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The Role of Satellite Stock Exchanges:
A Case Study of the Lahore Stock Exchange

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Abstract

In many countries, capital markets are often served by multiple stock exchanges, typically with one national or dominant exchange and several regional or satellite exchanges. While multiple exchanges create a competitive landscape, they also lead to fragmented liquidity and diseconomies in operations. This paper examines the role of the Lahore Stock Exchange (LSE) in comparison with the country's dominant exchange, the Karachi Stock Exchange (KSE), in four areas: (i) market efficiency in processing information, (ii) transaction costs, (iii) contribution to price discovery, and (iv) market integration. A comparative analysis of the exchange performance indicates the two exchanges to be at par in terms of informational efficiency and transaction costs. There is evidence of informational linkages and interdependencies between the two exchanges; the LSE appears to contribute to price discovery and competes to an appreciable extent. Against the background of proposals to merge the country's three stock exchanges, a major consideration in evaluating public policy is the relative performance of the LSE and its viability as an effective competitor. Eliminating inter-exchange competition by merging the stock exchanges is predicted to lead to higher transaction costs, lower incentives for regulatory compliance, and diminished motivation for promoting capital market development.

Keywords: Stock exchange, demutualization, market efficiency, transaction costs, price discovery, market integration, dually listed stocks, satellite and dominant exchanges.

JEL Classification: G14, G15, G38.

I. Introduction and Overview

A. Background

Capital markets in many countries are often served by multiple stock exchanges. When markets are imperfectly integrated, prices in one exchange

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usually adjust to those in the other with some time delay. This has been termed by Garbade and Silber (1979) as a *dominant-satellite* market relationship; the former is a satellite and the latter is dominant. While multiple exchanges create a competitive landscape, they can also lead to fragmented liquidity and diseconomies in operations. A key consideration in evaluating public policy toward the structure of the exchange industry is the relative role of satellite exchanges in the country's capital markets, particularly in creating a competitive environment.

There are three stock exchanges in Pakistan: Karachi, Lahore, and Islamabad. The Karachi Stock exchange (KSE) dominates all trading activity, while the Lahore Stock Exchange (LSE) and Islamabad Stock Exchange (ISE) account for a smaller share of the total volume. This study examines the role of the LSE relative to the KSE in its basic function as a stock exchange. Its performance is assessed in terms of relative efficiency in processing information (*market efficiency*), cost of intermediation (*transaction costs*), role in *price discovery*, and the extent of *market integration* through the flow of information.

The study was conducted against the background of ongoing efforts to demutualize the country's three stock exchanges. Currently, they are structured as mutual nonprofit companies owned by members who have the exclusive right to trade on the exchanges. The proposed restructuring will convert the exchanges to shareholder-owned for-profit corporations. Subsequently, the three exchanges may be consolidated into one corporate entity. An assessment of the LSE's relative role should provide insight into whether or not public interest is best served by the contemplated consolidation of the three stock exchanges.

The remainder of this section will provide an overview of the three stock exchanges and we examine various issues relating to the performance of the stock exchanges. Section II presents a review of the literature, and Section III provides empirical evidence of the LSE's performance, describes the data and econometric methodology used, and records the results achieved. Section IV concludes the findings of this study.

B. Overview of Stock Exchanges: Structure and Governance

The three stock exchanges in Pakistan are based in Karachi, Islamabad, and Lahore, and were established in 1949, 1970, and 1989, respectively. They are served by a national clearing and settlement system, a central depository company, and two rating agencies. A brief statistical overview of the three stock exchanges is provided in Table-1. Together, they list about 700 of the approximately 2,800 registered public companies in Pakistan. In addition to corporations, a number of nonbank financial institutions (NBFIs) are also listed on the exchanges; these include 54 insurance companies, 40 mutual funds, 5 development financial institutions, 8 investment banks, and 20 leasing companies. There is a substantial overlap in the listing of companies: most companies are listed on all three exchanges except for 116 that are listed solely on the KSE, 5 that are listed solely on the LSE, and 1 listed solely on the ISE. The KSE functions as the dominant exchange in terms of listings, market capitalization, volume of trading, and new listings. The regional stock exchanges have been losing their market share over time. In 2003, the KSE's share was over 81% of the volume traded, followed by the LSE accounting for 17%, and the ISE accounting for 2%. As Table-1 shows, the shares of the LSE and ISE had declined to 9.2% and 0.4%, respectively, by the end of 2007/08.

All three exchanges are privately owned and are mutual nonprofit organizations owned by about 300 broker members (each exchange has a membership maximum limit of 200, the difference being accounted for by overlapping members and brokers). The exchanges are registered as companies limited by guarantee and are licensed by the Securities Exchange Commission of Pakistan (SECP). A mutual form means that, by acquiring membership of an exchange (by purchasing a "card" or "seat"), the party obtains membership of as well as the right to trade on the exchange, subject to regulations. The difference from a corporate form is that the latter separates ownership from trading rights.

Table-1: Overview of Pakistan's Stock Exchanges

	Karachi (KSE)			Lahore (LSE)			Islamabad (ISE)		
Year Ending June 30	**2005/06**	**2006/07**	**2007/08**	**2005/06**	**2006/07**	**2007/08**	**2005/06**	**2006/07**	**2007/08**
Total Number of Listed Companies	658	658	652	518	520	514	240	246	248
Total Listed Paid-up Capital (Rs billion)	496	631	706	469	595	665	375	489	551
Total Market Capital-ization (Rs billion)	2,801	4,019	3,778	2,693	3,860	3,514	2,102	3,061	2,872
Volume of Shares Traded (in Rs million)									
Total Share Volume	79,455	54,042	63,316	15,009	8,243	6,467	396	237	569
Avg. Daily Volume	348.53	262.48	238.15	61.26	33.78	26.18	1.50	0.96	2.31
Exchange's Share of Total Volume (%)	83.8	86.4	90.0	15.8	13.2	9.2	0.4	0.4	0.8
Stock Indices: KSE100, LSE25, and ISE10									
Year Closing	9,989	13,772	12,289	4,379	4,850	3,869	2,634	2,716	2,750
Year High	12,274	13,772	15,676	5,740	5,031	5,091	na	na	na
Year Low	6,971	9,504	11,162	3,419	4,004	3,511	na	na	na
Change in Index (%)		37.9	-10.8		10.7	-20.2		3.1	1.2
New Listings during the Year									
Companies	14	16	7	7	10	2	na	9	3
Open-End Funds	5	6	7	5	11	10	na	1	4
Debt Securities	6	3	7	3	4	1	na	2	0
Total	25	25	21	15	25	13	6	12	7

As noted above, all three exchanges are in the process of being demutualized and subsequently corporatized. A draft ordinance, the Stock Exchanges (Corporatization, Demutualization and Integration) Ordinance 2007 was approved by the Government of Pakistan's federal cabinet in January 2008, which has yet to be voted on by the National Assembly.[1] The Ordinance provides a road map for converting the stock exchanges to corporations and a mechanism to facilitate the integration of these exchanges in that any two or more may file a scheme of integration for approval by the SECP.

[1] At the time of writing, the Ordinance had been stalled in the National Assembly; demutualization is being pursued through rules promulgated by the SECP.

The SECP is responsible primarily for regulating and supervising stock exchanges. However, the three stock exchanges are also frontline self-regulatory organizations (SROs) that deal with the listing of securities, admission of trading members, market surveillance, and broker conduct.

C. Stock Exchanges: Concerns and Issues

In order to render the capital market as a major source of long-term finance in Pakistan, the country's stock exchanges need to undergo further institutional and regulatory development. There should be a higher trading volume in more stocks, with more stocks participating in market moves (implying greater market breadth). The capacity to execute large buy-and-sell orders without significant price movements (market liquidity and depth) also needs to be enhanced. Market breadth and depth can be improved by broadening the investor base, bringing in new financing instruments, and developing NBFIs as key players in the securities market.

The SECP (2004) has examined various problems related to the working of the stock exchanges and concluded that a "mutual structure and fragmented market are at the heart of problem being faced by the stock market…. Fragmentation of market place has added to cost inefficiencies for all stakeholders. Because of the mutual structure the reforms in the past have not made substantial impact."

According to the Asian Development Bank (ADB) (2007), a key issue that relates more directly to the working of the stock exchanges is *market fragmentation*:

"Although the vast majority of listed securities are traded on more than one exchange in Pakistan, the market remains fragmented, which undermines its efficiency, particularly with regard to price discovery and investor confidence. This is mainly due to weak linkages between the exchanges. The three exchanges do not have any systematic exchange of price and other information. Self-regulation of the exchanges is weak, and no mechanism is in place to coordinate inter-market surveillance and development of a plan for sharing self-regulatory responsibilities. Brokers are not required to execute orders of their clients in the best interests of the latter in a fair and transparent manner. Due to lack of price information from other exchanges, brokers are often not in the position to avail of quotations from other exchanges."

ADB (2007) further suggests that there are two options for strengthening investor protection and efficiency of the market and increasing transparency: (i) merge the three exchanges, or (ii) strengthen linkages between exchanges to achieve a unified national market system in securities. ADB (2007) goes on to say that: "The second is more realistic under the present circumstances." SECP (2004), on the other hand advances both demutualization and integration as a remedy for the problems faced by the exchanges.

Both ADB (2007) and SECP (2004) seem to suggest that (i) the existence of multiple exchanges fragments the market and liquidity, increasing the cost of intermediation; (ii) the LSE and ISE cannot compete effectively with the KSE; and (iii) the LSE and ISE are not playing their economic role of price discovery and market making. The reports' conclusions are based on stakeholder surveys and are not supported by rigorous statistical analysis. This paper purports to provide econometric evidence on these issues.

D. Issues of Performance

The literature on financial markets presents no unanimously agreed measure of the performance and quality of services of a stock exchange. Researchers have focused on the different characteristics of markets, such as liquidity, informational efficiency, and volatility as criteria for market quality comparisons. Another approach has been to judge the quality of the exchanges' services based on transaction costs. In this study, we focus on an econometric analysis of four key aspects of the functioning of the LSE and KSE: (i) informational efficiency, (ii) comparative transaction costs, (iii) the role of the exchanges in price discovery, and (iv) market integration through the inter-exchange of information.

II. Review of the Literature

A number of studies have examined the relative contribution of US regional exchanges to the price discovery of stocks trading on the national exchanges, which have a bearing on our study of the LSE's role. These studies generally support the view that regional exchanges do play a role, albeit a minor one, in the price discovery process.[2] We start with an overview of some of the research carried out in this area.

Garbade and Silber (1979) suggest the terminology "*dominant*" and "*satellite*" markets, and analyze trading patterns on the New York Stock

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[2] Schreiber and Schwartz (1986) describe price discovery as the process by which markets attempt to find equilibrium prices.

Exchange (NYSE) and Pacific and Midwest regional exchanges. Their data consists of the time (truncated to the nearest minute) and price of every transaction in the stocks of five firms executed for 2 months, August 1973 and September 1975. They conclude that the regional exchanges are "satellites, but not pure satellites." Their results indicate that the price of transactions on regional exchanges contain information relevant for NYSE traders, i.e., at times, their prices contain new information not already included in the NYSE's earlier prices. This suggests that the advent of the consolidated tape permits information content embedded in regional prices to channel back into the dominant market. However, they find that this did not lead to a complete integration of the NYSE and regional exchanges.

In 1975, the US Congress decided to integrate the trading of major securities across markets, which led to the development of several electronic systems designed to integrate the trading of NYSE-listed stocks. Blume and Goldstein (1979) examine the impact of this mandate by analyzing individual quote and transaction records for 2,023 corporations for a 12-month period ending June 1995. The study finds that "most of the time, the NYSE quote matches or determines the best displayed quote, and the NYSE is the most frequent initiator of quote changes. Non-NYSE markets attracted a significant portion of their volume even when they were posting inferior bids or offers, indicating they obtained order flow for other reasons, such as 'payment for order flow.' Yet, when a non-NYSE market does post a better bid or offer, it does attract additional order flow." Thus, the electronic systems provide only a partial integration of markets.

Harris, et al (1995) show how regional exchanges in the US contribute to the price discovery process. Using 1-year's transaction data for IBM, the heaviest traded stock for the year, from the New York, Pacific, and Midwest stock exchanges, they form matched trade tuples to ensure synchronicity, to the effect that the time elapsed between the first recorded price and last recorded price in the tuple has a mean value of 102 seconds. Using an error correction model, the paper demonstrates that equilibrium IBM prices are also established by information revealed on the Midwest and Pacific exchanges. All three markets react to independent information reflected in each exchange's prices. Harris, et al (1995) report that not only do prices on the Pacific and Midwest exchanges respond to deviations from NYSE prices, but that NYSE prices also respond to deviations from prices on regional exchanges, although to a smaller extent.

This paper follows the methodology developed by Hasbrouck (1995) to estimate the LSE's information share in price discovery (Section III). Hasbrouck (1995) considers 30 stocks in the Dow Jones industrial average for the period August-October 1993. NYSE bid-and-offer quotes and the best non-NYSE bid-and-offer quotes from all quotes reported on the consolidated tape are used with 1-second time resolution. Price discovery appears to be concentrated at the NYSE; the median information share of NYSE is 92.7 percent. Thus, there is empirical evidence that some price discovery takes place on regional exchanges as well. The study also finds a significant positive correlation between the NYSE contribution to price discovery and its market share. However, for 28 of the 30 Dow stocks, the NYSE's information share is larger than its share of the trading volume in stocks, suggesting that regional markets partly appropriate the informational value of prices determined on the NYSE.

Eun and Sabherwal (2003) explore the extent to which US stock exchanges contribute to the price discovery of Canadian stocks traded on the Toronto Stock Exchange (TSE) and cross-listed on US exchanges, the NYSE, American Stock Exchange (AMEX), or NASDAQ. The study covers a 6-month period in 1998 using all intra-day quotes for 62 Canadian firms, excluding thinly traded firms. The study finds that prices on the TSE and US exchanges are cointegrated and mutually adjusting, i.e., "not only do the US prices adjust to the TSE prices, but they also provide feedback so that the TSE prices adjust to the U.S. prices." The US exchange contribution to the discovery of Canadian stocks ranges from 0.2 percent to 98.2 percent, with an average of 38.1 percent. The extent of the US stock exchange's contribution is directly related to its share of trading and to the proportions of informative trades.

Arnold, et al (1999) describes how the role of regional exchanges has changed from being venues for listing local securities to that of more direct competitors for the order flow of NYSE listings. This competition has led to mergers between regional exchanges in the US, and increased their ability to compete with the NYSE. The study uses monthly data for the period March 1945 to October 1953 on the dollar market share of the stock exchanges. The authors find that merging exchanges were able to increase their market share and lower the bid-ask spread. The empirical evidence suggests that regional exchanges survived because they were better able to reduce order fragmentation and achieve economies of scale.

While multiple exchanges create a competitive landscape, they also lead to fragmented liquidity and diseconomies in operations. Hamilton (1979) studies the fragmentation and competitive effects of trading NYSE-listed stocks on the regional exchanges (off-board trading). The study compares specialist spreads and the daily stock returns variance for a random sample of 315 NYSE-listed stock issues, based on quarterly observations for four quarters ending in March 1975. Hamilton (1979) finds that the competitive effect exceeds the fragmentation effect, i.e., the competitive effect tends to reduce both the NYSE specialist spreads and daily stock variances by more than the degree to which the fragmentation effect tends to increase them. Both these effects are, however, small, implying that off-board trading seems to have limited policy importance. Nevertheless, the author concludes that for "the present level of off-board trading, such a policy would seem to have precedence over a policy that protects exchange efficiency by restricting off-board trading."

The emergence of electronic communication networks (ECNs) also points to the possible value-added role that off-board trading may play. Huang (2000) examines price discovery by ECNs and NASDAQ market makers. The study uses quoted data for July 1998 using a 1-minute time interval. The use of quoted data minimizes the problems of infrequent trading and that associated with aligning data across dealers. The results show that ECNs are important contributors to the price discovery process. Further analysis suggests that ECNs' share of price discovery is enhanced by informed traders who prefer to trade anonymously, but is reduced by transactions by liquidity traders seeking lower trading costs.

While there is empirical evidence on the contributions of the US's regional exchanges, researchers have also noted certain negative aspects. Lee (1993) finds that, for NYSE-listed securities, the prices at which comparable orders are executed differ systematically by the exchange at which they are executed. The data used in this study consist of all trades and quotes for NYSE- and AMEX-listed firms, stamped to the nearest second, for 1988/89. The findings suggest that order flow may follow cash inducements (i.e., payment for order flow) rather than the best price execution.[3] These inter-market price differences depend on trade size—with the smallest trades exhibiting the biggest per share price difference—and raise questions about the adequacy of the existing inter-market trading system (ITS), the broker's fiduciary responsibility for "best execution" and the propriety of order-flow inducements.

Findings such as Lee's (1993) have led to allegations that diverting order flows to regional markets is used to ***"cream-skim"*** uninformed liquidity trades, leaving information-based trades to established markets. Easley, Kiefer, and O'Hara (1996) test this hypothesis using a sample of stocks known to be used in order purchase agreements that trade on the

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[3] Purchased order flow refers to the practice of dealers paying brokers for retail order flow.

NYSE and Cincinnati Stock Exchange. They select the 30 most actively traded stocks on Cincinnati and use both intra-day and inter-day trade data for a 60-day period in 1990. Their main empirical result is that there is a significant difference in the information content of orders executed in New York and Cincinnati, and that this difference is consistent with cream-skimming. By cream skimming the order flow, regional markets can exacerbate the fragmentation problem and undermine the viability of old markets and the trading process itself. Given widespread allegations of broker manipulations in Pakistan, the possibility of cream-skimming cannot be ruled out.

III. Empirical Evidence

A. Sample and Data

Our empirical analysis is based on a direct comparison between stocks that trade on the KSE as well the LSE. Our sample consists of 44 dually traded stocks, except in section II(d) where we compare transaction costs for which there were only 32 usable pairs. The stocks in the sample have the largest volume of transactions and hence a higher degree of liquidity compared to others. The period under study is from January 2005 to August 2007, a time characterized by a higher volume of trading and three short subperiods of significant market declines. Our data include daily closing stock prices as well as the volume for each stock. We carry out an econometric analysis on the first log price differences of daily closing prices (daily returns) to ensure that the time series remains stationery.

The literature shows that most studies employ an error correction model to determine the exchanges' contribution to the price discovery process, using high frequency data and transactions or quotes, with a minimum time interval. Such studies have focused on stocks such as IBM, which are very heavily traded on the highly liquid and active US stock exchanges. High frequency data is used to test for pricing dynamics across markets for two reasons. First, cointegration models are meant to capture "long-run" equilibrium relationships wherein time series can diverge temporarily from but then readjust to long-run cointegrated patterns. These short-term divergences may not be detected if the observation intervals are long and the adjustment process fast; daily stock price data may not detect the error correction from higher frequency trading. Second, the reaction of market participants to price differentials can be detected accurately only when the matched trades observed are synchronous across the exchanges. When trades are not time aligned, the parameters will not be efficiently estimated. Unfortunately, equivalent high frequency data is not available or feasible in the case of many emerging markets due to thin trading: when shorter intervals are considered, the incidence of nontrade increases. On the other hand, the use of daily closing prices instead (as in this study) may introduce some unspecified bias or noise, which should qualify our conclusions.

The effect of non- or thin trading on the portfolios has been widely studied. Thin and asynchronous trading appears to induce a spurious positive autocorrelation in stock *portfolios*: if one stock trades less frequently than the other, new information is impounded first into the more frequently traded stock price and then into the less traded stock price with a lag. This lag produces positive serial correlation in portfolios of stocks, although Lo and Mackinlay (1988) among others show the nontrading effect to be small.[4]

The effects of thin and nonsynchronous trading on individual stock returns, particularly for dually traded stocks, have not been widely explored except that successive transactions are likely to take place at bid-and-ask prices and induce a negative serial correlation (Roll 1984). Boudoukh, Richardson, and Whitelaw (1994) show that spurious autocorrelations induced by nontrading are aggravated if there is heterogeneity in the nontrading probabilities across stocks and in the covariances with the market portfolio. In the context of the same stock trading on multiple exchanges, there is likely to be homogeneity with respect to the above two conditions, considering that information flow (thus trading) is clustered within the trading day. Hence, relatively thin trading on one exchange may not show up seriously as cross-serial correlation with the same stock on the other exchange.

In using daily closing prices, we note that the "closing price" generally refers to the last price at which a stock trades during a regular trading session. However, it has been the practice in Pakistan to record the average of bid-ask quotes as the closing price in the absence of a trade.[5] Since quotes can be updated more frequently, they reflect current information and may attenuate the problems associated with nontrading. In any case, the market that happens to have relatively infrequent trades (the LSE in this case) will tend to have last-sale prices that were the most

[4] While various adjustments have been proposed to correct for the effect of thin trading on portfolios, these are not relevant in the case of individual stocks.
[5] The Center for Research in Security Prices (CRSP) tapes also reflect either the last trade of the day or the average of bid-ask quotes.

obsolete and therefore the least informative. To the extent that reported LSE prices may be stale, the role of the LSE would be understated.

Subject to the above mentioned reservations, the results in the next section show that our models are able to obtain the expected long-run cointegrating equilibrium of price equality across the two exchanges, and capture the short-term adjusting dynamics.

B. Informational Efficiency

A stock market must be able to generate timely and accurate price signals by efficiently producing, processing, and disseminating information. The concept of market efficiency reflects the extent to which the available information is incorporated in stock prices. Fama (1970) classifies market efficiency into three forms: (i) weak, (ii) semi-strong, and (iii) strong, depending on whether the market is efficient with respect to (i) the information contained in the series of past prices, (ii) publicly available information, and (iii) all available information whether public or private. The efficiency of weak forms of the KSE and LSE is tested here by examining (i) auto-correlation structure in returns, and (ii) time dependency in return volatility.

Autocorrelation Structure

Weak form efficiency, which implies that there is no predictability in historical stock returns, is tested by examining the presence of serial dependence in stock returns. The autocorrelation functions are estimated for the "stock return" defined as the first log difference of the closing stock price, P_t:

$$R_t = ln(P_t) - ln(P_{t-1})$$

A significant auto-correlation coefficient indicates serial dependence. Positive serial correlation means that stock prices adjust slowly to the arrival of new information, while negative serial correlation might arise for thinly traded securities with wide fluctuations around the intrinsic value.

Tables-A1 and A2 (see appendix) report the estimated serial correlation for sample stocks traded on the KSE and LSE, respectively, for 8 lag-days. The last two columns report the Ljung-Box Q-statistic and the associated significance level (p-value). A summary of the autocorrelations test for the KSE and LSE stock is presented below in Table-2.

Table-2: Summary of Autocorrelations Test
Stocks with Significant Autocorrelation; Total Sample Size = 44

Ljung-Box Q(8) Significance Level	KSE Stocks No.	KSE Stocks %	LSE Stocks No.	LSE Stocks %
<=.01	16	36.4	14	31.8
<=.05	6	13.6	8	18.2
<=.10	3	6.8	4	9.1
Total:	25	56.8	26	59.1

The table shows that, of the 44 companies traded on the KSE, 25 stocks (56.8%) show significant serial correlation up to eight lags.[6] For the LSE stocks, of 44 stocks, 26 (or 59%) exhibit significant serial correlation. Although both stock exchanges exhibit predictability in stock returns, hence rejecting weak-form efficiency or the random walk model, the overall incidence of autocorrelation in the two stock exchanges is similar. It is worth noting that, in Pakistan's case, stock returns exhibit significant positive serial correlation in contrast to developed markets, where at the individual stock level, autocorrelations have been reported as generally negative but insignificant.

In order to directly compare the informational efficiency of the two stock exchanges, we paired the correlation coefficients (for eight lags) for each stock traded on both exchanges. The following regression was estimated:

$$\rho_{LSE,\ i,k} = \beta_0 + \beta_1 \rho_{KSE,\ i,k} + \varepsilon_{i,k} \qquad i=1,2 \ldots 44, \text{ and } k=1,2 \ldots 8$$

Here $\rho_{LSE,\ i,k}$ and $\rho_{KSE,\ i,k}$ are correlation coefficients for stock i, and for k lags (up to 8) and for 44 pairs of coefficients. If the stock trading on the two stock exchanges is equally efficient in the weak form, then we should expect to see the values for the autocorrelation coefficients, $\rho_{LSE,\ i,k}$ and $\rho_{KSE,\ i,k}$, to be statistically equal, which would imply that the intercept equals zero and the slope coefficient equals one, i.e., $E[\beta_0] = 0$, and $E[\beta_1] = 1$. Results for the cross-exchange regression of autocorrelations are reported in Table-3. While the intercept is not significantly different from zero, the slope coefficient is 0.8038 and highly significant, implying that the typical

[6] The autocorrelation coefficients beyond eight lags were generally insignificant and were not included for this test.

autocorrelation on the LSE is only about 80% that of the KSE. The lower level of predictability in the LSE stocks implies that the LSE is relatively more efficient in the weak-form sense (*or rather, less market-inefficient*).[7] The test for the null hypothesis that the slope coefficient equals one, β_1=1.0, is strongly rejected; the t-statistic is -7.74, compared to a critical t-value of 2.59 at a 1% level of significance. It should be noted that the presence of statistically significant autocorrelation does not mean that it is also financially significant, testing for which is beyond the scope of this paper.

Table-3: Cross-Exchange Regression of Autocorrelations

Dependent Variable	**LSE Autocorrelation**		**Coefficients**
Adjusted R Square	0.74	F Statistic	1006.76
Observations	352	Significance F	0.0000
	Coefficients	**t Stat**	**P-value**
Intercept	-0.0003	-0.21	0.8361
KSE Autocorrelation	0.8038	31.73	0.0000

Analysis of Time Dependence in Volatility

Stock price behavior on the two stock exchanges is further investigated by examining the presence of ***conditional autoregressive heteroskedasticity*** (GARCH) effects in the stocks traded on the exchanges. Autoregressive conditional heteroskedasticity was proposed by Engle (1982) to explain the tendency of large residuals to cluster together. We employ a generalized GARCH-M(1,1) model (Engle, Lilien, and Robins [1987]) to account for the persistence in volatility in the returns series as follows:

$$R_t = \gamma_0 + \gamma_1 h_t + u_t \qquad \text{where } u_t \sim N(0, h_t) \qquad (1)$$

$$h_t = var(u_t) = c_0 + a_1 u^2_{t-1} + b_1 h_{t-1} \qquad (2)$$

Tables-A3 and A4 (see appendix) report results from the estimation of the GARCH-M model for KSE and LSE stocks, respectively. Table-4 summarizes the number and percentage of statistically significant coefficients from the estimation of the model. The "mean" coefficient relates to (γ) in

[7] The lower degree of serial correlation for the LSE was not correlated with a relatively lower volume.

the GARCH mean equation (1) and the coefficients C, A, and B, corresponding to the GARCH variance equation (2).

As can be seen from the table, the incidence of GARCH effects is similar in both markets. Specifically, the percentage of stocks with GARCH coefficients statistically significant at conventional 10% level is close in both exchanges. Respectively for the KSE and LSE, coefficient C is significant for 93% and 100% of stocks, coefficient A is significant for 98% and 91% of stocks, and coefficient B is statistically for 84% and 82% of stocks. Hence, stocks at both exchanges exhibit significant GARCH effects to a similar extent. The presence of statistical significant GARCH effects, however, does not mean that these afford financially feasible arbitrage opportunities.

Table-4: Summary of the GARCH Model Estimation

Number and Percentage of Significant Coefficients; Total Sample Size = 44

Karachi Stock Exchange								
Significance Level	**MEAN**		**Coefficient C**		**Coefficient A**		**Coefficient B**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
<.01	8	18.2	32	72.7	39	88.6	34	77.3
<.05	4	9.1	7	15.9	2	4.5	1	2.3
<.10	1	2.3	2	4.5	2	4.5	2	4.5
Total:	13	29.5	41	93.2	43	97.7	37	84.1
Lahore Stock Exchange								
Significance Level	**MEAN**		**Coefficient C**		**Coefficient A**		**Coefficient B**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
<.01	4	9.1	29	65.9	38	86.4	33	75.0
<.05	4	9.1	9	20.5	2	4.5	2	4.5
<.10	1	2.3	6	13.6	0	0.0	1	2.3
Total:	9	20.5	44	100.0	40	90.9	36	81.8

C. Comparative Transaction Costs

In stock trading, traders incur transaction costs that may be classified as either explicit or implicit (execution costs). Researchers have used different measures of execution costs and compared these estimates across markets (e.g., Roll 1984, Berkowitz, Logue and Noser 1988, Stoll 1989, Chan and Lakonishok 1993, Hasbrouck 1993, and Choi, et al 1988). Broadly, two different measures of transaction (or execution) costs have been used: (i) quoted bid-ask spreads, and (ii) effective bid-ask spreads. In a dealer market, transactions take place at the quoted bid or ask prices. Appropriately, the quoted bid-ask spreads have been used as measures of the transaction cost (see, for example, Demsetz 1968, Branch and Freed 1977, Benston and Hagerman 1974, Huang and Stoll 1996, and Barclay, et al 1999). Security transactions, however, frequently take place inside the spread. In this case, the quoted spread will tend to overstate investors' expected trading costs. A better measure for trading costs would, therefore, be the effective spread or simply the average difference between the price at which a dealer sells at one point in time and buys at an earlier point in time, (e.g., Roll 1984 and Stoll 1985). Applications of this effective spread method to measure trading costs have been used in numerous studies. Petersen and Fialkowski (1994) estimate the spread generated for orders submitted by retail brokers and those submitted electronically to the NYSE. They find a significant difference between the posted spread and effective spread.

The LSE and KSE are both order-driven markets, i.e., orders are executed as they arrive and are matched, and quoted bid and ask prices are not available. We, therefore, use the methodology suggested by Roll (1984) to compute the implicit effective bid-ask spread from the transaction prices. Roll (1984) shows that, because of trading costs, successive observed transactions price changes are negatively correlated despite the random walk behavior of the efficient price of a stock in a perfect market. On this basis, Roll (1984) derives the covariance between successive price changes as $Cov(\Delta P_t, \Delta P_{t-1}) = -s^2/4$, where the $Cov(\Delta P_t, \Delta P_{t-1})$ term represents the first-order serial covariance of transaction price changes and s the effective bid-ask spread. The estimated value of s is a dollar-weighted average spread faced by investors who trade at the observed prices rather than at the quoted bid-ask spread and is thus an appropriate measure of trading cost. The estimated effective bid-ask spread $\hat{S}_j$ can be written as follows:

$$\hat{S}_j = 2\sqrt{-Cov(\Delta P_t, \Delta P_{t-1})}$$

Roll (1984) shows that the covariances of stock prices in an efficient market are expected to be negative because of the quick adjustments of quotes around the efficient price by market makers. In empirical research, however, most of the covariances computed using daily price data turn out to be positive, for which Roll's (1984) measure cannot be computed. Roll (1984) and Harris (1990) explain that if the stock market is less than fully efficient, the speed of price adjustment tends to be slower and results in positive correlation in daily prices rather than the theoretical negative serial correlation. When longer time intervals are used, the number of stocks with positive covariances tends to fall and more negative correlations are expected as price adjustments take place.

For most of the stocks in the sample, the covariances computed using daily data turned out to be positive and, therefore, unusable. When we used weekly data, we were able to obtain negative covariances for 32 of 44 stocks in the sample. The following steps were used to estimate the effective bid-ask spread:

i) The sample comprises 44 pairs of dually listed stocks.
ii) Weekly returns are computed by taking the first log differences of the weekly closing stock prices, $R_t = ln(P_t) - ln(P_{t-1})$.
iii) Serial covariances for each stock are computed as $Cov(R_t, R_{t-1})$.
iv) The square roots of negative covariances, $sqrt(-Cov(R_t, R_{t-1}))$, are then multiplied by 200 to convert all measurements into percentages.

Table-5: Test of Equality of the Bid-Ask Spread on the KSE and LSE

t-Test Assuming Unequal Variances	KSE Spread	LSE Spread
Mean	4.04	4.31
Variance	4.29	4.76
Observations	32	32
Hypothesized Mean Difference	0	
Degrees of Freedom	62	
t Statistic	-0.5082	
P(T<=t) one-tail	0.3065	
t Critical one-tail	1.6698	
P(T<=t) two-tail	0.6131	
t Critical two-tail	1.9990	

The covariances of weekly transaction prices for each stock and the effective bid-ask spreads computed as above are reported in Table-A5 (see appendix). As expected, when weekly prices are used, 32 KSE stocks and 33 LSE stocks exhibit negative covariances. Of 44 stocks, we have 32 usable pairs of estimates of which 16 or exactly one half have lower bid-ask spreads on the KSE than the LSE. This suggests that transaction costs on the two exchanges are similar. The mean effective bid-ask spread is 4.04 percent and

4.31 percent of the stock price on the KSE and LSE, respectively, while the mean bid-ask spread ratio is 1.00, suggesting that the bid-ask spread on the two exchanges is about the same. A formal t-test for the mean difference, reported in Table-5, fails to reject the null hypothesis of equality of means of the spread between the two exchanges.

D. Competitive and Fragmentation Effects

Trading on multiple exchanges can have two opposite effects. The first is a competitive effect, i.e., trading on multiple exchanges will likely motivate the exchanges to supply better or cheaper transactions. Specialists are also likely to trade more against price movements, damping stock price volatility. The second is a fragmentation effect: trading on more than one exchange "fragments" the total market by reducing the trading volume for every exchange and reducing exchange efficiency due to loss of economies of scale. The effect of increasing multiple exchange trading might, therefore, be to increase competition but reduce exchange efficiency. Therefore, the public policy towards multiple exchanges should consider the tradeoff between the fragmentation and competitive effects. A consideration of such a tradeoff has been an argument for establishing common trading platforms. Its proponents believe that these platforms would reduce the tradeoff by preserving competition among the exchanges, and by centralizing the transacting of listed stocks, quotations, and reporting in a computerized system to help achieve greater economies of scale.

In order to estimate the competitive and fragmentation effect of LSE trading on the effective spread on the KSE, we run three multiple regression models as follows:

$$\text{Spread}_{KSE,\ i} = \beta_0 + \beta_1 LTO_i + \beta_2\ PCLSE_i + \varepsilon_i \tag{3}$$

$$\text{Spread}_{LSE,\ i} = \beta_0 + \beta_1 LTO_i + \beta_2\ PCLSE_i + \varepsilon_i \tag{4}$$

$$KOL_i = \beta_0 + \beta_1 LTO_i + \beta_2\ PCLSE_i + \varepsilon_i \tag{5}$$

Where for each stock i,

LTO_i is the volume of trade on the LSE,

$PCLSE_i$ is the percentage of the total trading volume that takes place on the LSE,

$Spread_{KSE,i}$ and $Spread_{LSE,i}$ are the effective bid-ask spreads on the KSE and the LSE respectively, and,

KOL_i is the relative effective bid-ask spread on the two stock exchanges (i.e., KOL= $Spread_{KSE,i}/Spread_{LSE,i}$).

The percentage of the total trading volume that takes place on the LSE (PCLSE) is expected to depress spreads on both the LSE and KSE due to the fragmentation effect, but PCLSE may also reduce the relative spread due to the competitive effect. The bid-ask spread would be negatively impacted by the trade volume in any case and is controlled for by including LTO. The null hypotheses in the three models would be that H_0: $\beta_1 = \beta_2 = 0$, indicating no impact of LSE trading on the bid-ask spread either on the KSE or on the LSE. The alternative hypotheses in equations (3) and (4) are that the higher volume would decrease the spread while the fragmentation effect would increase it (H_A: $\beta_1 < 0$, $\beta_2 > 0$). In model (5) the expected sign for β_1 may be positive or negative and is negative for β_2.

All three models are estimated using weighted least squares (weighting series: LTO), with White Heteroskedasticity, Consistent Standard Errors and Covariance.[8] The results from the three regression models are reported in Tables-6, panels A, B, and C. Table-6, panel A, depicts the results of regressing the KSE spread on the explanatory variables LTO and PSLSE. The coefficients are statistically significant (p-values 0.0045, and 0.0539, respectively) and carry the expected signs. There is a negative relationship between the bid-ask spread on the KSE and the trading volume on the LSE, meaning that a higher volume leads to a lower spread (transaction costs) at the KSE, an expected effect of higher volume. At the same time, the coefficient on the relative LSE volume (PCLSE) is positive, indicating the fragmentation effect of the higher relative volume at the LSE.

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[8] Weighted LS was applied as the residuals were found to be heteroskedastic with respect to volume.

Table-6: Results of Regression of Bid-Ask Spread on LSE Volume

No of observations: 32

Method: Weighted Least Squares; Weighting series: LTO (LSE VOLUME)

White Heteroskedasticity-Consistent Standard Errors and Covariance

Panel A: Results of Regression of KSE Spread on LSE Volume

Dependent Variable: BID-ASK SPREAD ON KSE

Variable	Coefficient	t-Statistic	Prob.
LTO	-0.34	-3.08	0.0045
PCLSE	2.42	2.01	0.0539
Constant	3.54	3.35	0.0023
Adjusted R-squared	0.77	F-statistic	15.07
Durbin-Watson stat	2.12	Prob(F-statistic)	0.0000

Panel B: Results of Regression of LSE Spread on LSE Volume

Dependent Variable: BID-ASK SPREAD ON LSE

Variable	Coefficient	t-Statistic	Prob.
LTO	-0.27	-1.94	0.0624
PCLSE	5.20	3.42	0.0018
Constant	2.72	2.02	0.0522
Adjusted R-squared	0.73	F-statistic	13.82
Durbin-Watson stat	2.21	Prob(F-statistic)	0.0001

Panel C: Results of Regression of Relative Spread on LSE Volume

Dependent Variable: KOL (= relative spread, KSE Spread divided by LSE Spread)

Variable	Coefficient	t-Statistic	Prob.
LTO	-0.79	-1.57	0.1259
PCLSE	-1.23	-2.31	0.0284
Constant	1.80	3.75	0.0008
Adjusted R-squared	0.84	F-statistic	3.44
Durbin-Watson stat	2.15	Prob(F-statistic)	0.0455

Panel B of Table-6 shows the results of regressing the LSE bid-ask spread on the explanatory variables LTO and PSLSE. The coefficients are statistically significant (p-values 0.0624 and 0.0018, respectively) and carry the expected signs. There is a negative relationship between the bid-ask spread on the LSE and the trading volume on the LSE, implying that a higher volume leads to a lower spread at the LSE. At the same time, the coefficient on the relative LSE volume (PCLSE) is positive, indicating the fragmentation effect of the relatively high volume at the LSE.

Table-6, Panel C, takes the relative spread (KOL) as the dependent variable and the volume on the LSE (LTO) and relative LSE volume (PCLSE) as the explanatory variables. The coefficient on LTO is no longer significant (although is still negative) at the conventional 10% level. However, the coefficient on the PCLSE is significant and negative, indicating that an increase in the relative volume traded on the LSE leads to a reduction in the relative spread, KOL. From the estimation of models (3) and (4), it appears that a higher volume traded at the LSE decreases the spread both at the KSE as well as at the LSE. However, as the estimated model (5) shows, due to the competitive effect, the decrease in the spread on the KSE is greater than that on the LSE, causing the relative spread (KOL) to decrease. The fragmentation effect captured in models (3) and (4) is to increase the spread while controlling for the effect of volume. It seems to imply that the LSE exerts appreciable competitive pressure on transaction costs, but that the some fragmentation effect leads to higher transaction costs.[9]

E. Market Integration and Cross Dependence

In countries with multiple stock exchanges, a key question is whether or not the market is integrated: reflecting the full and timely communication of inter-market information. In a fully integrated market, trade orders have an opportunity to be matched against the best available corresponding orders across all locations. Market integration lowers the execution costs and time delays in trading and enhances the market's price efficiency.

This section examines the interrelationship between the KSE and LSE. The first subsection examines the incidence of *Granger causality* between the two exchanges. The second subsection explores the long-term

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[9] In models parallel to 3, 4 and 5, (not reported here) when KTO and PCKSE are used as explanatory variables, the coefficients on KTO are negative and significant, as expected, but the PCKSE is insignificant in all cases, implying that KSE does not seem to exert either a competitive effect or fragmenting effect on the LSE spread.

relationship in price movements across exchanges by employing an error correction model (ECM), which is further used in the third subsection to look at the short-term dynamics of stock returns between the exchanges, and in the fourth subsection to estimate the contribution of each exchange in price discovery by variance decomposition.

Granger Causality

We start looking at the interrelationship between the KSE and LSE by examining the Granger causality between the two exchanges. The Granger (1969) approach to the question of whether x causes y is to see how much of the current y can be explained by past values of y and then to see whether adding lagged values of x can improve the explanatory power; y is said to be ***Granger-caused*** by x if x helps in the prediction of y, or equivalently if the coefficients on the lagged x's are statistically significant. Granger causality measures precedence and information content but does not by itself indicate causality in the more common use of the term. To test for Granger causality, we run bivariate regressions of the following form:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_l y_{t-l} + \beta_1 x + \ldots + \beta_l x_{t-l} \tag{6}$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \ldots + \alpha_l x_{t-l} + \beta_1 y + \ldots + \beta_l y_{t-l} \tag{7}$$

for all possible pairs of (x,y) series in the group, including up to l lags. The reported F-statistics are the Wald statistics for the joint hypothesis: $\beta_1 = \ldots = \beta_l = 0$, for each equation. The null hypothesis, therefore, is that x does not Granger-cause y in the first regression and that y does not Granger-cause x in the second regression.

The Granger causality test results are reported in Table-A6 (appendix). The tests are conducted on stock returns of 44 paired stocks traded at both exchanges for two lags. Of the 44 stocks, 10 do not exhibit statistically significant Granger causality. Five stocks show evidence of significant bi-directional causality. For 21 stocks, it shows that the KSE Granger-causes the LSE, while 8 stocks show the direction of causality from the LSE to the KSE. From the LSE perspective, 13 stocks out of 44 indicate that the ***causality*** direction is from the LSE to the KSE or runs in both directions. The analysis seems to suggest that, although the information flow is predominantly from the KSE to the LSE, for a substantial proportion of stocks (29.5% of the sample) the information flow takes place from the LSE to the KSE.

Long-Term Inter-Exchange Relationship: Cointegration Tests

The long-term relationship between stock returns on the KSE and LSE are studied employing cointegration analysis, which is useful in detecting any long-term relationship between time series variables (e.g., many macroeconomic variables) that may be nonstationary (Engle and Granger 1987). We use an ECM to test the long-term relationship between stock returns on stocks traded on both exchanges. A vector error correction (VEC) representation of the model is a restricted VAR that has the cointegration restrictions built into the specifications. Endogenous variables are restricted in the VEC representation so that they converge on their cointegrating relationships in the long run. At the same time, it allows a wide range of short-run deviations from the long-run equilibrium, which are corrected through a series of partial short-run adjustments. Johansen's method tests restrictions imposed by cointegration on the unrestricted VAR model.

We hypothesize a simple long-term relationship between the exchanges, without an intercept or a trend with one cointegrating equation and two lagged difference terms as follows:

$$\Delta R_{KSE,t} = \gamma_1(R_{LSE,t-1} - \beta R_{KSE,t-1}) + \delta_1 \Delta R_{KSE,t-1} + \delta_2 \Delta R_{KSE,t-2} + \lambda_1 \Delta R_{LSE,t-1} + \lambda_2 \Delta R_{LSE,t-2} + \varepsilon_{1,t} \tag{8}$$

$$\Delta R_{LSE,t} = \gamma_2(R_{LSE,t-1} - \beta R_{KSE,t-1}) + \delta_1 \Delta R_{KSE,t-1} + \delta_2 \Delta R_{KSE,t-2} + \lambda_1 \Delta R_{LSE,t-1} + \lambda_2 \Delta R_{LSE,t-2} + \varepsilon_{2,t} \tag{9}$$

The term $\gamma_i(R_{LSE,t-1} - \beta R_{KSE,t-1})$ is the error correction term representing the long-term relationship, and coefficients γ_1 and γ_2 may be considered the speed of adjustment parameters. The cointegrating equation is: $R_{KSE,t} = \beta R_{LSE,t}$. The error correction term in a long-run equilibrium is zero. However, if R_{KSE} and R_{ISE} deviate from the long-run equilibrium in the last period, the error correction term is nonzero and the returns will adjust to partially restore the equilibrium relation.

The results of the cointegration tests are reported in Table-A7 (appendix). The null hypothesis of "none", i.e. no cointegrating equation, CE(s), and the null hypothesis of "at most 1" CE(s) is rejected for all stocks in the sample. The Log Likelihood Ratio test indicates two cointegrating equations at a 5% significance level, implying that the returns on the stocks traded on the two exchanges exhibit a long-term relationship.

Short-Term Inter-Exchange Dynamics

The long-term relationship in the ECM is "disturbed" by short-term deviations from the equilibrium. The dynamics of the short-term adjustment process can be captured by the same ECM equations (8 and 9) that were introduced in the previous section. For the ECM to hold, at least one of the γ_i's must be significant. If both the coefficients (γ_i) are significant, it implies that both series influence each other or that there is a feedback relationship between the two. If only one of the error term coefficients (γ_i) is significant, it implies that one market is driving the other toward long-term equilibrium, but not the other way around. The sign on the error term coefficient (γ_i) should be negative for the previous period's positive (negative) deviation to lead to negative (positive) correction in the current period and drive it toward equilibrium.

The lagged terms of the change in returns, $\Delta R_{KSE,t-1}$ and $\Delta R_{LSE,t-1}$, included as independent variables, indicate a short-run dynamic (or cause-and-effect) relationship between the two markets. If the lagged coefficient of ΔR_{KSE} is significant in the regression of ΔR_{LSE}, or ΔR_{KSE} significantly affects ΔR_{LSE}, it would indicate that KSE stock returns affect the returns on the LSE. Similarly, if the lagged coefficient of ΔR_{LSE} is significant in the regression of ΔR_{KSE}, we can infer that LSE stock returns affect the returns on the KSE. If neither lagged coefficient is significant, then no inter-exchange "cause-and-effect" relationship can be inferred.

The detailed results from estimating the ECM are reported in Table-A8 (see appendix). The coefficients of the cointegration equation (β_i) are highly significant (p-values < 0.01) for all stocks in the sample with a value close to negative one, except for one with a positive but insignificant coefficient. Of the 44 stocks, 16 (or 36%) of the coefficients on the error correction term (γ_1 and γ_2) are significant in both the ECM equations, indicating a bi-directional relationship between the two markets. A summary of these results is provided in Table-7, which shows that in the ECM equation (8) for ΔKSE-returns, in the case of 24 stocks (55%) the LSE seems to exert a significant influence on the KSE at a lag of 1 day. For 23 (52%) stocks, the influence of the LSE is also at the 2-lag interval. On the other hand, for equation (9) for ΔLSE-returns, 17 and 13 stocks (39% and 30%) traded on the KSE impact the LSE stocks respectively at a lag of 1 day and 2 days, respectively.

Table-7: Error Correction Model - Summary Results
No. of Significant Coefficients for 44 Total Stock Pairs

Significance Level	Error Term Coefficient	$\Delta R_{LSE,t-1}$	$\Delta R_{LSE,t-1}$	$\Delta R_{KSE,t-1}$	$\Delta R_{KSE,t-1}$
A) Model 8 - Dependent Variable: ΔKSE Returns					
1%	14	13	5	4	3
5%	5	4	10	4	1
10%	4	7	8	1	3
Total	23	24	23	9	7
B) Model 9 - Dependent Variable: ΔLSE Returns					
1%	22	12	6	7	7
5%	5	4	7	7	4
10%	4	3	4	3	2
Total	31	19	17	17	13

F. Contribution of Exchanges in Price Discovery: Variance Decomposition

When securities are traded on multiple platforms, arbitrage ensures that price differences between markets do not diverge without bound. The transaction prices on different exchanges share a common implicit efficient price that is defined statistically as the random-walk component of the observed prices. The innovation variance in this random walk is a measure of the information intensity of the efficient price process. Hasbrouck (1991) defines the information share of a market as the proportion of this innovation variance that can be attributed to that market and provides a method of depicting the system dynamics by decomposing variation in an endogenous variable into the component shocks.

Following the estimation of the ECM for each dually traded stock, a variance decomposition analysis was performed to extract the proportion of information attributable to each exchange. The results of the variance decomposition are reported in Tables-A9 and A10 (see appendix), which show the percentage share contribution of the LSE to the variation in the innovation of long-memory trend. The decomposition of variance depends critically on the ordering of equations. Therefore, Table-A9 shows the decomposition of the variance of stock returns on the KSE, given that the innovation originates in the LSE (i.e., ordering: LRET→KRET). The table reports that percentage of the variance that is attributable to the LSE. It reports the percentage of the variance attributable to the LSE when the source of innovation is KSE (Ordering: KRET→ LRET).

The variance decomposition indicates that the price discovery attributable to the LSE varies from stock to stock, but on average about 4.70% of the price discovery takes place in the LSE at a 1-day interval. The maximum relative price discovery is 21% and the minimum is 0.22%. The results show that the LSE contributes to price discovery to a noticeable extent, implying that some additional information is being generated at the LSE and brought to bear on the market.

IV. Summary and Conclusions

A comprehensive econometric analysis was performed to assess the comparative performance of the LSE in discharging its basic economic role as a stock exchange in terms of relative *market efficiency*, *transaction costs*, its contribution to *price discovery*, and the extent of *market integration*. We obtain the following results:

(i) Overall, the degree of market efficiency depicted by the pattern of autocorrelation for the two stock exchanges is quite similar. The incidence of *conditional auto-regressive heteroskedasticity* (GARCH) is also comparable.

(ii) A comparison of effective bid-ask spreads shows that there is no statistically significant difference in the mean transaction costs on the two exchanges.

(iii) There is evidence of both a competitive effect and a fragmentation effect from LSE trading on the bid-ask spread on the KSE.

(iv) The Granger causality test and cointegration analysis seems to suggest that, although the information flow occurs predominantly from the KSE to the LSE, for a substantial number of stocks the information flow takes place from the LSE to the KSE. The results depict a long-term equilibrium relationship for all the stocks in the sample. For the majority of stocks in the sample, the LSE seems to exert a significant influence on the KSE at a 1-day and 2-day lag.

(v) The extent of price discovery attributable to the LSE varies from stock to stock, but is about 4.70% on average.

Our econometric analysis suggests that the LSE is at par with the KSE in terms of informational efficiency and transaction costs. The evidence also indicates informational linkages and interdependencies between the two markets, suggesting an integrated market. The LSE appears to contribute to price discovery to an appreciable extent and to exerting competitive pressure on the KSE. Overall, our evidence presents a picture in which the LSE plays an active and competitive role.

These findings have implications for consolidation or merger decisions which may be in the interest of exchange members but not in the best public interest, thus pointing to the need for caution in that respect. With the probable merger of the Lahore and Islamabad stock exchanges with the KSE, one concern is that the current competitive environment will disappear and the emergent monopolist market may have adverse consequences for the country's capital markets. These could include higher transaction costs, less incentive for regulatory compliance and less incentive for the exchanges to play an active role in capital market development. The concentration of economic power may also lead to discriminatory practices and business abuses. A for-profit exchange, especially a monopoly, may even withdraw from the upcountry and regional market segments if considered not sufficiently profitable. Pakistan's regional stock exchanges have been regarded the hub of the financial sector and their presence is still likely to be conducive to the growth of regional financial service centers, especially in an economy where financial and business deals are based more on trust, personal networks, and communication.

Table-A1: Autocorrelation Coefficients - KSE

Symbol	Lag-1	Lag-2	Lag-3	Lag-4	Lag-5	Lag-6	Lag-7	Lag-8	Q(8-0)	Significance Level
ABL	0.141	0.015	-0.008	0.036	-0.076	-0.078	0.010	-0.071	19.39	0.013
AHSL	-0.017	-0.042	-0.034	0.015	-0.025	-0.011	0.011	0.001	2.85	0.943
AICL	0.165	0.005	0.026	-0.045	-0.058	-0.052	0.040	-0.041	25.84	0.001
BAFL	0.120	-0.014	0.009	-0.099	-0.051	-0.057	-0.035	0.033	21.54	0.006
BAHL	0.125	0.050	-0.045	-0.046	0.006	-0.063	-0.042	-0.045	19.77	0.011
BOP	0.012	0.020	0.004	-0.005	-0.063	-0.033	0.031	-0.016	4.52	0.807
BOSI	0.171	-0.051	0.031	-0.043	0.019	-0.049	-0.059	-0.078	31.14	0.000
DAWH	0.000	0.036	0.100	-0.023	-0.077	0.018	0.099	-0.057	20.71	0.008
DGKC	0.084	0.013	0.021	-0.006	-0.051	-0.020	-0.028	-0.005	7.52	0.481
DSFL	0.137	0.010	0.013	-0.042	-0.112	-0.054	0.022	-0.058	26.56	0.001
EFUG	0.053	-0.011	0.029	-0.045	-0.044	0.026	0.022	0.011	5.79	0.671
ENGRO	0.012	-0.109	0.003	-0.085	-0.072	-0.068	0.016	-0.015	19.64	0.012
FABL	0.119	-0.024	0.035	-0.046	-0.151	-0.088	-0.034	-0.019	33.23	0.000
FCCL	0.105	-0.039	-0.004	-0.077	-0.031	0.020	0.038	-0.066	17.02	0.030
FFBL	-0.005	-0.028	0.023	-0.019	-0.002	-0.026	-0.011	0.003	1.65	0.990
HMB	0.026	-0.044	-0.011	-0.009	0.046	-0.029	0.035	-0.055	2.14	0.976
HUBC	0.036	-0.100	0.032	-0.045	-0.048	0.022	-0.005	-0.052	13.10	0.109
ICI	0.091	-0.076	0.021	0.024	0.019	-0.017	-0.030	-0.047	12.33	0.137
JOVC	0.400	0.193	0.140	0.124	0.089	0.078	0.065	0.015	165.27	0.000
KAPCO	0.019	-0.012	0.045	0.042	0.043	0.029	-0.001	0.035	4.84	0.775
LAKST	0.062	0.084	0.125	0.079	0.081	0.001	0.050	0.044	29.02	0.000
LUCKY	0.164	0.015	0.017	0.010	-0.040	-0.050	-0.057	-0.003	22.96	0.003
MCB	0.098	0.009	0.017	-0.037	-0.120	-0.079	-0.050	0.037	23.68	0.003
MLCF	0.149	0.000	0.037	0.001	-0.065	-0.054	-0.066	-0.006	23.28	0.003
NBP	0.074	0.039	0.050	-0.002	0.040	-0.031	-0.020	-0.015	8.43	0.393
NIB	0.020	-0.053	-0.045	-0.044	-0.053	-0.070	-0.062	-0.033	13.23	0.104
NML	0.168	0.033	-0.011	-0.091	-0.082	-0.019	-0.041	-0.034	31.55	0.000
NRL	0.108	0.009	-0.047	-0.038	0.000	-0.079	0.036	0.008	15.19	0.056
OGDC	0.126	0.091	0.077	0.013	0.000	0.047	0.028	0.034	22.69	0.004
PAKRI	0.166	0.024	0.029	-0.062	-0.042	0.011	-0.024	-0.001	23.15	0.003
PCCL	0.093	-0.075	-0.002	-0.043	-0.041	-0.051	0.001	-0.038	14.42	0.071
PICIC	0.116	-0.041	0.012	0.005	-0.017	-0.065	0.001	-0.046	14.47	0.070
PKGS	-0.036	-0.072	0.050	-0.058	-0.025	0.020	-0.018	-0.017	9.24	0.323
POL	0.073	0.015	-0.010	0.063	-0.028	-0.006	0.042	-0.015	8.24	0.410
PPL	0.107	0.046	0.090	0.044	-0.023	0.022	0.025	0.037	17.55	0.025
PSMC	-0.042	-0.034	0.021	-0.051	0.002	-0.011	-0.027	0.004	4.22	0.837
PSO	0.042	-0.067	0.040	0.023	-0.052	-0.025	0.014	-0.037	8.72	0.366
PTC	0.068	-0.047	0.027	-0.042	-0.052	0.056	0.010	-0.029	10.70	0.219
SCBPL	0.220	0.033	-0.096	-0.146	-0.136	-0.092	-0.043	-0.103	12.30	0.138
SHELL	0.068	-0.056	0.005	0.009	0.004	0.006	0.015	-0.049	6.99	0.538
SPCB	0.107	-0.071	0.052	0.049	-0.035	-0.051	0.030	-0.039	18.43	0.018
SSGC	0.098	0.059	-0.035	0.007	-0.120	-0.133	-0.034	-0.055	33.63	0.000
UBL	0.117	-0.091	-0.105	-0.071	-0.016	0.036	0.005	0.045	21.65	0.006
WTL	-0.007	0.036	0.035	-0.008	0.092	-0.015	0.048	-0.028	4.31	0.828
PKSE100	0.102	-0.005	0.065	-0.004	-0.056	-0.019	0.000	-0.020	12.26	0.140

Table-A2: Autocorrelation Coefficients - LSE

Symbol	Lag-1	Lag-2	Lag-3	Lag-4	Lag-5	Lag-6	Lag-7	Lag-8	Q(8-0)	Significance Level
ABL	0.009	0.005	0.005	-0.042	-0.006	0.001	-0.004	-0.030	1.43	0.994
AHSL	-0.021	-0.043	-0.030	0.012	-0.026	-0.009	0.008	0.006	2.77	0.948
AICL	0.175	0.000	0.019	-0.020	-0.051	-0.056	0.009	-0.037	25.40	0.001
BAFL	0.126	-0.013	-0.002	-0.097	-0.051	-0.051	-0.034	0.033	21.72	0.005
BAHL	0.097	0.061	-0.043	-0.058	-0.016	-0.036	-0.041	-0.072	17.67	0.024
BOP	0.004	0.020	0.006	-0.003	-0.078	-0.022	0.026	-0.010	5.15	0.741
BOSI	0.165	-0.051	0.027	-0.041	0.009	-0.041	-0.062	-0.076	28.76	0.000
DAWH	-0.007	0.046	0.082	-0.032	-0.080	0.040	0.082	-0.043	17.56	0.025
DGKC	0.082	0.011	0.032	-0.013	-0.050	-0.015	-0.036	-0.012	8.09	0.424
DSFL	0.102	0.001	0.028	-0.065	-0.066	-0.071	0.031	-0.052	18.78	0.016
EFUG	0.052	-0.006	0.026	-0.043	-0.043	0.018	0.025	0.008	5.39	0.715
ENGRO	-0.029	-0.147	0.035	-0.042	-0.070	-0.087	-0.007	0.009	25.20	0.001
FABL	0.135	-0.037	0.049	-0.058	-0.147	-0.105	-0.020	-0.010	38.75	0.000
FCCL	0.088	-0.035	0.004	-0.088	-0.017	0.010	0.033	-0.061	14.53	0.069
FFBL	0.072	-0.061	0.000	-0.059	-0.079	-0.096	-0.041	-0.036	20.42	0.009
HMB	-0.017	-0.009	0.032	-0.035	0.038	-0.067	0.013	-0.050	7.43	0.491
HUBC	0.026	-0.115	0.049	-0.010	-0.076	0.000	0.022	-0.047	16.37	0.037
ICI	0.012	-0.018	0.020	0.021	0.001	-0.022	-0.004	-0.051	2.95	0.937
JOVC	0.384	0.204	0.151	0.130	0.080	0.072	0.056	0.021	160.60	0.000
KAPCO	0.013	-0.034	0.065	0.078	0.006	0.025	-0.007	0.067	9.99	0.266
LAKST	0.079	0.101	0.114	0.087	0.074	0.008	0.044	0.045	30.68	0.000
LUCK	0.141	0.004	0.032	0.017	-0.060	-0.030	-0.068	0.017	20.15	0.010
MCB	0.085	0.018	0.022	-0.041	-0.113	-0.073	-0.061	0.044	22.03	0.005
MLCF	0.076	-0.085	0.012	0.051	-0.051	-0.044	-0.110	-0.009	12.50	0.130
NBP	0.084	0.031	0.051	0.006	0.034	-0.028	-0.022	-0.017	8.79	0.360
NIB	0.015	-0.065	-0.040	-0.046	-0.037	-0.067	-0.078	-0.030	13.97	0.083
NML	0.144	0.031	0.007	-0.073	-0.087	-0.015	-0.038	-0.043	25.02	0.002
NRL	0.105	0.009	-0.057	-0.032	-0.005	-0.078	0.043	0.013	15.57	0.049
OGDC	0.117	0.104	0.079	0.015	-0.011	0.047	0.025	0.028	23.02	0.003
PAKRI	0.166	0.026	0.027	-0.062	-0.041	0.006	-0.033	0.023	23.73	0.003
PCCL	0.126	-0.072	-0.006	-0.064	-0.035	-0.035	-0.043	-0.011	19.46	0.013
PICIC	0.107	-0.005	-0.004	-0.052	-0.027	-0.067	0.033	-0.048	15.11	0.057
PKGS	-0.027	-0.089	0.048	-0.053	-0.033	0.011	0.001	-0.021	10.24	0.248
POL	0.098	0.055	0.088	0.045	-0.034	0.018	0.021	0.035	16.89	0.031
PPL	0.098	0.055	0.088	0.045	-0.034	0.018	0.021	0.035	16.89	0.031
PSMC	0.093	-0.036	0.006	-0.054	-0.029	-0.005	-0.024	0.012	9.46	0.305
PSO	0.038	-0.076	0.047	0.005	-0.046	-0.028	0.022	-0.038	9.46	0.305
PTC	0.059	-0.043	0.038	-0.040	-0.053	0.071	0.002	-0.034	11.50	0.175
SCBPL	-0.024	-0.028	-0.014	-0.008	-0.010	0.015	0.026	0.026	0.34	1.000
SHELL	0.070	-0.049	-0.003	0.004	-0.002	0.021	0.013	-0.056	7.32	0.503
SPCB	0.083	-0.054	0.043	0.047	-0.021	-0.083	0.018	-0.011	14.33	0.074
SSGC	0.082	0.057	-0.019	-0.010	-0.114	-0.125	-0.036	-0.069	30.03	0.000
UBL	-0.013	-0.026	-0.034	0.014	-0.007	0.006	0.023	-0.001	1.46	0.993
WTL	-0.008	-0.010	0.000	-0.007	0.004	-0.020	0.003	-0.009	0.47	1.000
LSE25	0.080	0.023	0.068	-0.009	-0.045	-0.003	0.007	-0.026	9.45	0.306

Table-A3: Results of GARCH Estimation - Karachi Stock Exchange

Symbol	Mean			C			A			B		
	Coeff	T-Stat	Signif	Coeff	T-Stat	Signif	Coeff	T-Stat	Signif	Coeff	T-Stat	Signif
ABL	0.0020	0.00	0.00	0.0007	0.00	0.00	0.0500	0.00	0.00	0.0500	0.00	0.00
AHSL	-0.0014	-0.56	0.58	0.0040	50.49	0.00	-0.0018	-0.92	0.36	0.0060	0.11	0.91
AICL	0.0021	1.95	0.05	0.0004	3.04	0.00	0.2902	4.17	0.00	0.2689	1.55	0.12
BAFL	0.0000	-0.02	0.98	0.0001	2.43	0.01	0.3343	4.10	0.00	0.6110	6.60	0.00
BAHL	0.0041	7.23	0.00	0.0003	7.87	0.00	2.6334	6.94	0.00	-0.0014	-0.55	0.58
BOP	0.0003	0.27	0.79	0.0008	14.07	0.00	0.2940	4.06	0.00	-0.0075	-0.25	0.80
BOSI	-0.0014	-1.27	0.20	0.0003	4.32	0.00	0.2915	4.54	0.00	0.4130	4.16	0.00
DAWH	-0.0002	-0.21	0.83	0.0000	1.76	0.08	0.1173	3.31	0.00	0.7957	10.31	0.00
DGKC	0.0015	1.38	0.17	0.0002	2.27	0.02	0.1827	2.47	0.01	0.5201	2.78	0.01
DSFL	-0.0009	-0.82	0.41	0.0001	2.50	0.01	0.1209	4.14	0.00	0.8303	19.71	0.00
EFUG	0.0009	1.46	0.14	0.0020	99.12	0.00	0.0500	3.11	0.00	0.0500	7.74	0.00
ENGRO	0.0015	1.98	0.05	0.0001	4.00	0.00	0.2334	4.53	0.00	0.6294	9.49	0.00
FABL	0.0009	0.96	0.34	0.0001	3.45	0.00	0.1505	3.93	0.00	0.7750	16.68	0.00
FCCL	0.0001	0.07	0.95	0.0002	3.07	0.00	0.2260	3.89	0.00	0.5832	5.76	0.00
FFBL	-0.0019	-3.05	0.00	0.0002	7.34	0.00	0.6755	4.01	0.00	0.2182	3.52	0.00
FFBL	-0.0005	-0.17	0.87	0.0005	131.3	0.00	-0.0017	-57.75	0.00	0.9020	1919.7	0.00
HMB	-0.0008	-0.64	0.52	0.0000	2.35	0.02	1.3341	5.77	0.00	0.4154	7.65	0.00
HUBC	-0.0002	-0.23	0.82	0.0002	4.32	0.00	0.2418	3.65	0.00	0.2320	1.62	0.10
ICI	0.0020	2.51	0.01	0.0000	2.81	0.01	0.1933	3.80	0.00	0.7351	11.36	0.00
JOVC	-0.0003	-0.28	0.78	0.0003	4.88	0.00	0.6406	7.99	0.00	0.2405	3.37	0.00
KAPCO	0.0006	0.97	0.33	0.0001	4.58	0.00	0.4542	3.16	0.00	0.3449	3.40	0.00
LAKST	0.0002	0.27	0.79	0.0001	8.91	0.00	0.4979	4.50	0.00	0.2090	3.69	0.00
LUCKY	0.0022	2.11	0.03	0.0001	2.81	0.00	0.2003	4.57	0.00	0.6780	9.37	0.00
MCB	0.0031	3.19	0.00	0.0001	2.38	0.02	0.1500	3.36	0.00	0.7744	11.78	0.00
MLCF	-0.0007	-0.68	0.49	0.0003	3.07	0.00	0.3129	4.13	0.00	0.2905	1.68	0.09
NBP	0.0025	2.68	0.01	0.0002	2.66	0.01	0.2676	3.72	0.00	0.5326	4.22	0.00
NIB	-0.0058	-5.30	0.00	0.0003	3.89	0.00	1.2796	5.35	0.00	0.2246	2.11	0.04
NML	0.0013	1.49	0.14	0.0001	3.13	0.00	0.2114	4.49	0.00	0.6880	10.85	0.00
NRL	-0.0001	-0.14	0.89	0.0001	2.92	0.00	0.2802	4.51	0.00	0.6028	7.06	0.00
OGDC	0.0009	1.38	0.17	0.0000	2.93	0.00	0.1615	5.36	0.00	0.8089	25.34	0.00
PAKRI	0.0010	0.98	0.33	0.0001	2.39	0.02	0.2304	3.85	0.00	0.6697	7.62	0.00
PCCL	-0.0004	-0.37	0.71	0.0004	3.35	0.00	0.2410	4.03	0.00	0.3980	2.88	0.00
PICIC	-0.0022	-2.14	0.03	0.0006	11.12	0.00	0.3760	3.82	0.00	-0.0079	-0.28	0.78
PKGS	0.0005	0.77	0.44	0.0001	3.14	0.00	0.1931	4.44	0.00	0.6299	8.09	0.00
POL	0.0004	0.42	0.67	0.0000	0.55	0.58	0.0656	6.00	0.00	0.9520	178.36	0.00
PPL	0.0011	1.30	0.19	0.0000	1.87	0.06	0.1361	3.13	0.00	0.8297	14.67	0.00
PSMC	0.0012	0.04	0.97	0.0009	0.03	0.97	0.0500	1.76	0.08	0.0500	1.76	0.08
PSO	0.0004	0.54	0.59	0.0000	2.83	0.00	0.1897	4.19	0.00	0.7640	15.56	0.00
PTC	0.0005	0.55	0.58	0.0000	2.50	0.01	0.1861	3.86	0.00	0.7399	10.97	0.00
SCBPL	-0.0022	0.00	0.00	0.0006	0.00	0.00	0.0500	0.00	0.00	0.0500	0.00	0.00
SHELL	-0.0009	-1.04	0.30	0.0005	7.77	0.00	0.1245	2.28	0.02	0.0232	0.23	0.82
SPCB	0.0005	0.43	0.66	0.0002	3.13	0.00	0.2329	4.47	0.00	0.5241	5.02	0.00
SSGC	0.0004	0.48	0.63	0.0000	2.71	0.01	0.1604	4.20	0.00	0.7797	15.57	0.00
UBL	0.0018	0.00	0.00	0.0008	0.00	0.00	0.0500	0.00	0.00	0.0500	0.00	0.00
WTL	0.0020	1.24	0.22	0.0002	1.28	0.20	0.1177	1.79	0.07	0.6518	2.98	0.00
PKSE100	0.0022	4.34	0.00	0.0000	3.61	0.00	0.2160	5.38	0.00	0.7353	17.55	0.00

Table-A4: Results of GARCH Estimation Lahore Stock Exchange

	Mean			C			A			B		
Symbol	Coeff	T-Stat	Signif	Coeff	T-Stat	Signif	Coeff	T-Stat	Signif	Coeff	T-Stat	Signif
ABL	0.0063	1.52	0.13	0.0042	21.21	0.00	-0.0013	-1.03	0.30	0.1753	6.65	0.00
AHSL	-0.0014	-0.59	0.56	0.0042	12.20	0.00	-0.0017	-0.73	0.47	-0.0566	-1.53	0.13
AICL	0.0021	1.93	0.05	0.0003	2.47	0.01	0.2806	3.74	0.00	0.3499	1.79	0.07
BAFL	-0.0003	-0.33	0.74	0.0002	2.82	0.00	0.3563	4.82	0.00	0.5431	5.93	0.00
BAHL	0.0045	6.98	0.00	0.0003	7.45	0.00	2.1135	5.92	0.00	-0.0033	-1.11	0.27
BOP	0.0006	0.49	0.62	0.0008	12.66	0.00	0.3179	4.36	0.00	-0.0083	-0.35	0.72
BOSI	-0.0012	-1.17	0.24	0.0003	4.66	0.00	0.3339	4.64	0.00	0.3606	3.72	0.00
DAWH	-0.0002	-0.26	0.80	0.0000	1.68	0.09	0.1121	3.14	0.00	0.8154	11.18	0.00
DGKC	0.0016	1.32	0.19	0.0002	1.88	0.06	0.1758	2.19	0.03	0.5364	2.44	0.01
DSFL	-0.0010	-0.97	0.33	0.0000	2.58	0.01	0.1336	4.31	0.00	0.8293	22.70	0.00
EFUG	0.0008	2.41	0.02	0.0017	3904.9	0.00	-0.0039	-169.7	0.00	0.0806	29.60	0.00
ENGRO	0.0013	1.58	0.11	0.0001	2.91	0.00	0.1947	3.84	0.00	0.6830	8.74	0.00
FABL	0.0004	0.41	0.68	0.0001	3.46	0.00	0.1487	4.63	0.00	0.7733	18.63	0.00
FCCL	-0.0002	-0.15	0.88	0.0002	3.12	0.00	0.2386	3.93	0.00	0.5541	5.12	0.00
FFBL	0.0012	1.48	0.14	0.0001	2.48	0.01	0.1584	3.24	0.00	0.7143	8.11	0.00
HMB	0.0000	-0.01	0.99	0.0011	16.91	0.00	0.0007	0.14	0.89	0.0299	0.40	0.69
HUBC	-0.0001	-0.19	0.85	0.0002	2.50	0.01	0.1593	3.26	0.00	0.2874	1.19	0.23
ICI	0.0019	2.14	0.03	0.0001	3.13	0.00	0.1620	3.93	0.00	0.7313	11.72	0.00
JOVC	-0.0005	-0.43	0.67	0.0004	3.76	0.00	0.6015	7.25	0.00	0.2585	2.97	0.00
KAPCO	0.0002	0.34	0.74	0.0002	4.79	0.00	0.3366	3.30	0.00	0.1877	1.43	0.15
LAKST	0.0003	0.43	0.67	0.0002	9.06	0.00	0.4096	4.21	0.00	0.2295	4.21	0.00
LUCK	0.0022	2.18	0.03	0.0001	2.56	0.01	0.1882	4.34	0.00	0.7055	9.88	0.00
MCB	0.0030	3.04	0.00	0.0000	2.46	0.01	0.1194	3.58	0.00	0.8203	17.25	0.00
MLCF	0.0009	0.61	0.54	0.0001	1.65	0.10	0.1639	2.58	0.01	0.7428	6.95	0.00
NBP	0.0024	2.46	0.01	0.0001	2.44	0.01	0.2283	3.67	0.00	0.6121	5.51	0.00
NIB	-0.0067	-6.21	0.00	0.0000	1.66	0.10	0.4511	6.93	0.00	0.0326	22.63	0.00
NML	0.0014	1.59	0.11	0.0001	3.27	0.00	0.1977	4.71	0.00	0.7087	12.68	0.00
NRL	-0.0002	-0.25	0.80	0.0001	2.76	0.01	0.2765	4.44	0.00	0.6062	6.86	0.00
OGDC	0.0009	1.28	0.20	0.0000	2.77	0.01	0.1597	5.03	0.00	0.8094	23.01	0.00
PAKRI	0.0011	1.12	0.26	0.0001	2.13	0.03	0.2159	3.47	0.00	0.6552	5.84	0.00
PCCL	-0.0008	-0.65	0.52	0.0004	4.23	0.00	0.2819	4.24	0.00	0.3345	2.78	0.01
PICIC	0.0003	0.26	0.79	0.0002	3.86	0.00	0.2100	3.95	0.00	0.5738	6.29	0.00
PKGS	0.0005	0.66	0.51	0.0001	2.91	0.00	0.1876	4.37	0.00	0.6155	6.79	0.00
POL	0.0011	1.34	0.18	0.0000	1.87	0.06	0.1461	3.03	0.00	0.8170	13.07	0.00
PPL	0.0011	1.34	0.18	0.0000	1.87	0.06	0.1461	3.03	0.00	0.8170	13.07	0.00
PSMC	0.0011	1.07	0.28	0.0007	18.06	0.00	0.1818	35.61	0.00	-0.0308	-17.40	0.00
PSO	0.0004	0.62	0.54	0.0000	3.04	0.00	0.1798	5.03	0.00	0.7757	19.32	0.00
PTC	0.0006	0.73	0.47	0.0000	2.69	0.01	0.1916	4.22	0.00	0.7454	12.79	0.00
SCBPL	-0.0013	-0.84	0.40	0.0002	3.56	0.00	2.9748	4.72	0.00	0.0393	1.58	0.11
SHELL	-0.0008	-0.89	0.38	0.0005	5.50	0.00	0.1187	2.17	0.03	0.0525	0.35	0.73
SPCB	0.0007	0.58	0.56	0.0003	2.75	0.01	0.2253	4.00	0.00	0.5118	3.94	0.00
SSGC	0.0004	0.48	0.63	0.0000	2.37	0.02	0.1803	3.85	0.00	0.7459	11.04	0.00
UBL	-0.0023	-5.66	0.00	0.0005	11.51	0.00	3.4123	50.05	0.00	-0.0006	-2.40	0.02
WTL	0.0032	0.77	0.44	0.0091	21.75	0.00	-0.0003	-0.33	0.74	-0.0373	-2.97	0.00
LSE25	0.0015	2.24	0.03	0.0000	3.46	0.00	0.2198	5.67	0.00	0.7360	17.94	0.00

Table-A5: Covariance and Bid-Ask Spreads Using Weekly Data

	KSE			LSE			Relative Spread
Stock	Covariance		b-a spread	Covariance		b-a spread	KSE/LSE (1)
ABL	(0.00049)		4.42	(0.00050)		4.45	0.994
AHSL	(0.00143)		7.57	(0.00167)		8.17	0.926
AICL	(0.00050)		4.49	(0.00022)		2.96	1.516
BAFL	(0.00067)		5.17	(0.00065)		5.10	1.013
BAHL	(0.00061)		4.94	(0.00087)		5.89	0.839
BOP	0.00054	*		0.00051	*		
BOSI	(0.00044)		4.22	(0.00060)		4.89	0.862
DAWH	(0.00018)		2.69	(0.00029)		3.41	0.789
DGKC	(0.00001)		0.73	(0.00000)		0.36	2.037
DSFL	(0.00066)		5.14	(0.00046)		4.28	1.201
EFUG	(0.00004)		1.30	(0.00004)		1.25	1.037
ENGRO	(0.00035)		3.73	(0.00038)		3.90	0.957
FABL	(0.00043)		4.16	(0.00051)		4.52	0.919
FCCL	(0.00037)		3.86	(0.00052)		4.58	0.843
FFBL	(0.00039)		3.94	(0.00067)		5.17	0.763
HMB	0.00109	*		0.00006	*		
HUBC	(0.00007)		1.64	(0.00007)		1.62	1.013
ICI	0.00009	*		0.00006	*		
JOVC	0.00359	*		0.00359	*		
KAPCO	0.00011	*		0.00004	*		
LAKST	0.00051	*		0.00053	*		
LUCKY	(0.00040)		3.99	(0.00046)		4.31	0.927
MCB	(0.00020)		2.85	(0.00007)		1.64	1.740
MLCF	(0.00057)		4.77	(0.00051)		4.53	1.054
NBP	0.00051	*		0.00050	*		
NIB	(0.00315)		11.23	(0.00375)		12.24	0.917
NML	(0.00056)		4.74	(0.00055)		4.68	1.013
NRL	(0.00018)		2.70	(0.00017)		2.58	1.048
OGDC	0.00087	*		0.00083	*		
PAKRI	(0.00039)		3.94	(0.00030)		3.48	1.131
PCCL	(0.00119)		6.89	(0.00118)		6.88	1.002

PICIC	(0.00001)		0.65	(0.00043)		4.13	0.157
PKGS	(0.00037)		3.82	(0.00051)		4.50	0.850
POL	0.00040	*		0.00071	*		
PPL	0.00076	*		0.00071	*		
PSMC	(0.00097)		6.23	(0.00070)		5.28	1.180
PSO	(0.00017)		2.61	(0.00015)		2.45	1.064
PTC	(0.00008)		1.74	(0.00009)		1.94	0.897
SCBPL	(0.00024)		3.13	(0.00074)		5.44	0.575
SHELL	0.00014	*		0.00011	*		
SPCB	(0.00021)		2.88	(0.00060)		4.91	0.585
SSGC	(0.00061)		4.94	(0.00060)		4.92	1.004
UBL	(0.00043)		4.15	(0.00030)		3.45	1.202
WTL	0.00085	*		(0.00026)		3.23	
Average Spread			4.04			4.28	1.00

Notes: (1) *'d are stocks with Covariance > 0 (2) no of stocks with negative covariance is 32 and 33 for KSE and LSE respectively. Stocks with positive covariance were ignored (3) No of stocks for which relative spread KSE/LSE < 1 is 16. No of stocks for which relative spread KSE / LSE >= 1 is 16 (5) Relative spread is the KSE spread divided by the LSE spread (6) the bid-ask spreads are in percentage of the stock prices (7) The estimated bid-asks spread is S_j=200x-Cov_j , where Cov_j is the serial-covariance of returns on stock j.

Table-A6: Results of the Granger Causality Tests

Symbol	Null Hypothesis: KRET does not Granger Cause LRET			Null Hypothesis: LRET does not Granger Cause KRET		
	F-Statistic	Probability		F-Statistic	Probability	
ABL	42.37	0.0000	***	0.44	0.6470	
AHSL	1.85	0.1587		0.50	0.6061	
AICL	11.13	0.0000	***	0.11	0.8971	
BAFL	0.35	0.7032		4.30	0.0140	**
BAHF	9.10	0.0001	***	2.18	0.1135	
BOP	0.16	0.8486		3.02	0.0493	**
BOSI	5.96	0.0027	***	0.59	0.5569	
DAWH	3.35	0.0355	**	1.32	0.2686	
DGKC	0.49	0.6150		4.06	0.0177	**
DSFL	12.81	0.0000	***	0.12	0.8826	
EFUG	0.15	0.8615		1.47	0.2307	
ENGRO	22.50	0.0000	***	0.17	0.8446	
FABL	15.47	0.0000	***	0.26	0.7738	
FCCL	1.88	0.1531		8.36	0.0003	***
FFBL	0.22	0.8057		2.10	0.1235	
HMB	24.57	0.0000	***	14.09	0.0000	***
HUBC	6.60	0.0015	***	1.99	0.1376	
ICI	33.76	0.0000	***	0.99	0.3706	
JOVC	10.75	0.0000	***	0.55	0.5790	
KAPCO	1.82	0.1624		0.95	0.3859	
LAKST	0.68	0.5066		1.85	0.1588	
LUCK	13.93	0.0000	***	0.45	0.6394	
MCB	0.49	0.6140		2.61	0.0746	*
MLCF	2.33	0.0984	*	2.40	0.0922	*
NBP	1.02	0.3606		3.24	0.0397	**
NIB	3.80	0.0228	**	1.58	0.2068	
NML	7.36	0.0007	***	0.28	0.7552	
NRL	4.38	0.0130	**	0.97	0.3801	
OGDC	3.89	0.0209	**	4.09	0.0172	**
PAKRI	3.21	0.0409	**	0.12	0.8883	

PCCL	1.20	0.3016		13.03	0.0000	***
PICIC	7.46	0.0006	***	8.81	0.0002	***
PKGS	7.01	0.0010	***	0.05	0.9474	
POL	15.07	0.0000	***	1.42	0.2416	
PPL	2.12	0.1207		0.64	0.5270	
PSMC	0.35	0.7032		0.09	0.9164	
PSO	1.57	0.2082		3.50	0.0306	**
PTC	0.37	0.6908		1.21	0.2997	
SCBPL	0.16	0.8511		1.52	0.2241	
SHELL	2.11	0.1224		0.32	0.7228	
SPCB	18.33	0.0000	***	1.82	0.1629	
SSGC	4.49	0.0116	**	2.57	0.0776	*
UBL	10.24	0.0000	***	0.21	0.8124	
WTL	12.71	0.0000	***	1.34	0.2637	

Table-A7: Summary Results from Cointegration Tests

	Johansen Cointegrating Test				Normalized Cointegrating Coefficients		
Symbol	Eigen-value	Likelihood Ratio	Eigen-value	Likelihood Ratio	KRET	SE	Likelihood Ratio
ABL	0.5288	489.20	0.2084	115.93	-0.9580	0.0140	2500.17
AHSL	0.3739	437.64	0.1837	132.35	-1.0010	0.0019	3485.75
AICL	0.4138	508.86	0.2165	159.57	-1.0078	0.0085	3564.64
BAFL	0.4730	594.56	0.2376	176.86	-0.9931	0.0038	3917.52
BAHF	0.4494	575.67	0.2469	185.42	-0.9957	0.0048	3834.67
BOP	0.5016	631.97	0.2388	177.92	-1.0042	0.0028	4068.83
BOSI	0.4513	558.93	0.2266	167.55	-1.0053	0.0056	3704.17
DAWH	0.4445	538.00	0.2092	153.48	-1.0009	0.0064	4124.55
DGKC	0.4563	563.13	0.2246	165.89	-1.0128	0.0030	4163.46
DSFL	0.4749	588.18	0.2273	168.13	-0.9923	0.0076	3422.37
EFUG	0.4533	570.70	0.2357	175.81	-1.0035	0.0039	3534.25
ENGRO	0.5055	667.91	0.2717	207.30	-1.0174	0.0117	3636.17
FABL	0.5388	668.61	0.2225	164.06	-1.0386	0.0080	3562.49
FCCL	0.5810	828.25	0.3286	260.19	-1.0011	-0.0054	3649.62
FFLB	0.3463	432.10	0.2107	154.52	-0.3191	-0.1161	4058.08
HMB	0.4791	186.21	0.2398	55.12	-1.0121	0.0090	1087.11
HUBC	0.4987	639.40	0.2518	189.15	-0.9908	0.0091	4004.91
ICI	0.5122	646.06	0.2367	176.62	-0.9773	0.0123	3436.31
JOVC	0.4964	558.66	0.1571	111.46	-1.0032	0.0044	3517.33
KAPCO	0.3132	368.48	0.2270	149.85	-1.0585	0.0208	3520.65
LAKST	0.4076	476.94	0.1859	134.51	-0.9971	0.0037	4807.63
LUCK	0.4624	567.80	0.2214	163.15	-1.0012	0.0060	3746.01
MCB	0.4779	589.45	0.2245	165.73	-0.9966	0.0040	4000.97
MLCF	0.4223	311.12	0.2466	105.90	-1.0133	0.0087	2104.76
NBP	0.4680	569.22	0.2149	157.72	-1.0019	0.0021	4437.26
NIB	0.4237	573.23	0.2778	212.84	-1.0084	0.0076	2924.77
NML	0.4516	564.31	0.2326	172.60	-0.9977	0.0066	3748.64
NRL	0.5048	650.59	0.2532	190.93	-1.0014	0.0026	4438.98
OGDC	0.4498	527.71	0.1910	138.18	-1.0049	0.0028	4435.93
PAKRI	0.5145	634.16	0.2189	161.56	-0.9999	0.0022	4347.73
PCCL	0.4595	586.52	0.2474	185.35	-1.0087	0.0088	3387.73
PICIC	0.4678	586.54	0.2357	175.30	-1.0471	0.0127	3295.47

PKGS	0.4700	606.67	0.2538	191.44	-0.9937	0.0058	4230.91
POL	0.4531	566.92	0.2336	173.49	-1.0049	0.0098	3479.09
PPL	0.4425	524.77	0.1979	143.79	-1.0094	0.0030	4264.33
PSMC	0.6082	823.48	0.3295	246.24	-1.0002	-0.0015	4371.74
PSO	0.4241	545.11	0.2455	184.23	-1.0049	0.0043	4311.74
PTC	0.4196	532.59	0.2387	177.82	-0.9956	0.0050	4087.48
SCBPL	0.4728	92.41	0.2829	31.60	-1.0242	0.0148	585.20
SHELL	0.1697	164.82	0.0675	45.02	-1.0014	0.0031	4264.60
SPCB	0.4783	593.11	0.2282	168.93	-0.9946	0.0092	3342.38
SSGC	0.4554	576.54	0.2416	180.32	-1.0049	0.0058	3857.74
UBL	0.4193	461.93	0.3001	183.06	-0.9917	0.0091	2854.29
WTL	0.4544	242.31	0.2075	67.21	-0.9917	0.0200	1459.30

Note: The null hypothesis of none CE(s) and the null hypothesis of 'at most 1' CE(s) is rejected in all cases, since the 1 percent critical values are 16.31 and 6.51 respectively. L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Table-A8: Results of the Error Correction Model

Symbol	Cointegration Coefficient		Dep. Variable	Error Term Coefficient		$\Delta R_{LSE,t-1}$		$\Delta R_{LSE,t-2}$		$\Delta R_{KSE,t-1}$		$\Delta R_{KSE,t-2}$		Adj. R^2	F-Statistic
ABL	-0.96	***	ΔKRET	-1.17	***	0.34	*	0.19	*	-0.84	***	-0.45	***	0.29	51.83
			ΔLRET	1.42	***	-0.53	***	-0.16		-0.06		-0.16	*	0.42	90.84
AHSL	-1.00	***	ΔKRET	0.56		-0.89		-0.19		0.24		-0.15		0.32	77.67
			ΔLRET	2.86	*	-1.52		-0.39		0.86		0.05		0.33	80.03
AICL	-0.99	***	ΔLRET	-1.39	***	0.02		-0.12		-0.52	*	-0.19		0.27	62.77
			ΔKRET	0.56		-0.42		-0.30	*	-0.11		-0.03		0.25	55.96
BAFL	-0.99	***	ΔLRET	-1.27		0.33		0.02		-0.87		-0.34		0.26	57.84
			ΔKRET	1.15		-0.37		-0.15		-0.19		-0.17		0.27	61.75
BAHL	-1.00	***	ΔKRET	-0.34		-0.14		-0.25		-0.43		0.01		0.26	58.48
			ΔLRET	1.87	***	-0.73		-0.43	*	0.15		0.17		0.30	70.56
BOP	-1.00	***	ΔLRET	-0.71		0.15		0.37		-0.83		-0.70		0.34	83.93
			ΔKRET	1.78	*	-0.60		0.10		-0.07		-0.43		0.34	84.17
BOSI	-1.01	***	ΔLRET	-1.32	**	-0.01		-0.14		-0.49		-0.21		0.26	59.56
			ΔKRET	0.91	*	-0.59		-0.32		0.10		-0.05		0.25	55.13
DAWH	-1.00	***	ΔKRET	0.87	*	-1.12	***	-0.79	***	0.40		0.41	*	0.38	100.97
			ΔLRET	2.68	***	-1.61	***	-1.04	***	0.89	**	0.66	***	0.40	111.31
DGKC	-1.01	***	ΔLRET	1.95	*	-1.79	**	-0.66		1.18		0.32		0.30	70.80
			ΔKRET	4.11	***	-2.31	***	-0.84	**	1.72	**	0.51		0.31	75.11
DSFL	-0.99	***	ΔLRET	-1.75	***	0.28		0.08		-0.83	***	-0.40	**	0.32	77.51
			ΔKRET	0.52		-0.37		-0.16		-0.20		-0.15		0.26	58.07
EFUG	-1.00	***	ΔKRET	-0.22		0.02		0.10		-0.65		-0.45		0.31	73.77
			ΔLRET	-2.21	***	0.61		0.30		-1.25	**	-0.65	*	0.32	76.68
ENGRO	-1.02	***	ΔKRET	-0.30		-0.40	*	-0.29	**	-0.20		-0.10		0.31	73.94
			ΔLRET	2.10	***	-1.13	***	-0.54	***	0.57	***	0.15		0.41	115.63
FABL	-1.04	***	ΔLRET	-1.91	***	0.44	*	-0.01		-1.04	***	-0.38	***	0.32	77.79
			ΔKRET	0.50		-0.37		-0.31	**	-0.18		-0.04		0.28	64.09
FCCL	-1.00	***	D(LRET)	-0.40		-0.83	*	-0.41	*	0.28		0.08		0.30	68.83
			D(KRET)	1.83	***	-1.41	***	-0.58	**	0.85	**	0.25		0.28	63.10
FFBL	1.34		ΔLRET	-0.41	***	-0.42	**	-0.60	***	0.46	**	0.58	***	0.46	141.12
			ΔKRET	-0.42	***	0.06		-0.39	*	0.01		0.39	**	0.46	136.96
HMB	-1.01	***	ΔKRET	-1.73		2.34	***	1.32	***	-3.00	***	-1.61	***	0.42	36.53
			ΔLRET	0.73		1.56	*	1.03	**	-2.21	***	-1.33	***	0.50	50.87
HUBC	-0.99	***	ΔLRET	-1.59	***	0.33		-0.04		-0.92	***	-0.37	***	0.35	86.92
			ΔKRET	0.75	**	-0.40		-0.30	**	-0.19		-0.10		0.32	76.92

ICI	-0.98	***	ΔKRET	-0.81	***	0.02		-0.09		-0.56	***	-0.26	***	0.29	68.54
			ΔLRET	1.70	***	-0.79	***	-0.39	***	0.18		0.00		0.42	119.35
JOVC	-1.00	***	ΔLRET	-1.13	**	-0.20		-0.20		-0.23		-0.07		0.21	43.55
			ΔKRET	1.17	**	-0.91	***	-0.45	**	0.49		0.20		0.17	34.70
KAPCO	-1.06	***	ΔKRET	-0.47	*	-0.44	**	-0.26	**	-0.24		-0.12		0.34	0.34
			ΔLRET	0.94	***	-0.54	***	-0.28	**	-0.08		-0.08		0.36	0.36
LAKST	-1.00	***	ΔKRET	-0.51		-0.53		-0.41		-0.16		0.06		0.35	90.29
			ΔLRET	1.25		-0.90		-0.55		0.21		0.19		0.35	89.12
LUCK	-1.00	***	ΔLRET	-2.15	***	0.48		0.00		-1.02	***	-0.32		0.30	70.37
			ΔKRET	0.16		-0.14		-0.18		-0.39		-0.13		0.25	54.05
MCB	-1.00	***	ΔLRET	-0.10		-0.62		-0.17		0.01		-0.16		0.29	68.72
			ΔKRET	2.12	***	-1.30	**	-0.38		0.69		0.05		0.29	69.07
MLCF	-1.01	***	ΔLRET	-1.22	*	0.16		0.24		-0.71		-0.64	**	0.30	40.63
			ΔKRET	0.93		-0.31		0.12		-0.22		-0.50	*	0.29	38.62
NBP	-1.00	***	ΔLRET	-0.06		-0.15		-0.39		-0.48		0.05		0.31	73.78
			ΔKRET	2.26		-0.80		-0.57		0.16		0.23		0.32	78.43
NIB	-1.01	***	ΔKRET	-0.16		-0.70	*	-0.37	*	0.10		0.04		0.30	69.72
			ΔLRET	2.00	***	-1.20	***	-0.46	**	0.60	*	0.14		0.32	76.35
NML	-1.00	***	ΔLRET	-1.04	**	-0.22		-0.17		-0.32		-0.13		0.27	62.70
			ΔKRET	1.11	**	-0.79	**	-0.36	*	0.25		0.08		0.24	53.63
NRL	-1.00	***	ΔKRET	2.72	**	-2.52	***	-0.98	**	1.95	**	0.70		0.27	0.26
			ΔLRET	5.20	***	-3.26	***	-1.22	***	2.69	***	0.94	**	0.29	0.28
OGDC	-1.00	***	ΔLRET	1.36		-2.20	***	-0.66		1.56	**	0.35		0.32	78.52
			ΔKRET	3.46	***	-2.74	***	-0.85	**	2.12	***	0.54		0.32	77.37
PAKRI	-1.00	***	ΔKRET	1.34		-1.54	*	-0.74	*	0.99		0.42		0.25	55.95
			ΔLRET	3.88	***	-2.31	***	-1.00	**	1.76	**	0.67		0.27	60.00
PCCL	-1.01	***	ΔLRET	-0.50		-0.19		-0.07		-0.33		-0.29	**	0.26	57.65
			ΔKRET	1.70	***	-0.76	***	-0.28	*	0.25		-0.07		0.31	74.57
PICIC	-1.05	***	ΔLRET	-0.96	***	-0.06		0.08		-0.50	**	-0.43	***	0.30	70.81
			ΔKRET	1.08	***	-0.66	***	-0.15		0.15		-0.16		0.29	69.04
PKGS	-0.99	***	ΔKRET	0.09		-0.74	*	-0.31		0.06		-0.10		0.35	90.42
			ΔLRET	2.49	***	-1.36	***	-0.51	**	0.69		0.10		0.37	97.35
POL	-1.00	***	ΔLRET	-0.78	**	-0.49	**	-0.23	*	-0.13		-0.07		0.35	86.81
			ΔKRET	1.44	***	-1.03	***	-0.43	***	0.44	*	0.15		0.31	73.37
PPL	-1.01	***	ΔLRET	-0.60		-0.80		-0.35		0.17		0.00		0.32	78.26
			ΔKRET	1.53		-1.34	*	-0.52		0.72		0.17		0.31	75.56
PSMC	-1.00	***	ΔKRET	2.33		-1.55		-0.81		1.01		0.47		0.26	54.29

			ΔLRET	-0.23		-0.77		-0.56		0.23		0.22		0.26	53.97
PSO	-1.00	***	ΔKRET	-0.02		-1.04	*	-0.43		0.42		0.05		0.32	0.32
			ΔLRET	2.25	***	-1.59	**	-0.59	*	0.97		0.21		0.33	0.32
PTC	-1.00	***	ΔLRET	0.90		-1.44	***	-0.70	**	0.82		0.32		0.31	72.79
			ΔKRET	2.85	***	-1.89	***	-0.89	***	1.27	**	0.52	*	0.31	74.81
SCBPL	-1.02	***	ΔKRET	-2.83	**	1.18		0.52		-1.67		-0.77		0.20	7.01
			ΔLRET	-0.56		0.61		0.33		-1.05		-0.58		0.14	4.87
SHELL	-1.00	***	ΔKRET	-0.78		-0.09		-0.10		-0.50		-0.26		0.29	67.29
			ΔLRET	1.71	**	-0.86		-0.34		0.27		-0.02		0.29	68.71
SPCB	-0.99	***	ΔLRET	-1.34	***	0.00		-0.01		-0.53	**	-0.37	***	0.35	86.85
			ΔKRET	0.97	***	-0.66	***	-0.26	**	0.10		-0.12		0.29	68.73
SSGC	-1.00	***	ΔLRET	-0.91	*	-0.25		-0.08		-0.34		-0.18		0.29	68.29
			ΔKRET	1.40	***	-0.87	**	-0.24		0.29		-0.01		0.28	63.77
UBL	-0.99	***	ΔKRET	0.11		-0.51		-0.35	*	0.01		0.05		0.22	36.97
			ΔLRET	2.09	***	-0.95	***	-0.49	**	0.45		0.19		0.27	47.51
WTL	-0.99	***	ΔLRET	-1.10	***	-0.18		-0.36	***	-0.49	*	0.01		0.41	51.02
			ΔKRET	1.16	***	-0.77	***	-0.53	***	0.10		0.17		0.39	46.14

Table-A9: Variance Decomposition of KSE Returns - *Ordering: LRET KRET*

Symbol	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	Lag 7	Lag 8	Lag 9	Lag 10
ABL	21.64	18.82	16.55	13.95	14.75	13.70	12.75	12.19	11.93	11.50
AHSL	0.34	0.44	0.50	0.43	0.47	0.49	0.48	0.49	0.49	0.49
AICL	5.95	5.42	5.14	4.37	4.42	4.28	4.11	4.01	3.94	3.87
BAFL	1.67	1.53	1.55	1.39	1.23	1.14	1.09	1.02	0.97	0.93
BAHF	2.31	2.49	2.04	2.28	2.23	2.10	2.06	2.03	1.99	1.96
BOP	0.81	1.26	1.10	1.08	0.97	0.86	0.79	0.72	0.66	0.61
BOSI	3.18	2.62	2.40	2.07	2.04	1.93	1.81	1.75	1.70	1.65
DAWH	2.48	3.59	3.39	4.43	4.40	4.47	4.57	4.67	4.71	4.76
DGKC	0.86	2.27	2.15	1.74	1.57	1.54	1.42	1.35	1.28	1.24
DSFL	5.96	5.43	4.97	4.67	4.68	4.52	4.38	4.32	4.26	4.20
EFUG	1.07	1.25	1.17	1.24	1.27	1.26	1.26	1.27	1.28	1.28
ENGRO	11.46	10.81	10.45	10.10	10.13	9.94	9.78	9.73	9.67	9.60
FABL	7.10	6.54	6.48	5.51	5.72	5.69	5.47	5.33	5.32	5.26
FCCL	2.84	2.38	2.24	1.79	1.70	1.51	1.34	1.23	1.13	1.04
FFBL	3.68	4.36	5.63	5.65	5.81	6.09	6.27	6.48	6.69	6.89
HMB	2.68	8.01	9.27	7.74	8.17	7.16	6.42	5.88	5.41	5.01
HUBC	7.18	6.18	6.14	5.26	5.18	5.02	4.78	4.64	4.57	4.47
ICI	16.92	14.95	13.63	12.46	12.66	11.96	11.40	11.17	10.97	10.70
JOVC	3.71	3.05	2.59	2.13	2.18	2.03	1.86	1.75	1.70	1.63
KAPCO	11.73	10.58	9.98	9.06	8.63	8.29	7.97	7.74	7.55	7.38
LAKST	0.90	0.82	0.74	0.77	0.72	0.69	0.67	0.65	0.63	0.62
LUCK	4.05	3.99	4.12	3.65	3.79	3.79	3.71	3.69	3.69	3.67
MCB	1.57	1.59	1.51	1.29	1.15	1.02	0.91	0.82	0.75	0.69
MLCF	3.37	2.84	2.57	3.04	2.65	2.43	2.38	2.24	2.12	2.05
NBP	0.47	0.91	0.94	0.74	0.66	0.58	0.52	0.47	0.43	0.39
NIB	4.13	3.64	4.10	4.01	3.81	3.86	3.83	3.78	3.77	3.75
NML	4.22	3.54	3.02	2.53	2.50	2.29	2.12	2.01	1.93	1.85
NRL	0.81	1.65	2.61	2.58	2.52	2.78	2.88	2.90	2.94	3.00
OGDC	0.80	0.80	1.67	1.33	1.18	1.13	1.05	0.98	0.92	0.87
PAKRI	0.72	0.98	1.25	1.31	1.27	1.37	1.42	1.42	1.44	1.47
PCCL	6.72	6.51	5.81	4.93	4.34	3.88	3.50	3.20	2.96	2.74
PICIC	11.91	9.92	8.62	8.12	7.75	7.03	6.46	6.13	5.85	5.58
PKGS	2.94	2.99	3.31	2.91	3.07	3.10	3.07	3.08	3.10	3.10
POL	8.57	7.47	6.33	5.30	5.09	4.55	4.16	3.88	3.65	3.44
PPL	0.86	0.78	0.76	0.62	0.61	0.54	0.48	0.45	0.42	0.39
PSMC	0.22	0.21	0.18	0.14	0.14	0.12	0.11	0.10	0.09	0.08

PSO	1.53	1.33	2.14	1.83	1.72	1.78	1.75	1.70	1.70	1.68
PTC	1.67	1.89	1.99	1.66	1.47	1.38	1.27	1.18	1.11	1.05
SCBPL	3.67	3.90	3.24	2.72	2.31	2.10	1.88	1.70	1.56	1.45
SHELL	1.54	1.34	1.25	1.12	1.12	1.06	1.01	0.99	0.97	0.95
SPCB	8.34	7.12	6.40	5.80	5.73	5.33	5.02	4.85	4.70	4.54
SSGC	3.52	3.04	2.49	2.33	2.11	1.87	1.73	1.63	1.52	1.44
UBL	4.71	5.11	4.93	5.11	5.13	5.12	5.13	5.15	5.15	5.16
WTL	16.13	14.60	13.91	11.09	11.30	10.50	9.62	9.26	8.87	8.47
Average	4.70	4.52	4.35	3.92	3.87	3.69	3.52	3.41	3.33	3.25
Max:	21.64	18.82	16.55	13.95	14.75	13.70	12.75	12.19	11.93	11.50
Min:	0.22	0.21	0.18	0.14	0.14	0.12	0.11	0.10	0.09	0.08

Table-A10: Variance Decomposition of LSE Returns – *Ordering: KRET LRET*

Symbol	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	Lag 7	Lag 8	Lag 9	Lag 10
ABL	21.64	19.10	17.86	16.53	15.06	13.40	12.60	11.90	11.28	10.66
AHSL	0.34	0.60	0.53	0.43	0.39	0.35	0.31	0.29	0.26	0.24
AICL	5.95	5.32	4.73	3.99	3.51	3.13	2.85	2.61	2.42	2.26
BAFL	1.67	1.40	1.21	1.08	1.04	0.94	0.87	0.84	0.79	0.76
BAHF	2.31	2.91	2.68	2.14	1.87	1.64	1.46	1.32	1.20	1.11
BOP	0.81	0.87	0.78	0.62	0.80	0.74	0.68	0.66	0.65	0.63
BOSI	3.18	2.76	2.60	2.32	2.03	1.85	1.73	1.61	1.51	1.43
DAWH	2.48	3.67	3.20	3.03	2.75	2.48	2.28	2.16	2.01	1.90
DGKC	0.86	1.76	2.23	2.14	2.21	2.38	2.43	2.47	2.52	2.56
DSFL	5.96	5.97	5.31	4.24	3.82	3.39	3.04	2.78	2.57	2.38
EFUG	1.07	1.28	1.12	0.88	0.78	0.69	0.62	0.56	0.51	0.47
ENGRO	11.46	12.25	11.29	8.99	8.05	7.30	6.51	5.95	5.49	5.06
FABL	7.10	6.87	6.10	5.30	4.79	4.27	3.80	3.49	3.23	2.98
FCCL	2.84	2.49	3.35	3.11	2.78	2.74	2.71	2.60	2.54	2.50
FFBL	3.68	3.76	3.80	4.90	5.33	5.62	6.08	6.48	6.85	7.25
HMB	2.68	10.07	13.56	12.24	11.13	9.98	9.25	8.56	7.93	7.40
HUBC	7.18	6.51	5.89	5.08	4.72	4.27	3.84	3.59	3.36	3.14
ICI	16.92	16.39	15.34	12.74	11.55	10.36	9.47	8.77	8.20	7.66
JOVC	3.71	3.04	2.83	2.78	2.48	2.22	2.10	2.00	1.90	1.81
KAPCO	11.73	10.52	9.46	7.68	7.04	6.43	5.86	5.46	5.11	4.81
LAKST	0.90	0.82	0.71	0.56	0.53	0.48	0.43	0.40	0.37	0.35
LUCK	4.05	4.70	4.07	3.40	2.95	2.62	2.33	2.11	1.92	1.76
MCB	1.57	1.48	1.71	1.51	1.50	1.54	1.52	1.50	1.50	1.50
MLCF	3.37	2.81	2.95	2.29	2.28	2.14	1.92	1.81	1.73	1.63
NBP	0.47	0.68	0.60	0.70	0.69	0.63	0.62	0.61	0.59	0.58
NIB	4.13	4.13	3.58	2.89	2.56	2.27	2.02	1.83	1.67	1.54
NML	4.22	3.70	3.52	3.14	2.86	2.62	2.47	2.34	2.23	2.14
NRL	0.81	2.21	2.33	1.93	1.70	1.76	1.66	1.57	1.51	1.47
OGDC	0.80	0.73	2.32	2.05	1.95	2.06	2.09	2.08	2.08	2.09
PAKRI	0.72	1.33	1.21	0.96	0.84	0.82	0.74	0.68	0.64	0.60

PCCL	6.72	5.98	6.02	5.08	5.22	5.12	4.94	4.83	4.80	4.73
PICIC	11.91	9.77	9.66	7.81	7.49	7.13	6.68	6.32	6.12	5.91
PKGS	2.94	4.12	3.71	2.91	2.60	2.36	2.10	1.92	1.76	1.62
POL	8.57	7.79	8.69	7.49	7.01	6.54	6.29	6.00	5.80	5.61
PPL	0.86	0.88	1.13	0.98	0.88	0.85	0.81	0.77	0.75	0.72
PSMC	0.22	0.19	0.22	0.24	0.22	0.21	0.22	0.21	0.21	0.21
PSO	1.53	1.43	1.46	1.16	1.05	0.96	0.85	0.77	0.71	0.65
PTC	1.67	1.77	2.54	2.77	2.72	2.85	2.95	3.00	3.04	3.09
SCBPL	3.67	3.51	4.39	5.06	4.85	4.99	5.15	5.18	5.21	5.27
SHELL	1.54	1.55	1.38	1.20	1.07	0.95	0.87	0.80	0.74	0.69
SPCB	8.34	7.46	7.54	6.05	5.55	5.08	4.72	4.38	4.16	3.93
SSGC	3.52	3.09	3.20	2.76	2.56	2.41	2.29	2.19	2.11	2.04
UBL	4.71	4.95	4.28	3.37	2.90	2.56	2.26	2.03	1.85	1.69
WTL	16.13	15.00	13.03	14.17	12.67	11.52	11.04	10.39	9.82	9.41
Average	4.70	4.72	4.64	4.11	3.79	3.51	3.31	3.13	2.99	2.87
Max:	21.64	19.10	17.86	16.53	15.06	13.40	12.60	11.90	11.28	10.66
Min:	0.22	0.19	0.22	0.24	0.22	0.21	0.22	0.21	0.21	0.21

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