granger Cause BAHL	0.001*
8	BAHL/KASBB	KASBB does not Granger Cause BAHL	0.017**	BAHL does not Granger Cause KASBB	0.259
9	BAHL/MEBL	MEBL does not Granger Cause BAHL	0.118	BAHL does not Granger Cause MEBL	0.218
10	BAHL/NBP	BAHL does not Granger Cause NBP	0.000*	NBP does not Granger Cause BAHL	0.562
11	BAHL/NIB	NIB does not Granger Cause BAHL	0.033**	BAHL does not Granger Cause NIB	0.957
12	BAHL/SMBL	SMBL does not Granger Cause BAHL	0.026**	BAHL does not Granger Cause SMBL	0.692
13	BAHL/SCBPL	SCBPL does not Granger Cause BAHL	0.266	BAHL does not Granger Cause SCBPL	0.18
14	BAHL/SILK	BAHL does not Granger Cause SILK	0.355	SILK does not Granger Cause BAHL	0.076***
15	BAHL/SNBL	BAHL does not Granger Cause SNBL	0.191	SNBL does not Granger Cause BAHL	0.037**
16	ABL/BOK	ABL does not Granger Cause BOK	0.475	BOK does not Granger Cause ABL	0.001*
17	ABL/BIPL	ABL does not Granger Cause BIPL	0.892	BIPL does not Granger Cause ABL	0.027**
18	ABL/JSBL	JSBL does not Granger Cause ABL	0.003*	ABL does not Granger Cause JSBL	0.757
19	ABL/MEBL	MEBL does not Granger Cause ABL	0.010**	ABL does not Granger Cause MEBL	0.735
20	ABL/SBL	SBL does not Granger Cause ABL	0.883	ABL does not Granger Cause SBL	0.522
21	ABL/UBL	ABL does not Granger Cause UBL	0.020**	UBL does not Granger Cause ABL	0.010**
22	ABL/SCBPL	ABL does not Granger Cause SCBPL	0.061***	SCBPL does not Granger Cause ABL	0.038**
23	AKBL/KASBB	KASBB does not Granger Cause AKBL	0.012**	AKBL does not Granger Cause KASBB	0.031**
24	AKBL/NIB	NIB does not Granger Cause AKBL	0.252	AKBL does not Granger Cause NIB	0.033**
25	AKBL/SBL	SBL does not Granger Cause AKBL	0.647	AKBL does not Granger Cause SBL	0.018**
26	AKBL/SNBL	SNBL does not Granger Cause AKBL	0.106	AKBL does not Granger Cause SNBL	0.359
27	BOK/BIPL	BOK does not Granger Cause BIPL	0.000*	BIPL does not Granger Cause BOK	0.213
28	BOK/MEBL	MEBL does not Granger Cause BOK	0.038**	BOK does not Granger Cause MEBL	0.004*
29	BOK/SCBPL	SCBPL does not Granger Cause BOK	0.055***	BOK does not Granger Cause SCBPL	0.068*
30	BOP/KASBB	KASBB does not Granger Cause BOP	0.000*	BOP does not Granger Cause KASBB	0.037**
31	BOP/NIB	NIB does not Granger Cause BOP	0.019**	BOP does not Granger Cause NIB	0.017**
32	BOP/SBL	SBL does not Granger Cause BOP	0.049**	BOP does not Granger Cause SBL	0.005*
33	BOP/SNBL	SNBL does not Granger Cause BOP	0.020**	BOP does not Granger Cause SNBL	0.12
34	BIPL/JSBL	JSBL does not Granger Cause BIPL	0.008*	BIPL does not Granger Cause JSBL	0.028**
35	BIPL/MEBL	MEBL does not Granger Cause BIPL	0.016**	BIPL does not Granger Cause MEBL	0.131
36	FABL/HMB	HMB does not Granger Cause FABL	0.002*	FABL does not Granger Cause HMB	0.226
37	FABL/NBP	FABL does not Granger Cause NBP	0.033**	NBP does not Granger Cause FABL	0.002*
38	FABL/NIB	NIB does not Granger Cause FABL	0.000*	FABL does not Granger Cause NIB	0.390
39	FABL/SMBL	SMBL does not Granger Cause FABL	0.002*	FABL does not Granger Cause SMBL	0.773
40	FABL/SILK	SILK does not Granger Cause FABL	0.006*	FABL does not Granger Cause SILK	0.291
41	HBL/HMB	HMB does not Granger Cause HBL	0.56	HBL does not Granger Cause HMB	0.31
42	HBL/JSBL	JSBL does not Granger Cause HBL	0.263	HBL does not Granger Cause JSBL	0.351
43	HBL/KASBB	KASBB does not Granger Cause HBL	0.816	HBL does not Granger Cause KASBB	0.039**
44	HBL/MCB	MCB does not Granger Cause HBL	0.004*	HBL does not Granger Cause MCB	0.000*
45	HBL/MEBL	MEBL does not Granger Cause HBL	0.571	HBL does not Granger Cause MEBL	0.467
46	HBL/NBP	NBP does not Granger Cause HBL	0.375	HBL does not Granger Cause NBP	0.349
47	HBL/NIB	NIB does not Granger Cause HBL	0.9	HBL does not Granger Cause NIB	0.397
48	HBL/SMBL	SMBL does not Granger Cause HBL	0.981	HBL does not Granger Cause SMBL	0.384
49	HMB/NBP	NBP does not Granger Cause HMB	0.000*	HMB does not Granger Cause NBP	0.000*
50	HMB/SILK	HMB does not Granger Cause SILK	0.087***	SILK does not Granger Cause HMB	0.007*
51	KASBB/NIB	NIB does not Granger Cause KASBB	0.000*	KASBB does not Granger Cause NIB	0.001*
52	KASBB/SBL	SBL does not Granger Cause KASBB	0.001*	KASBB does not Granger Cause SBL	0.000*
53	KASBB/SILK	SILK does not Granger Cause KASBB	0.004*	KASBB does not Granger Cause SILK	0.001*
54	KASBB/SNBL	SNBL does not Granger Cause KASBB	0.195	KASBB does not Granger Cause SNBL	0.000*
55	MEBL/UBL	UBL does not Granger Cause MEBL	0.029**	MEBL does not Granger Cause UBL	0.057**
56	NBP/SILK	SILK does not Granger Cause NBP	0.034**	NBP does not Granger Cause SILK	0.591
57	NIB/SNBL	SNBL does not Granger Cause NIB	0.293	NIB does not Granger Cause SNBL	0.221
58	SBL/SNBL	SNBL does not Granger Cause SBL	0.000*	SBL does not Granger Cause SNBL	0.196
59	UBL/SCBPL	SCBPL does not Granger Cause UBL	0.000*	UBL does not Granger Cause SCBPL	0.000*

60	SMBL/SILK	SILK does not Granger Cause SMBL	0.001*	SMBL does not Granger Cause SILK	0.081**

* Significant at 1 percent, **Significant at 5 percent, ***Significant at 10 percent.

Table 8

Pair-wise Granger Causality Test Results for Financial Services Sector

Table 8 provides pair-wise Granger Causality Test Results, for each cointegrated trading pair of Financial Services Sector identified in Table 6. For every trading pair two null hypotheses have been given along with their p-values. The acceptance or rejection of the null hypothesis determines the direction of causality in each trading pair.

	Trading Pairs	Direction of Causality	p-value	Direction of Causality	p-value
1	FDIBL/AHL	FDIBL does not Granger Cause AHL	0.624	AHL does not Granger Cause FDIBL	0.00954*
2	FDIBL/DEL	FDIBL does not Granger Cause DEL	0.245	DEL does not Granger Cause FDIBL	0.00000043*
3	FDIBL/IGIBL	FDIBL does not Granger Cause IGIBL	0.023**	IGIBL does not Granger Cause FDIBL	0.01046**
4	FDIBL/JSCL	FDIBL does not Granger Cause JSCL	0.319	JSCL does not Granger Cause FDIBL	1.6E-05*
5	FDIBL/FNEL	FDIBL does not Granger Cause FNEL	0.576	FNEL does not Granger Cause FDIBL	0.02073**
6	FDIBL/FCSC	FDIBL does not Granger Cause FCSC	0.393	FCSC does not Granger Cause FDIBL	6.5E-06*
7	FDIBL/JSIL	FDIBL does not Granger Cause JSIL	0.591	JSIL does not Granger Cause FDIBL	0.0000014*
8	FDIBL/JSGCL	FDIBL does not Granger Cause JSGCL	0.091***	JSGCL does not Granger Cause FDIBL	0.00045*
9	FDIBL/KASBSL	FDIBL does not Granger Cause KASBSL	0.053***	KASBSL does not Granger Cause FDIBL	4.7E-10*
10	FDIBL/PASL	FDIBL does not Granger Cause PASL	0.001*	PASL does not Granger Cause FDIBL	1.0E-05*
11	FDIBL/SCLL	FDIBL does not Granger Cause SCLL	0.723	SCLL does not Granger Cause FDIBL	0.50789
12	FDIBL/SPLC	FDIBL does not Granger Cause SPLC	0.183	SPLC does not Granger Cause FDIBL	0.11682
13	AHL/DEL	AHL does not Granger Cause DEL	0.001*	DEL does not Granger Cause AHL	0.04378**
14	AHL/ESBL	AHL does not Granger Cause ESBL	0.016**	ESBL does not Granger Cause AHL	0.31485
15	AHL/FCSC	AHL does not Granger Cause FCSC	0.081***	FCSC does not Granger Cause AHL	0.21266
16	AHL/KASBSL	AHL does not Granger Cause KASBSL	0.202	KASBSL does not Granger Cause AHL	0.00017*
17	DEL/ESBL	ESBL does not Granger Cause DEL	0.647	DEL does not Granger Cause ESBL	0.00229*
18	DEL/IGIBL	DEL does not Granger Cause IGIBL	0.012**	IGIBL does not Granger Cause DEL	0.18355
19	DEL/JSCL	DEL does not Granger Cause JSCL	0.186	JSCL does not Granger Cause DEL	0.00000077*
20	DEL/FNEL	DEL does not Granger Cause FNEL	0.107	FNEL does not Granger Cause DEL	0.18414
21	DEL/FCSC	DEL does not Granger Cause FCSC	0.088***	FCSC does not Granger Cause DEL	2.2E-06*
22	DEL/JSIL	DEL does not Granger Cause JSIL	0.072***	JSIL does not Granger Cause DEL	0.00418*
23	DEL/JSGCL	DEL does not Granger Cause JSGCL	0.000*	JSGCL does not Granger Cause DEL	0.0000001*
24	DEL/KASBSL	DEL does not Granger Cause KASBSL	0.074***	KASBSL does not Granger Cause DEL	0.00000000014*
25	DEL/PASL	DEL does not Granger Cause PASL	0.000*	PASL does not Granger Cause DEL	0.00049*
26	DEL/SIBL	DEL does not Granger Cause SIBL	0.005*	SIBL does not Granger Cause DEL	0.10931
27	DEL/TRIBL	DEL does not Granger Cause TRIBL	0.001*	TRIBL does not Granger Cause DEL	0.00491*
28	ESBL/JSCL	ESBL does not Granger Cause JSCL	0.464	JSCL does not Granger Cause ESBL	0.00611*
29	ESBL/FNEL	ESBL does not Granger Cause FNEL	0.363	FNEL does not Granger Cause ESBL	0.47728
30	ESBL/FCSC	ESBL does not Granger Cause FCSC	0.405	FCSC does not Granger Cause ESBL	0.01547**
31	ESBL/JSGCL	ESBL does not Granger Cause JSGCL	0.953	JSGCL does not Granger Cause ESBL	0.01357**
32	ESBL/KASBSL	ESBL does not Granger Cause KASBSL	0.359	KASBSL does not Granger Cause ESBL	0.00093*
32	ESBL/OLPL	ESBL does not Granger Cause OLPL	0.333	OLPL does not Granger Cause ESBL	0.18549
34	ESBL/PASL	ESBL does not Granger Cause PASL	0.292	PASL does not Granger Cause ESBL	6.4E-05*
35	GRYL/IGIBL	GRYL does not Granger Cause IGIBL	0.76877	IGIBL does not Granger Cause GRYL	0.86253
36	GRYL/JSCL	GRYL does not Granger Cause JSCL	0.17222	JSCL does not Granger Cause GRYL	0.05647***
37	GRYL/FNEL	GRYL does not Granger Cause FNEL	0.96619	FNEL does not Granger Cause GRYL	0.50531
38	GRYL/FCSC	GRYL does not Granger Cause FCSC	0.53427	FCSC does not Granger Cause GRYL	0.32847
39	GRYL/JSIL	GRYL does not Granger Cause JSIL	0.10984	JSIL does not Granger Cause GRYL	0.64746

Continued—

Table 8—(*Continued*)

40	GRYL/JSGCL	GRYL does not Granger Cause JSGCL	0.98607	JSGCL does not Granger Cause GRYL	0.23617
41	GRYL/KASBSL	GRYL does not Granger Cause KASBSL	0.33830	KASBSL does not Granger Cause GRYL	0.31856
42	GRYL/OLPL	GRYL does not Granger Cause OLPL	0.12011	OLPL does not Granger Cause GRYL	0.04313**
43	GRYL/PASL	GRYL does not Granger Cause PASL	0.3759	PASL does not Granger Cause GRYL	0.29695
44	GRYL/SCLL	GRYL does not Granger Cause SCLL	0.25314	SCLL does not Granger Cause GRYL	0.3681
45	GRYL/SPLC	GRYL does not Granger Cause SPLC	0.05378***	SPLC does not Granger Cause GRYL	0.00405*
46	IGIBL/JSCL	IGIBL does not Granger Cause JSCL	0.57933	JSCL does not Granger Cause IGIBL	0.000000056*
47	IGIBL/FNEL	IGIBL does not Granger Cause FNEL	0.81196	FNEL does not Granger Cause IGIBL	0.02041**
48	IGIBL/FCSC	IGIBL does not Granger Cause FCSC	0.79704	FCSC does not Granger Cause IGIBL	0.00338*
49	IGIBL/JSIL	IGIBL does not Granger Cause JSIL	0.64385	JSIL does not Granger Cause IGIBL	0.00000000019*
50	IGIBL/JSGCL	IGIBL does not Granger Cause JSGCL	0.22881	JSGCL does not Granger Cause IGIBL	0.000093*
51	IGIBL/KASBSL	IGIBL does not Granger Cause KASBSL	0.42880	KASBSL does not Granger Cause IGIBL	0.00000066*
52	IGIBL/SIBL	IGIBL does not Granger Cause SIBL	0.31957	SIBL does not Granger Cause IGIBL	0.58752
53	IGIBL/TRIBL	IGIBL does not Granger Cause TRIBL	0.07367***	TRIBL does not Granger Cause IGIBL	0.13207
54	JSCL/JSIL	JSCL does not Granger Cause JSIL	0.02360**	JSIL does not Granger Cause JSCL	0.18699
55	JSCL/JSGCL	JSCL does not Granger Cause JSGCL	0.00013*	JSGCL does not Granger Cause JSCL	0.2979
56	JSCL/KASBSL	JSCL does not Granger Cause KASBSL	0.00023*	KASBSL does not Granger Cause JSCL	0.55267
57	FCSC/JSGCL	FCSC does not Granger Cause JSGCL	0.000034*	JSGCL does not Granger Cause FCSC	0.00191*
58	FCSC/KASBSL	FCSC does not Granger Cause KASBSL	0.24617	KASBSL does not Granger Cause FCSC	0.00012*
59	FCSC/PASL	FCSC does not Granger Cause PASL	0.00055*	PASL does not Granger Cause FCSC	0.70983
60	FCSC/SIBL	FCSC does not Granger Cause SIBL	0.76366	SIBL does not Granger Cause FCSC	0.48351
61	FCSC/TRIBL	FCSC does not Granger Cause TRIBL	0.00012*	TRIBL does not Granger Cause FCSC	0.08037***
62	JSIL/JSGCL	JSIL does not Granger Cause JSGCL	0.00116*	JSGCL does not Granger Cause JSIL	0.16529
63	JSIL/KASBSL	JSIL does not Granger Cause KASBSL	0.00027*	KASBSL does not Granger Cause JSIL	0.25675
64	JSGCL/KASBSL	JSGCL does not Granger Cause KASBSL	0.03094**	KASBSL does not Granger Cause JSGCL	0.06883***
65	JSGCL/PASL	JSGCL does not Granger Cause PASL	0.08093***	PASL does not Granger Cause JSGCL	0.00157*
66	JSGCL/TRIBL	JSGCL does not Granger Cause TRIBL	0.01116**	TRIBL does not Granger Cause JSGCL	0.07006***
67	KASBSL/SPLC	KASBSL does not Granger Cause SPLC	0.87545	SPLC does not Granger Cause KASBSL	0.05085***
68	KASBSL/SIBL	KASBSL does not Granger Cause SIBL	0.51602	SIBL does not Granger Cause KASBSL	0.14843
69	KASBSL/TRIBL	KASBSL does not Granger Cause TRIBL	0.000068*	TRIBL does not Granger Cause KASBSL	0.59387
70	MCBAH/SCLL	MCBAH does not Granger Cause SCLL	0.21970	SCLL does not Granger Cause MCBAH	0.06382***
71	MCBAH/SPLC	MCBAH does not Granger Cause SPLC	0.73239	SPLC does not Granger Cause MCBAH	0.75992
72	OLPL/SCLL	OLPL does not Granger Cause SCLL	0.00039*	SCLL does not Granger Cause OLPL	0.00421*
73	PASL/SPLC	PASL does not Granger Cause SPLC	0.6873	SPLC does not Granger Cause PASL	0.1347
74	PASL/SIBL	PASL does not Granger Cause SIBL	0.00974*	SIBL does not Granger Cause PASL	0.77292
75	PASL/TRIBL	PASL does not Granger Cause TRIBL	0.00312*	TRIBL does not Granger Cause PASL	0.20855
76	SCLL/SIBL	SCLL does not Granger Cause SIBL	0.0073*	SIBL does not Granger Cause SCLL	0.19709
77	SPLC/SIBL	SPLC does not Granger Cause SIBL	0.00442*	SIBL does not Granger Cause SPLC	0.03593**

* Significant at 1 percent, **Significant at 5 percent, ***Significant at 10 percent.

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APPENDIX VI

Table 9

Cointegration (Directional) Regression Results for Commercial Banks

On the basis of the direction of causality (Uni-directional Causality) identified in Table 7 for trading pairs of Commercial Banks, Table 9 presents the results of Cointegration directional regression. Results presented in Table 9 include indentified dependent variable and an independent variable in a pair, coefficient of the independent variable along with a p-value given in (), regression constant. Table 9 also contains the ADF Test results for testing Stationarity of the Cointegration regression residual along with the p-value given in ().

	Dependent Vari.	Independent Vari.	Coeff. (p-value)	cont	Residual ADF (t-statistic)	p-value		Dependent Vari.	Independent Vari.	Coeff. (p-value)	cont	Residual ADF (t-statistic)	p-value
1	BAHL	FABL	0.5812 (0.000)*	23.61016	-3.8999	0.0124**	15	BIPL	BOK	1.3391 (0.000)*	-1.56108	-4.0016	0.0015*
2	BAHL	HMB	0.4781 (0.000)*	20.9131	-4.7210	0.0007*	16	BOP	SNBL	1.8304 (0.000)*	-3.24987	-3.1873	0.0211**
3	BAHL	KASBB	1.0195 (0.000)*	28.18701	-3.7632	0.0189**	17	BIPL	MEBL	0.3592 (0.000)*	-2.03251	-3.3139	0.0146**
4	NBP	BAHL	3.3711 (0.000)*	-47.1737	-5.0585	0.0002*	18	FABL	HMB	0.5624 (0.000)*	0.717819	-4.0477	0.0012*
5	BAHL	NIB	1.6054 (0.000)*	26.55518	-3.8510	0.0145**	19	FABL	NIB	2.6246 (0.000)*	5.427415	-4.1568	0.0008*
6	BAHL	SMBL	1.2250 (0.000)*	26.52914	-3.7731	0.0183**	20	FABL	SMBL	2.0361 (0.000)*	5.26936	-3.3659	0.0125**
7	BAHL	SILK	1.7729 (0.000)*	26.15899	-3.7202	0.0215**	21	FABL	SILK	3.2383 (0.000)*	3.897978	-3.9692	0.0017*
8	BAHL	SNBL	0.6498 (0.000)*	26.20657	-3.8015	0.0168**	22	KASBB	HBL	0.0206 (0.000)*	0.198711	-2.8660	0.0498**
9	ABL	BOK	2.3337 (0.000)*	50.81223	-3.8655	0.0138**	23	SNBL	KASBB	1.2111 (0.000)*	3.949449	-3.2217	0.0191**
10	ABL	BIPL	1.5024 (0.000)*	54.87699	-3.7509	0.0196**	24	NBP	SILK	13.4228 (0.000)*	21.7032	-3.0897	0.0277**
11	ABL	JSBL	2.0844 (0.000)*	55.34554	-3.8163	0.0161**	25	SBL	SNBL	0.2733 (0.000)*	0.370128	-3.9730	0.0016*
12	ABL	MEBL	0.6842 (0.000)*	48.75288	-3.9042	0.0123**							
13	NIB	AKBL	0.1922 (0.000)*	-0.44271	-3.5417	0.0072*							
14	SBL	AKBL	0.1002 (0.000)*	0.688091	-4.1347	0.0009*							

* Significant at 1 percent, **Significant at 5 percent, ***Significant at 10 percent.

Table 10

Cointegration (Directional) Regression Results for Financial Services Sector

On the basis of the direction of causality (Uni-directional Causality) identified in Table 8 for trading pairs of Financial Services Sector, Table 10 presents the results of Cointegration directional regression. Results presented in Table 10 include indentified dependent variable and an independent variable in a pair, coefficient of the independent variable along with a p-value given in (), regression constant. Table 10 also contains the ADF Test results for testing Stationarity of the Cointegration regression residual along with the p-value given in ().

	Dependent Vari.	Independent Vari.	Coeff. (p-value)	cont	Residual ADF (t-statistic)	p-value		Dependent Vari.	Independent Vari.	Coeff. (p-value)	cont	Residual ADF (t-statistic)	p-value
1	FDIBL	AHL	0.022 (0.000)*	0.9391	–3.6719	0.0047*	19	GRYL	JSCL	0.0459 (0.000)*	2.1951	–4.8257	0.0001*
2	FDIBL	DEL	0.4413 (0.000)*	0.7483	–5.3018	0.0000*	20	GRYL	OLPL	0.0925 (0.000)*	2.0081	–5.2584	0.0000*
3	FDIBL	JSCL	0.0593 (0.000)*	0.8801	–3.9091	0.0021*	21	IGIBL	JSCL	0.0803 (0.000)*	1.0600	–4.0200	0.0014*
4	FDIBL	FNEL	0.0882 (0.000)*	1.1233	–3.3445	0.0133*	22	IGIBL	FNEL	0.1260 (0.000)*	1.3466	–3.4668	0.0091*
5	FDIBL	FCSC	0.1910 (0.000)*	0.9069	–4.0146	0.0014*	23	IGIBL	FCSC	0.2292 (0.000)*	1.2156	–3.6535	0.0050*
6	FDIBL	JSIL	0.1276 (0.000)*	0.7231	–3.6734	0.0047*	24	IGIBL	JSIL	0.1836 (0.000)*	0.7650	–4.4445	0.0003*
7	ESBL	AHL	0.0353 (0.000)*	1.4183	–2.7528	0.0657***	25	IGIBL	JSGCL	0.0336 (0.000)*	0.9958	–3.7915	0.0031*
8	FCSC	AHL	0.1197 (0.000)*	0.0303	–4.3509	0.0004*	26	IGIBL	KASBSL	0.2804 (0.000)*	0.7851	–3.8290	0.0027*
9	AHL	KASBSL	7.3470 (0.000)*	–1.9622	–2.7436	0.0671***	27	TRIBL	IGIBL	1.4681 (0.000)*	–1.1119	–4.1332	0.0009*
10	ESBL	DEL	0.6531 (0.000)*	1.2258	–3.0762	0.0287**	28	JSIL	JSCL	0.4202 (0.000)*	1.8400	–3.7587	0.0035*
11	IGIBL	DEL	0.5484 (0.000)*	0.9852	–3.2389	0.0182**	29	JSGCL	JSCL	2.1842 (0.000)*	4.6630	–3.4752	0.0089*
12	DEL	JSCL	0.1343 (0.000)*	0.3012	–4.3547	0.0004*	30	KASBSL	JSCL	0.2498 (0.000)*	1.4770	–3.5062	0.0081*
13	SIBL	DEL	0.2696 (0.000)*	1.9144	–3.1713	0.0221**	31	FCSC	KASBSL	1.0593 (0.000)*	–1.0784	–3.5066	0.0080*
14	ESBL	JSCL	0.0853 (0.000)*	1.4554	–2.7354	0.0685***	32	PASL	FCSC	0.4627 (0.000)*	0.5522	–3.0213	0.0333**
							33	JSGCL	JSIL	4.7029 (0.000)*	–1.1674	–2.7882	0.0603***
							34	KASBSL	JSIL	0.5513 (0.000)*	0.7092	–3.2210	0.0191**
							35	KASBSL	SPLC	0.9838 (0.000)*	3.7645	–3.5790	0.0064*
15	ESBL	FCSC	0.2678 (0.000)*	1.5210	–3.3724	0.0122**	36	TRIBL	KASBSL	0.6692 (0.000)*	–1.2134	–4.0567	0.0012*
16	ESBL	JSGCL	0.0384 (0.000)*	1.2938	–2.8211	0.0557***	37	MCBAH	SCLL	–1.2208 (0.000)*	22.6492	–4.0032	0.0015*
17	ESBL	KASBSL	0.3271 (0.000)*	1.0211	–3.0346	0.0322**	38	SIBL	PASL	0.2894 (0.000)*	1.7810	–3.3519	0.0130**
18	ESBL	PASL	0.5847 (0.000)*	1.1869	–4.3860	0.0003*	39	TRIBL	PASL	0.9436 (0.000)*	–0.2571	–3.7394	0.0037*
							40	SIBL	SCLL	0.2410 (0.000)*	1.6021	–3.3991	0.0113**

* Significant at 1 percent, **Significant at 5 percent, ***Significant at 10 percent.

Appendix VII

Table 11

Vector Error Correction Model for Commercial Banks

For all the cointegrated trading pairs in Table 9 depicting stationary residual series, the error component has been modeled using Vector Error Correction Model (VECM) for which the results are given in Table 11. For VECM, log differences of stock prices have been employed. Table 11 includes Long run β Coefficient and its [t-statistic] for each cointegrated pair. Speed of Adjustment Coefficients γ1 and γ2 are also given along with their [t-statistic].

	Cointegrated Pairs	Stock Returns	Long run β Coefficient and [t-statistic]	Speed of Adjustment Coefficient [t-statistic] γ1	γ2		Cointegrated Pairs	Stock Returns	Long run β Coefficient and [t-statistic]	Speed of Adjustment Coefficient [t-statistic] γ1	γ2
1	BAHL/FABL	D(BAHL(–1))	2.1968	–0.0586 [–6.69236]	0.0112	14	SBL/AKBL	D(SBL(–1))	0.008576	–0.029508 [–3.18985]	0.114769
		D(FABL(–1))	[14.4977]		[2.24338]			D(AKBL(–1))	[0.83123]		[2.55400]
2	BAHL/HMB	D(BAHL(–1))	–5.1874	–0.0831 [–7.36522]	–0.0005	15	BIPL/BOK	D(BIPL(–1))	–2.804577	–0.021053 [–2.83659]	0.002953
		D(HMB(–1))	[–18.6267]		[–0.07867]			D(BOK(–1))	[–18.2003]		[0.54793]
3	BAHL/KASBB	D(BAHL(–1))	109.2040	–0.0513 [–6.10595]	–0.0020	16	BOP/SNBL	D(BOP(–1))	–3.184867	–0.015118 [–2.41349]	0.001631
		D(KASBB(–1))	[18.9841]		[–1.35322]			D(SNBL(–1))	[–18.8377]		[0.48197]
4	NBP/BAHL	D(NBP(–1))	6.2869	–0.0362 [–6.13575]	0.0023	17	BIPL/MEBL	D(BIPL(–1))	–0.484138	–0.015176 [–2.39326]	0.008355
		D(BAHL(–1))	[14.3942]		[1.08320]			D(MEBL (–1))	[–15.0934]		[0.66998]
5	BAHL/NIB	D(BAHL(–1))	–26.608	–0.0525 [–5.86007]	–0.0014	18	FABL/HMB	D(FABL (–1))	3.041034	–0.043057 [–5.73502]	0.018313
		D(NIB(–1))	[–21.3260]		[–1.23619]			D(HMB (–1))	[16.2935]		[2.06832]
6	BAHL/SMBL	D(BAHL(–1))	–12.255	–0.0476 [–5.57379]	–0.0008	19	FABL/NIB	D(FABL (–1))	–23.49303	–0.041225 [–5.10291]	–0.002011
		D(SMBL(–1))	[–18.8430]		[–0.49040]			D(NIB(–1))	[–20.9658]		[–1.08006]
7	BAHL/SNBL	D(BAHL(–1))	123.4980	–0.0481 [–5.85832]	–0.0033	20	FABL/SMBL	D(FABL(–1))	–19.06986	–0.029402 [–4.34719]	0.000169
		D(SNBL(–1))	[18.2288]		[–1.45229]			D(SMBL(–1))	[–19.0906]		[0.07275]

Continued—

Table 11—(*Continued*)

8	BAHL/SILK	D(BAHL(–1))		–0.051 [–6.26651]	
		D(SILK(–1))	16.0746 [18.2065]		0.0011 [0.79015]
9	ABL/BOK	D(ABL(–1))		–0.0599 [–6.47245]	
		D(BOK(–1))	–53.3772 [–20.6643]		–0.0025 [–1.98667]
10	ABL/BIPL	D(ABL(–1))		–0.0563 [–6.19890]	
		D(BIPL(–1))	–16.0092 [–20.4628]		–0.0018 [–1.12564]
11	ABL/JSBL	D(ABL(–1))		–0.0486 [–5.79719]	
		D(JSBL(–1))	–19.0039 [–19.8613]		–0.0006 [–0.62591]
12	ABL/MEBL	D(ABL(–1))		–0.0591 [–6.20863]	
		D(MEBL(–1))	–6.4267 [–20.1588]		–0.0078 [–2.36566]
13	NIB/AKBL	D(NIB(–1))		–0.0108 [–1.61586]	
		D(AKBL(-1))	-0.07675 [-8.21175]		0.0955 [2.95370]

21	FABL/SILK	D(FABL(–1))		–0.03419 [–5.02514]	
		D(SILK(–1))	146.8413 [18.9168]		0.002288 [1.16274]
22	KASBB/HBL	D(KASBB(–1))		–0.008937 [–2.77087]	
		D(HBL(–1))	–0.014373 [–4.96063]		0.009231 [0.16207]
23	SNBL/KASBB	D(SNBL(–1))		–0.025673 [–3.06487]	
		D(KASBB(–1))	–2.350703 [–18.8064]		0.001515 [0.29131]
24	NBP/SILK	D(NBP(–1))		–0.027807 [–4.79866]	
		D(SILK(–1))	190.4803 [18.7952]		0.000358 [0.91714]
25	SBL/SNBL	D(SBL(–1))		–0.033859 [–3.12691]	
		D(SNBL(–1))	–0.325853 [–14.1252]		0.011061 [0.44216]

Table 12

Vector Error Correction Model for Financial Services Sector

For all the cointegrated trading pairs in Table 10 depicting stationary residual series, the error component has been modeled using Vector Error Correction Model (VECM) for which the results are given in Table 12. For VECM, log differences of stock prices have been employed. Table 12 includes Long run β Coefficient and its [t-statistic] for each cointegrated pair. Speed of Adjustment Coefficients γ1 and γ2 are also given along with their [t-statistic].

	Cointegrated Pairs	Stock Returns	Long run β Coefficient and [t-statistic]	Speed of Adjustment Coefficient [t-statistic] γ1	γ2		Cointegrated Pairs	Stock Returns	Long run β Coefficient and [t-statistic]	Speed of Adjustment Coefficient [t-statistic] γ1	γ2
1	FDIBL/AHL	D(FDIBL(–1))	–0.019315	–0.031812 [–3.30189]	0.054080	22	IGIBL/FNEL	D(IGIBL(–1))	0.231905	–0.04956 [–5.50098]	0.087592
		D(AHL(–1))	[–5.24008]		[0.47173]			D(FNEL(–1))	[14.6064]		[2.74258]
2	FDIBL/DEL	D(FDIBL(–1))	–2.588218	–0.137529 [–7.98745]	–0.002591	23	IGIBL/FCSC	D(IGIBL(–1))	–0.068855	–0.024715 [–2.80272]	0.035045
		D(DEL(–1))	[–22.7248]		[–0.11908]			D(FCSC(–1))	[–3.27266]		[1.82772]
3	FDIBL/JSCL	D(FDIBL(–1))	–0.038733	–0.043342 [–3.64555]	0.082940	24	IGIBL/JSIL	D(IGIBL(–1))	–0.021308	–0.054083 [–5.01955]	0.135760
		D(JSCL(–1))	[–5.68741]		[1.15780]			D(JSIL(–1))	[–1.76307]		[3.51931]
4	FDIBL/FNEL	D(FDIBL(–1))	0.370759	–0.059747 [–5.94349]	0.059412	25	IGIBL/JSGCL	D(IGIBL(–1))	–0.014201	–0.03288 [–3.36403]	0.153874
		D(FNEL(–1))	[16.6720]		[1.62395]			D(JSGCL(–1))	[–3.74714]		[1.48559]
5	FDIBL/FCSC	D(FDIBL(–1))	–0.083461	–0.045059 [–3.68319]	0.054825	26	IGIBL/KASBSL	D(IGIBL(–1))	–0.032959	–0.033948 [–3.55983]	0.058937
		D(FCSC(–1))	[–4.29110]		[1.83737]			D(KASBSL(–1))	[–1.53782]		[2.67901]
6	FDIBL/JSIL	D(FDIBL(–1))	–0.099844	–0.032884 [–3.09409]	0.056210	27	TRIBL/IGIBL	D(TRIBL(–1))	–2.049311	–0.03069 [–3.58503]	0.003966
		D(JSIL(–1))	[–9.15115]		[1.32916]			D(IGIBL(–1))	[–16.0130]		[1.09014]
7	ESBL/AHL	D(ESBL(–1))	–0.030834	–0.027807 [–2.64295]	0.025670	28	JSIL/JSCL	D(JSIL(–1))	–0.219192	–0.0243 [–1.84488]	0.012750
		D(AHL(–1))	[–4.63482]		[0.42555]			D(JSCL(–1))	[–8.70638]		[0.58442]
8	FCSC/AHL	D(FCSC(–1))	–0.173071	–0.024423 [–3.21811]	0.028153	29	JSGCL/JSCL	D(JSGCL(–1))	–2.31639	–0.010112 [–1.21334]	0.005645
		D(AHL(–1))	[–16.2000]		[0.75230]			D(JSCL(–1))	[–23.7371]		[1.37420]

Continued—

Table 12—(*Continued*)

9	AHL/KASBSL	D(AHL(–1))		–0.003615 [–0.86544]
		D(KASBSL(–1))	–6.970244 [–18.5089]	
10	ESBL/DEL	D(ESBL(–1))		–0.069215 [–5.52993]
		D(DEL(–1))	0.876937 [10.9883]	
11	IGIBL/DEL	D(IGIBL(–1))		–0.079991 [–6.58810]
		D(DEL(–1))	2.414926 [18.5549]	
12	DEL/JSCL	D(DEL(–1))		–0.05546 [–4.12513]
		D(JSCL(–1))	–0.034454 [–3.43876]	
13	SIBL/DEL	D(SIBL(–1))		–0.03771 [–3.24110]
		D(DEL(–1))	0.267976 [3.45499]	
14	ESBL/JSCL	D(ESBL(–1))		–0.029934 [–2.77626]
		D(JSCL(–1))	–0.051042 [–4.00034]	
15	ESBL/FCSC	D(ESBL(–1))		–0.029534 [–2.76647]
		D(FCSC(–1))	–0.035455 [–0.97287]	
16	ESBL/JSGCL	D(ESBL(–1))		–0.030514 [–2.74668]
		D(JSGCL(–1))	–0.031231 [–4.81474]	
17	ESBL/KASBSL	D(ESBL(–1))		–0.033806 [–3.01345]
		D(KASBSL(–1))	–0.201769 [–5.52764]	
18	ESBL/PASL	D(ESBL(–1))		–0.080183 [–6.07900]
		D(PASL(–1))	0.517249 [9.29244]	
19	GRYL/JSCL	D(GRYL(–1))		–0.049979 [–4.55651]
		D(JSCL(–1))	0.165826 [5.13007]	
20	GRYL/OLPL	D(GRYL(–1))		–0.095607 [–7.96700]
		D(OLPL(–1))	2.177157 [16.5884]	
21	IGIBL/JSCL	D(IGIBL(–1))		–0.047519 [–4.34022]
		D(JSCL(–1))	–0.023225 [–3.15714]	

					–0.02026	
	30	KASBSL/JSCL	D(KASBSL(–1))		[–2.03111]	
0.001527				–0.177445		0.047565
[1.78128]			D(JSCL(–1))	[–11.2157]		[1.76590]
					–0.014724	
	31	FCSC/KASBSL	D(FCSC(–1))		[–1.76841]	
0.034502				–1.303408		0.010302
[3.71409]			D(KASBSL(–1))	[–19.5045]		[1.20194]
					–0.012411	
	32	PASL/FCSC	D(PASL(–1))		[–1.35292]	
0.034104				–0.234482		0.022040
[2.45157]			D(FCSC(–1))	[–6.62978]		[1.67156]
					–0.003932	
	33	JSGCL/JSIL	D(JSGCL(–1))		[–0.71101]	
0.174838				–5.941587		0.002702
[3.18455]			D(JSIL(–1))	[–23.9589]		[1.61516]
					–0.013585	
	34	KASBSL/JSIL	D(KASBSL(–1))		[–1.48783]	
0.011506				–0.511235		0.022783
[1.49624]			D(JSIL(–1))	[–18.7492]		[1.55469]
					–0.01167	
	35	KASBSL/SPLC	D(KASBSL(–1))		[–2.48194]	
0.021119				–4.155565		0.001923
[0.67898]			D(SPLC(–1))	[–21.5997]		[0.73082]
					–0.045089	
	36	TRIBL/KASBSL	D(TRIBL(–1))		[–3.93622]	
0.021081				–0.143323		0.036783
[1.68788]			D(KASBSL(–1))	[–2.80295]		[3.40445]
					–0.030546	
	37	MACBAH/SCLL	D(MCBAH(–1))		[–4.60142]	
0.028929				36.49555		–0.002715
[0.46042]			D(SCLL(–1))	[21.7511]		[–1.13404]
					–0.043652	
	38	SIBL/PASL	D(SIBL(–1))		[–3.53746]	
0.017342				–0.508298		–0.004458
[1.24966]			D(PASL(–1))	[–8.98474]		[–0.49363]
					–0.037536	
	39	TRIBL/PASL	D(TRIBL(–1))		[–4.17065]	
0.049464				–0.043496		0.023109
[4.30419]			D(PASL(–1))	[–0.70553]		[3.46128]
					–0.05772	
	40	SIBL/SCLL	D(SIBL(–1))		[–4.64782]	
0.022418				0.369581		0.033901
[1.32287]			D(SCLL(–1))	[6.63143]		[2.75978]
0.003701						
[0.41263]						
0.118659						
[2.00433]						

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