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

Jamshed Y. Uppal*

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

[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)	KSE Stocks		LSE Stocks	
Significance Level	**No.**	**%**	**No.**	**%**
<=.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.

[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:

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

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

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:

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

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

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			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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Trade and Income Convergence in Selected South Asian Countries and Their Trading Partners

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Abstract

This paper analyzes trade among and the convergence of per capita income for India, Pakistan, Bangladesh, and Sri Lanka. The extent of trade and its relationship with the magnitude of income convergence is studied among these countries and their trading partners. We use intra-trade convergence and the difference-in-differences approach for the estimations. The results demonstrate that an increase in trade between the groups decreases the per capita income differential. Our results suggest that trade liberalization policies could be effective in achieving convergence. More importantly, we find that the per capita income of our source countries converged more rapidly under post-liberalization regimes than pre-liberalization regimes.

Keywords: Intra-trade, income convergence, per capita income, South Asia.

JEL Classification: C21.

I. Introduction and Literature Review

An extensive body of literature recognizes the link between trade and income convergence and divergence among countries (see studies based on cross-country growth regressions such as Baumol (1986), Dowrick and Nguyen (1989), Barro (1991), and Levine and Renelt (1992); studies that are based on beta convergence [regression toward the mean] such as Barro (1984), Barro and Sala-i-Martin (1992), Baumol (1986), and De Long (1988); and other sets of studies based on sigma convergence [concerning cross sectional dispersion] including Barro (1984), Dowrick and Nguyen (1989) among others). The theoretical relationship between trade and convergence is examined by incorporating the role of international trade and

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liberalization. The argument here is that trade liberalization causes a convergence in per capita income—since trade liberalization increases competition and domestic firms' absorption capacity for knowledge and ideas, knowledge levels among countries converge to a common level, leading to per capita income convergence (see Sachs and Warner (1995), Ben-David (1993, 1994a, 1994b, 1996, 2000) and Ben-David and Kimhi (2004) among others). Ben-David and Loewy (1998) posit a model that demonstrates how moving toward free trade increases trade volumes and reduces income differentials among liberalizing countries.

The evidence indicates a higher incidence of income convergence in some subsets of countries but no convergence tendencies among other subsets of wealthier countries (see Baumol, (1986), Baumol, et al (1989), Baldwin (2003), and Ben-David (1993, 1994b) among others). The literature based on endogenous growth demonstrates a lack of income convergence,[1] [Romer (1986) and Lucas (1988)], but strong evidence of conditional convergence in studies such as Barro (1991), Mankiw, et al (1992), and Levine and Renelt (1992).[2] These studies point toward a number of factors such as human capital and government policies that help account for convergence. Other studies such as Grossman and Helpman (1991) suggest that trade can contribute to the local knowledge stock and new ideas. Baldwin, et al (2001) argues that the exogenously falling cost of trade has resulted in technological externalities in the world's northern countries. However, studies based on endogenous models, such as Eicher (1999), result in income convergence. Young (1991) presents a static trade model based on five different equilibriums, most of which lead to convergence, and supports the idea that trade should generate convergence. Kravis (1970) argues that trade is only one of the various contributors to growth, and may not necessarily emerge as the dominant factor. In an earlier analysis, Corden (1971) combines the traditional theory of gains from trade with the growth models of Solow (1956) and Swan (1956), who argue that trade not only produces static gains but also increases capital accumulation and leads to higher growth of per capita output. Corden (1971) implies that a country

[1] International trade can affect the economic growth rate but the effects may be considered 'level' or 'growth' effects or both. Pioneered by Romer (1986) and Lucas (1988), technology is assumed to be endogenously driven because investment in research and development advances technology that responds to market incentives. Romer and Batiz (1991) distinguish between level effects and growth effects. Roderick (1996) argues that "trade restrictions have level affects, but no growth effects. That is, a twenty percent tariff may reduce five percent of GDP, but it will not affect the long run growth rate of the economy."

[2] The greater the gap between initial per capita income level and long-run per capita income level, the faster the rate of convergence.

that moves from autarky to free trade attains a higher steady-state income and as a result grows faster during the transition period. However, Johnson (1967), in the context of the Hickscher-Ohlin model, views the interplay of trade and growth from a different perspective.

These contributions hardly settle the debate on the level and growth effects of trade in the context of different countries.[3] In addition to this, traditional growth literature, the neoclassical growth model [Solow 1956, and Koopman's (1965)] modifications imply that differences in initial capital and labor endowments, if eliminated over time, will cause convergence in per capita incomes. Barro and Martin (1991, 1992) and Mankiw, et al (1992) test this hypothesis across regions in the context of Solow (1956), where every country reaches its steady-state growth level independently of each other.

By integrating modern trade and neoclassical growth theories along with recent international data and evidence, one can trace the interplay of trade, growth, and income disparities. From aspects of traditional trade theory, the factor price equalization (FPE) theorem provides a base for equalizing factor prices when certain conditions are fulfilled [see Slaughter (1997)].[4] Slaughter (1997) also argues that per capita income might still diverge when factor quantities across the selected countries are dissimilar, even if the FPE theorem holds. Parikh and Shibata (2004) use panel data and the beta-sigma, single difference, and difference-in-differences approaches to convergence for pre-post liberalized eras, concluding that there is no evidence of acceleration or deceleration after liberalization for some Asian economies. The sigma-convergence approach shows significant convergence of per capita income, while the difference-in-differences approach also indicates a significant convergence. This study also uses dynamic models by using panel fixed effects; Generalized Method of Moments (GMM) estimations demonstrate no evidence of acceleration or deceleration in convergence.

The link between convergence and openness across history is noted by Williamson (1991) who argues that convergence and global economic

[3] Economists doubt whether trade has a growth effect [Dollar and Kraay (2001, 2003) and Srinivasan, (1999)]. In the context of the Cass-Koopmans model, Srinivasan holds "that one can obtain a positive long run growth effect of trade liberalization" conditioned on "a production function in which the marginal product of capital is bounded below by a sufficiently high positive value as capital labour- ratio goes to infinity."

[4] Samuelson (1971) shows that, in the standard specific-factors framework, free trade can generate convergence. Mokhtari and Rassekh (1989) find that the FPE theorem holds for 16 OECD countries for the period 1961-1984.

integration is linked to the Industrial Revolution of 1850; there is evidence of convergence in two subperiods during which the movement of goods and factors occurred relatively freely, 1870-1913 and post-1950. According to this study, income gaps appear to grow over time; countries that trade extensively with one another tend to exhibit a higher incidence of income convergence. By testing for a negative relationship between average annual rates of growth and initial levels of income, Baumol (1986) concludes that industrial countries appear to belong to one convergence strand and middle-income countries to another, while low-income countries diverge over time. In a critical review of Sachs and Warner (1995), Rodriguez and Rodrik (2001) argue that the Sachs and Warner openness index is driven largely by black market premiums and the state monopoly of exports rather than trade policy.

Some points need to be emphasized. First, the mixed empirical results are similar to theoretical models on trade and convergence, but both theory and empirical evidence are inconclusive as to whether or not trade leads to income convergence, especially for South Asian countries that have liberalized their trade, financial, and industrial policies. Second, there is scant evidence to determine the magnitude of trade and extent of income convergence or divergence within the trading group of countries. Whether or not the rate of convergence, assuming it existed, is accelerated or decelerated after liberalization is questionable. Third, no study appears to have determined the rate of convergence for South Asian countries that have liberalized trade, or increasing trends in trade, investment, and bilateral economic relations with their trading partners.[5] Fourth, most other studies are based on growth rates regressed on the initial level of income to determine convergence, while no structural breaks or pre- or post-liberalization period studies have been taken into account. Fifth, most of these studies suffer from endogeneity, i.e., the problem of co-linking the relationship between trade liberalization and income convergence [see Ben-David (1993, 1994a, 1996)].[6] These studies examine various trade reform

[5] Although not used, the bilateral/trading group convergence, the only study by Parikh and Shibata (2004) on different regions (not including Pakistan and Bangladesh) used the beta and sigma convergence and difference-in difference approaches for Africa, Asia, and Latin America, and found no beta convergence in Asian countries and convergence in sigma and difference-in-difference approach.

[6] Frankel and Romer (1999) tackle the endogeneity problem by employing a gravity model and creating an instrument based on countries that share a common border and are landlocked. Frankel and Rose (2002) test the hypothesis that a currency union stimulates trade among its constituent units, and that trade in turn stimulates output. Rodriguez and Rodrik (2001) criticize Frankel and Romer on the grounds that the Frankel and Rose

programs and find significant convergence with significant increases in the volume of trade. They also prove that no convergence occurred prior to the implementation of trade reforms. Finally, if trade liberalization produces convergence in theory, then it should be evident for countries that are major trading partners rather than randomly selected countries.

The objectives of this paper, in addition to the aspects mentioned above, are (i) to measure the impact of the magnitude of trade and the intra-trade relationship before and after liberalization on bilateral and intra-group per capita income differentials for individual countries in South Asia by focusing on their trading partners; (ii) to examine the nature and rate of convergence or divergence for the countries in question; (iii) to determine whether or not the increasing trend of bilateral foreign direct investment (FDI) flows or bilateral investments, or increasing bilateral trade or trade openness policies, have a positive correlation with economic growth, thus leading to a reduction in income differentials. The policy outcomes that are expected to emerge from this study will help understand the dynamics of regional and bilateral free trade (including such agreements as SAFTA), individual countries' bilateral and free trade agreements, and the formulation of long-term development and economic objectives.

The remaining paper is organized as follows: Section II discusses the methodology and framework for analysis; Section III presents our empirical results and discussions; and Section IV provides concluding remarks and policy implications.

II. Methodology

A number of different approaches to convergence can be used to examine the magnitude of trade and extent of income convergence for the South Asian countries under study (Pakistan, India, Bangladesh, and Sri Lanka) by focusing on their trading partner countries before and after trade liberalization. Trade indicators such as the Sachs-Warner Index, Lerner Openness Index, growth rate of exports, tariff averages, collected tariff ratios, and black market premiums are used in different studies. However, the most common indicators are the openness index and trade dependency ratio (i.e., the ratio of exports and imports to gross domestic product [GDP]).[7] Pre-liberalization and post-liberalization are defined as the periods 1972-1988 and 1989-2005, respectively. Although the selected

constructed trade share is not a valid instrument. For the debate on endogeneity, see Sachs (2003), Irwin and Tervio (2002), Cyrus (2004), and Ben-David (1996).

[7] See McCulloch and Cierea (2001).

South Asian countries initiated trade liberalization differently and in different periods, these countries had already started to liberalize their trade policies in the period considered pre-liberalization. According to the World Bank, Sri Lanka initiated its trade liberalization policies in the mid-1970s, while Pakistan and Bangladesh adopted trade liberalization policies after the mid 1980s. India initiated trade liberalization policies in 1990/91 [see Kumar (2005)]. These source countries adopted a number of policy steps such as tariff cuts and export-oriented measures along with financial liberalization. The main purpose of this study is to examine whether or not trade liberalization caused the per capita income of these countries to converge toward their trading partners over the sample period. Data on per capita income (in US$ constant at 2000) and GDP data was taken from World Development Indicators (2006). Bilateral trade data was collected from various volumes of the *Direction of Trade Statistics* (an IMF publication).

Trade and Income Convergence Approaches

(a) Intra-Group Convergence Approach

Construction of Trade Groups[8]

The study focuses on four source countries: India, Pakistan, Sri Lanka, and Bangladesh. Each source country has 29 trading partners. The first five years are considered the initial period. Trading groups were formulated on the basis of exports and imports, and the magnitude of trade. Thus, each source country has four trading groups, giving us a total of sixteen trading groups. Group I includes all those trading partners that imported more than 4 percent of the exports of the source country during the initial period. The 4 percent is assumed to be a significant number that is incorporated for analysis based on their trade patterns. Group II consists of trading partners who imported less than 4 percent of the source country's exports during the first 5 years.

Two trading groups were created for each source country on the basis of imports. Group I includes all those trading partners from which the source country imported more than 4 percent of its imports during the first

[8] For intra-group convergence, we have followed the approach used by Ben-David (2004).

5 years. Group II comprises trading partners from which the source country imported less than 4 percent of its imports during the first 5 years.[9]

The total volume of trade for each intra-trade group is calculated for each export-based and import-based group for each year from 1972 to 2005. To obtain a measure of how the source country's trade with its trading partners grew relative to its GDP, we divide the total volume of intra-trade by the GDP of the source country.[10] This ratio is represented by the variables $R^x_{i,t}$ and R^m_{it} (where i stands for source country and the superscripts x and m denote the group as being export-based or import-based, respectively), which are calculated for each trading group over the sample period. When regressed on trend (T_t), these trade ratios give us

$$R^x_{it}=\alpha^x_{1,i}+\alpha^x_{2,i}T_t+\varepsilon^x_{it} \qquad (1)$$

$$R^m_{it}=\alpha^m_{1,I}+\alpha^m_{2,i}T_t+\varepsilon^m_{it} \qquad (2)$$

The results of the above equations are reported in Table-1. The overall trade ratio behavior depicts an increasing trend over the sample period. Does an increasing trend cause per capita income to converge across the trading groups? Our main assumption is that trade, along with other factors, causes per capita income to converge within the intra-trade groups. The study uses a number of control variables as other factors. These include size, population, output, distance, political stability, and special attributes of trading partners. However it is neither feasible nor convenient to incorporate all the control variables in estimating the intra-trade group equation.[11]

Convergence Model for Intra-Trade Group

Our intra-trade estimation results show an increasing trend over the sample period, making it possible to examine the behavior of each group's

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[9] We include these trading partners in our analysis for a broader picture. Were only major trading partners taken into account, we might lose out on group size. Although some countries traded less in the initial period, their trade share increased over time.

[10] Our methodology for constructing the trade ratio differs somewhat from Ben-David and Kimhi (2000), where the trade ratio is the ratio of total intra-group trade to the group's *aggregate* GDP. Our main interest is to determine whether income convergence results from an increase in source countries' volume of trade.

[11] The estimation process for control variables is tricky in the case of the intra-trade group. We have thus excluded this option and used Ben-David's (1996) method of convergence.

income differential over the sample period and any evidence of income convergence within the groups.

The convergence measure adopted here is the same used by Ben-David (1996):

$$(y_{i,t} - \bar{y}_t) = \phi(y_{i,t-1} - \bar{y}_{t-1}) + \varepsilon_{i,t} \tag{3}$$

where $y_{i,t}$ denotes the log of source country's per capita income at time t and $\bar{y}_t$ gives the average of the concerned group's log of per capita incomes at time t, $\varepsilon_{i,t}$ is an error term, and φ is a convergence (divergence) parameter. A positive (negative) φ demonstrates the convergence (divergence) of per capita income in the group. It also indicates the rate of convergence within a given trading group. The data for countries within each group are pooled together to estimate equation (3) and φ is calculated to examine the income convergence rate for each group.

The Augmented-Dickey-Fuller (ADF) form of equation (3) can be written as follows:

$$z_{i,t} = \phi z_{i,t-1} + \sum_{j=1}^{k} c_j \Delta z_{i,t-j} + \varepsilon_{i,t} \tag{4}$$

where $z_{i,t} = (y_{i,t} - \bar{y}_t)$ and $\Delta z_{i,t} = z_{i,t} \quad z_{i,t-1}$. In corroboration with Ben-David (1996), the number of lags, k, is determined by setting an upper bound of ***k*** max=4 and thereafter estimating the equation. If the coefficient is not significant at the last lag, then k is reduced by one lag and thereafter to repeat the estimation procedure.[12] The results are reported in Table-2.

(b) Difference-in-Differences Approach

A typical difference-in-differences approach can be used by following Meyer (2004) and Slaughter (2001). This is used to determine when some economic agents apply some policy "treatment" at a single point in time; outcome can then be observed both for before and after the application of the treatment.

This approach is used to capture the trade liberalization effect on per capita income convergence among the liberalizing countries and their

[12] Although other approaches have been used to measure convergence, this measure is more appropriate in terms of usage, simplicity, and applicability to small samples.

trade partners for both pre- and post-liberalization periods. To examine this proposition, the difference-in-differences approach gauges convergence patterns among liberalized countries pre- and post-liberalization with the convergence behavior of control countries in both periods.

The difference-in-differences equation to be estimated can be written as follows:

$$\sigma(y)_{jrt} = \alpha_1 + \alpha_2(d_r) + \alpha_3(d_j) + \alpha_4(d_{jr}) + \beta_1(t) + \beta_2(t)(d_r) + \beta_3(t)(d_j) + \beta_4(t)(d_{jr}) + \varepsilon_{jrt} \qquad (5)$$

Per capita income dispersion within each group at each point in time is measured and denoted by $\sigma(y)_{jr}$. The subscript j shows two groups of countries: j=0 and j=1 for the pre-liberalizing group and control group, respectively. The subscript r index indicates pre- and post-liberalization periods with r=0 and r=1 for the former and latter, respectively. Similarly, t stands for time periods, d is a set of dummy variables, and ε_{jrt} is a white noise error term.

As given earlier, the trade liberalized group comprises Pakistan, India, Sri Lanka, and Bangladesh. Each has one trade liberalized group along with three control groups of their trading partners. The control groups were constructed based on the "similarity criteria" given in Slaughter (1998).

The first control group consisted of all trading partners in the trade liberalized group, the second group consisted of all Asian countries, and the third group comprised all non-Asian trading partners.

Equation (5) estimates an individual intercept term and per capita income convergence rate for each liberalizing and control group for both pre- and post-liberalization periods. These are given below:

Country Group/Regime	**Intercept**	**Convergence Rate**
Liberalizing group pre-liberalization	$\alpha 1$	$\beta 1$
Liberalizing group post-liberalization	$\alpha 1 + \alpha 2$	$\beta 1 + \beta 2$
Control group pre-liberalization	$\alpha 1 + \alpha 3$	$\beta 1 + \beta 3$
Control group post-liberalization	$\alpha 1 + \alpha 2 + \alpha 3 + \alpha 4$	$\beta 1 + \beta 2 + \beta 3 + \beta 4$

A positive (negative) rate reveals convergence (divergence) in the above notation. The calculation of difference-in-differences of estimated rates demonstrates the impact of trade liberalization on per capita income convergence. For instance, the difference in convergence rates within the liberalizing group for pre- and post-liberalization period is $(\beta_1+\beta_2)-\beta_1=\beta_2$. Similarly, the difference in convergence rates within the control group is given by $(\beta_1+\beta_2+\beta_3+\beta_4)-(\beta_1+\beta_3)=\beta_2+\beta_4$. Thus, the difference in differences (between the liberalizing and control groups) is $(\beta_2+\beta_4)-\beta_2=\beta_4$. The parameter β_4 quantifies the change in pre- and post-liberalization convergence rates within the liberalizing group relative to the control group.

The main assumption in equation (5) is that the only difference between the two groups is the trade-policy change. Thus, $\beta_4$will be positive (negative) if trade leads to the convergence (divergence) of per capita income.

III. Results and Discussion

A. Intra-Group Convergence Approach

Table-1 reports the trend behavior of the intra-trade ratio of export-based groups and import-based groups [equations (1) and (2)] over time. The coefficients of the trade ratio have positive signs for all groups, which indicates an increase in the trade ratio over time. Eight export-based groups (except Group I for Pakistan) show positive significant trade ratio coefficients. The import-based groups also show an increasing trend in the trade ratio over the sample period.

The results of equation (4) are reported in Table-2. Table-2a consists of export-based groups and Table-2b presents the results for import-based groups. The trade groups are listed according to source country. The coefficient of income convergence, φ, for most of the trade groups is positive and lies within the unit number. These findings imply that trade leads to the convergence of per capita income among the groups. A few groups demonstrate income divergence, but the overall results support the idea that trade is one of several significant determinants that influences per capita income and leads it to converge.

We have focused on selected South Asian countries and their trading partners, although there are other ways of comparing trade groups with countries other than trading partners by considering geographic characteristics, etc.

B. Difference-in-Differences Approach

Prior to estimating the difference-in-difference regressions, the rates of per capita income convergence within the liberalizing group for pre- and post-liberalization periods are examined by employing the following single-difference regression.

$$\sigma(y)_{jrt} = \alpha_1 + \alpha_2(d_r) + \beta_1(t) + \beta_2(t)(d_r) + u_{jrt} \tag{6}$$

where all variables have been defined earlier, u_{jrt} is a white-noise additive error term, and β_2 captures the effect of trade liberalization within the liberalizing group in absolute terms. However, it does not indicate any relative comparison across the liberalizing and control groups.

The result of equation (6) is reported in Table-3. The estimated results indicate a divergence in income in the pre-liberalization period for the liberalizing group, and convergence in the post-liberalization period.

The estimated results of main equation (5) are reported in Tables-4 and 5. Table-4 displays the convergence rates for the control groups in both pre-and post-liberalization periods. According to these results, three control groups produce a mixed outcome. For instance, in the case of all trading partner countries, there is income convergence in the pre-liberalization period and income divergence in the post-liberalization period. In the case of non-Asian trade partner countries, there is divergence in the pre-liberalization period and again in the post-liberalization period. Asian trading partner countries demonstrate income convergence in both periods.

Table-5 represents the difference-in-differences between the liberalizing and control groups. The calculated difference positive coefficient β_4 demonstrates income convergence among liberalizing countries and control group countries during the post-liberalizing period. As explained above, the positive (negative) value of β_4 indicates that trade liberalization in the liberalizing group tends to cause income convergence (divergence) over the post-liberalization period. Overall, our results favor the proposition that income converges.

Although there are arguments against the use of the difference-in-differences approach in that it does not provide clear-cut consequences of trade policies, it remains promising for trade liberalization advocates.

IV. Conclusion and Policy Implications

This study was an attempt to examine the impact of trade liberalization on the per capita income convergence of selected South Asian countries and their trade partners for the sample period 1972-2005. Two types of approaches, the intra-trade approach and difference-in-differences approach, were employed.

Our results demonstrate that the intra-trade ratio increases over time. We adopted the convergence methodology of Ben-David (1996) to examine whether or not increasing trade among groups of countries causes their per capita income to converge over the sample period. The results show that the most trade groups exhibited income convergence.

The outcomes of pre-and post-trade liberalization were examined using the difference-in-differences approach. The liberalizing group of countries consisted of selected South Asian countries, while three control groups were constructed to examine the impact of trade liberalization, especially in terms of pre- and post-liberalization. Overall, the results of both approaches indicate that trade, along with other factors, tends to cause per capita income convergence across trading partners.

This implies that liberalization policies have helped trading countries grow more rapidly in terms of per capita income, thus increasing their convergence rate. The convergence in per capita income can also be explained by other factors, but the effects of liberalization cannot be ignored. The study considers testing the period of liberalization using different approaches but does not look at the impact of tariff cuts and other economic or social variables. Nor does it take into account the impact of different economic policies during different periods by the countries in question.

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Table-1: Regression of Groups Trade Ratio on Trend

Export-based groups $R^{x}_{it}=\alpha^{x}_{1,i}+\alpha^{x}_{2,i}T_{t}+\varepsilon^{x}_{it}$				Import-based groups $R^{m}_{it}=\alpha^{m}_{1,i}+\alpha^{m}_{2,i}T_{t}+\varepsilon^{m}_{it}$		
Source Country	$\langle_{1,i}^{x}$	$\Im_{2,i}^{x}$	R	$\langle_{1,i}^{m}$	$\langle_{2,i}^{m}$	R
Pakistan G01	12.091 (19.34)*	0.0163 (0.50)	0.007	9.945 (19.83)*	0.0145 (0.54)	0.009
India GO1	3.50 (12.38)*	0.098 (6.49)*	0.57	3.36 (13.45)*	0.080 (5.97)*	0.53
Sri Lanka G01	13.7 (10.31)*	0.488 (7.12)*	0.62	13.68 (10.54)*	0.587 (8.41)*	0.69
Bangladesh G01	2.81 (7.63)*	0.196 (9.97)*	0.76	3.41 (13.51)*	0.163 (12.06)*	0.82
Pakistan G02	4.30 (11.5)*	0.123 (6.15)*	0.54	6.44 (12.68)*	0.125 (4.600)*	0.41
India G02	0.55 (2.58)*	0.16 (14.58)*	0.87	0.68 (12.68)*	0.186 (4.59)*	0.87
Sri Lanka G02	5.05 (5.88)*	0.53 (11.64)*	0.81	3.26 (4.33)*	0.44 (10.99)*	0.80
Bangladesh G02	2.74 (12.99)*	0.20 (17.85)*	0.91	2.13 (8.20)*	0.23 (16.8)*	0.90

t-statistics are in parenthesis. The number of observations is 33 in each of the estimations.
* *x* and *m* denote trade groups based on exports and imports respectively.

Table-2(a): Trade Group's Convergence Coefficients
Export-based Groups

Source country/Group	No. of countries	ϕ	t-statistics	k
Pakistan G01	9	-0.668	-4.69*	1
Pakistan G02	20	0.475	2.63*	4
India G01	11	0.607	3.25*	4
India G02	19	0.377	2.90*	3
Sri Lanka G01	7	0.642	3.82*	4
Sri Lanka G02	22	-0.396	-2.43*	3
Bangladesh G01	8	0.175	4.77*	4
Bangladesh G02	21	0.385	7.44*	4

The number of observations is 29 in each of the estimations. The list of countries in each group is in the appendix. * denotes the significance level at 5%.

Table-2(b): Import-based Groups

Source country/Group	No. of countries	φ	t-statistics	k
Pakistan G01	7	0.649	4.76*	3
Pakistan G02	22	0.594	3.39*	3
India G01	9	0.639	3.62*	4
India G02	19	-0.802	-4.59*	4
Sri Lanka G01	10	0.753	4.85*	3
Sri Lanka G02	19	-0.554	-4.11*	3
Bangladesh G01	14	0.403	3.61*	4
Bangladesh G02	15	-0.524	-4.41*	3

The number of observations is 29 in each of the estimations. The list of countries in each group is in the appendix. * denotes the significance level at 5%.

Table-3: Difference in Differences in Rates of Per Capita Income Convergence Pre and Post-Liberalization for Liberalizing Group

Case Name	Pre-liberalization convergence rate, $\beta 1$	Post-liberalization Convergence rate, $\beta 1+\beta 2$	Difference in convergence Rate $\beta 2$	Number of Observations
Selected South Asian Countries	0.0126 (6.664)*	-0.0027 (-2.76)*	-0.0153	16

As explained in the text, the liberalizing group consists on four South Asian countries; Pakistan, India, Sri Lanka and Bangladesh. T-statistics are reported in parenthesis.* denotes significance at the 5% level.

Table-4: Control Groups

Case Name	Pre-liberalization convergence rate	Post-liberalization Convergence rate,	Difference in convergence Rate	Number of Control Countries
All Trade partner countries	-0.00526 (-3.104)*	0.006 (3.67)*	0.011	26
Asian trade partner Countries	-0.00105 (-2.56)*	-0.0025 (-2.81)*	-0.0014	6
Non-Asian trade partner Countries	0.001204 (1.42)	-0.0013 (-7.21)*	-0.0025	20

Reading across the columns, reports the following parameters ($\beta1+\beta3$); ($\beta1+\beta2+\beta3+\beta4$) and $\beta2+\beta4$.T-statistics are reported in the parenthesis.* denotes the significance level at 5%.

Table-5: Difference in Differences in Rates of Per Capita Income Convergence Pre vs. Post-Liberalization; Liberalizing vs. Control Countries

Case Name	Difference-in-Differences Estimate among all trade partner countries $\beta4$	Difference -in-Differences Estimate among Asian trade partner countries $\beta4$	Difference-in-Differences Estimate among Non-Asian trade partner countries $\beta4$
Selected South Asian Countries	0.0213	0.0139	0.0128

Appendix

List of Countries

Table-A1: Trade Groups i) Export-Based trade groups

Source country/ group	Trade partner countries
Pakistan G01	AUST, CAND, GER, HK, INDO, ITY, JAP, U.K, U.S.A
Pakistan G02	AUT, BD, BELG, DEN, FIN, FRA, GRE, IND, IRE, KOR, MAL, NETH, NEZ, NOR, POR, SING, SPA,SRI, SWED, SWZ
India G01	AUST, CAND, FRA, GER, HK, INDO, ITY, JAP, KOR, U.K, U.S.A
India GO2	AUT, BD, BELG, DEN, GRE, IRE, MAL, NETH, NEZ, NOR, PAK, POR, SING, SPA, SRI, SWED, SWZ
Sri Lanka G01	AUST, CAND, GER, IND, JAP, U.K, U.S.A
Sri Lanka G02	AUT, BELG, DEN, FIN, FRA, GRE, HK, INDO, IRE, ITY, KOR, MAL, NETH, NEZ, NOR, PAK, POR, SING, SPA, SWED, SWZ,
Bangladesh G01	BELG, CAND, GER, IND, JAP, SING, U.K, U.S.A
Bangladesh G02	AUST, AUT, DEN, FIN, FRA, IND, KOR, MAL, NETH, NEZ, NOR, PAK, POR, SPA,SRI, SWED, SWZ

Table-A2: Import-based Group

Source country/ group	Trade partner countries
Pakistan G01	AUST,CAND,GER,HK,JAP, U.K,U.S.A
Pakistan G02	AUT, BD, BELG, DEN, FIN, FRA, IND, IRE, KOR, MAL, NETH, NEZ, NOR, POR, SING, SPA,SRI, SWED, SWZ, INDO, HK,
India G01	AUST, BELG, CAND, DEN, FIN, FRA, GER, HK, INDO, ITY, JAP, KOR, MAL, NETH, NEZ, SING, SRI, SWED, U.K, U.S.A
India GO2	NOR, AUT, BD, GRE, IRE, PAK, SPA, SWZ
Sri Lanka G01	AUST, CAND, FRA, GER, HK, IND, INDO, ITY, JAP, KOR, MAL, SWZ, U.K, U.S.A
Sri Lanka G02	AUT, BD, BELG, DEN, FIN, GRE, IRE, NETH, NEZ, NOR, PAK, POR, SING, SPA, SWED
Bangladesh G01	AUST, BELG, CAND, FRA, GER, HK, IND, INDO, ITY, JAP, KOR, U.K, U.S.A
Bangladesh G02	AUT,DEN,FIN,GRE,IRE,MAL,NETH,NEZ,NOR, PAK,POR,SING,SPA,SRI, SWED,SWZ,

Table-A3: Liberalizing and Control Groups

Liberalizing Group
PAK, INDIA, BANGLADESH, SRI LANKA
Control Groups
ALL COUNTRIES
AUST, AUT,BELG,CAND,DEN,FIN,FRA,GER, GRE, HK, INDO, IRE, ITY, JAP, KOR, MAL, NETH, NEZ, NOR, POR, SING, SPA, SWED, SWZ, U.K, U.S.A
ASIAN GROUP
HK, INDO, JAP, KOR, MAL, SING,
NON-ASIAN GROUP
AUST, AUT, BELG, CAND, DEN, FIN, FRA, GER, GRE, IRE, ITY, NETH, NEZ, NOR, POR, SPA, SWED, SWZ, U.K, U.S.A

Table-A4: Legend of Countries

	Code	Country
1	AUST	Austrailia
2	AUT	Austria
3	BD	Bangladesh
4	BELG	Belgium
5	CAND	Canada
6	DEN	Denmark
7	FIN	Finland
8	FRA	France
9	GER	Germany
10	GRE	Greece
11	HK	Hong Kong
12	IND	India
13	INDO	Indonesia
14	IRE	Ireland
15	ITY	Italy
16	JAP	Japan
17	KOR,	Korea
18	MAL	Malaysia
19	NETH	Nether Land
20	NEZ	New Zealand
21	NOR	Norway
22	PAK	Pakistan
23	POR	Portugal
24	SING,	Singapore
25	SPA	Spain
26	SRI	Sri Lanka
27	SWED	Sweden
28	SWZ,	Switzerland
29	U.K	United Kingdom
30	U.S.A	United States

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An Analysis of Host Country Characteristics that Determine FDI in Developing Countries: Recent Panel Data Evidence

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Abstract

This paper analyzes a range of host country characteristics that determine foreign direct investment (FDI) flows to developing countries, using panel data on 72 countries for the period 1970-2008. Keeping in view the endogeneity problem of the chosen host country's characteristics, the model is estimated using the General Method of Moments (GMM) technique. The analysis shows that gross domestic product (GDP), economic growth, and per capita income positively affect FDI—a result consistent with the market-seeking behavior of multinational corporations (MNCs). Furthermore, we find that remittances have a significant and positive impact on FDI. On the other hand, inflation and the balance of payments deficit have negative effects on FDI. MNCs are attracted to host countries that are outward looking and follow trade-promoting policies. This is confirmed by the positive effect of openness on FDI flows to developing countries. The study also finds that the effect of military expenditures on FDI is negative and significant. Finally, our analysis finds that the real exchange rate has a significantly negative impact on FDI.

Keywords: Investment, panel data, developing countries, FDI, GMM.

JEL Classification: F21.

I. Introduction

Most developing countries experience a shortage of capital, which is reflected in their respective savings-investment and import-export gaps. This implies that developing countries have insufficient savings/foreign exchange to finance their investment needs. To bridge this gap, they need an inflow of foreign capital. Foreign direct investment (FDI) is thus an important source of capital for growth in developing countries.

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In the 1960s and 1970s, many countries maintained a cautious and sometimes negative position towards foreign investment. In the 1980s, however, attitudes shifted radically toward a more welcoming policy stance. This change was due mainly to the economic problems facing the developing world. While FDI has surged, other forms of capital flows to developing countries have diminished: Aid has declined continuously as a share of capital inflows since the 1960s, while commercial loans, a major source of capital flows in the 1970s, have virtually disappeared since the debt crisis of the 1980s.

It is generally assumed that FDI contributes to economic growth and restructuring in developing economies. However, there is increasing competition between developing (and developed) countries to attract FDI flows to enter into, or consolidate their position within, an increasingly integrated world production, trading, and investment system. In this study, we focus on the inflow of FDI, using panel data for 72 developing countries. In order to overcome constraints to the supply of FDI, we aim to identify the determinants of FDI inflows.

The rest of the paper is organized as follows: Section II provides a literature review. Section III explains the model and framework of analysis used. Section IV describes the dataset and construction of variables. Section V presents our findings from the empirical analysis, and Section VI presents a summary with some policy implications.

II. Literature Review

The earlier literature describes the determinants of FDI theoretically without giving empirical results (for example, Lall 1978). Later studies based on empirical analysis have increasingly appeared in the literature. These studies differ from earlier studies on the basis of theory. Initially, pure economic theory, i.e., that of international trade and the theory of the firm, were adopted as the theoretical base for empirical studies of FDI determinants. These theories assume the presence of perfect competition and an identical production function, and attribute FDI flows to the difference in interest rates across countries. However, this does not explain the large volume of FDI flows across countries.[1]

Recent theories, as a base for FDI and in particular the growth of multinational corporations (MNCs), have turned to explanations based on

[1] FDI flows to developing countries increased manifold, rising from US$33.7 billion in 1990 to US$172.9 billion in 1997 (Government of Pakistan 2000/01).

market imperfections, oligopolistic interdependence, and monopolistic advantage. It is assumed that, for FDI to take place, a necessary condition is that investing firms have some monopolistic advantage that local competitors do not have.

Wang and Swain (1995) explore the factors that explain foreign capital inflow into Hungry and China during the period 1978-92. More specifically, they analyze the relative importance of market size, cost of capital, labor costs, tariff barriers, exchange rates, import volumes, and economic growth in OECD countries within the framework of a one-equation model.[2] They estimate their chosen model using Ordinary Least Squares (OLS) regressions; the findings of their study suggest that the size of the host country's market plays a positive role, while the cost of capital variable is negatively correlated with investment inflows. They find little evidence to support classical hypotheses concerning tariff barriers and import variables.

In a survey article, De Mello (1997) discusses more recent developments in the literature on the determinants of FDI and the impact of inward FDI on growth in developing countries. The study argues that the policy regime of host countries is a potentially important FDI determinant. The recent literature has provided policymakers in developing countries with more adequate tools and more accurate benchmarks for cross-country comparisons and policy evaluation. Foreign investors are motivated primarily by international rent seeking under standard profit maximizing assumptions. The most important factors explaining FDI inflows into developing countries in recent years are (i) the foreign acquisition of domestic firms in the process of privatization, (ii) the globalization of production, and (iii) increased economic and financial integration.

De Mello (1997) also presents a brief summary of case studies such as O'Sullivan (1993), Bajorubio and Sovilla-Rivero (1994), Wang and Swain (1995), Milner and Pentecost (1996), and Lee and Mansfield (1996), which specify the exchange rate, inflation, domestic expenditures, and trade ratio as important determinants of FDI.

[2] Most of these independent variables, except average growth rates and the cost of capital in home countries, can be found in Aggarwal's (1980) study. Many earlier empirical studies (for instance, Petrochilos 1989 and Huang 1992) have supported Jorgenson's (1963) hypotheses that the cost of capital determines FDI, while others suggest that the faster growth of home countries has played a positive role in driving FDI in host countries (Jeon 1992).

Using a panel dataset for sub-Saharan Africa (SSA) countries, Asiedu (2002) explores the determinants of FDI and examines why SSA has been relatively unsuccessful in attracting FDI in spite of policy reforms. The results of this study indicate that better infrastructure and a higher return on investment has a positive impact on FDI in non-SSA countries, while there is no significant impact on FDI in SSA countries. The coefficient on openness to trade is conducive to FDI in both SSA and non-SSA countries. However, the marginal benefit from increased openness is lower for SSA countries. The author concludes that factors that determine FDI in the developing world have a different impact on FDI in SSA countries. The results of this study are based on the OLS estimation technique, which does not address the problem of endogeneity.

Using a panel dataset for 20 developing countries during the 1990s, Sekkat and Varoudakis (2007) assess the importance of openness, infrastructure availability, and sound economic and political conditions in attracting FDI. Their analysis shows that openness constitutes a key factor in attracting FDI to an economy. Their findings also highlight the importance of investment climate (infrastructure, economic, and political environment) in increasing a country's attractiveness with respect to FDI. The authors suggest that an improvement in business climate can result in a larger increase in FDI inflows relative to a greater degree of openness.

Botric and Skuflic (2006) analyze FDI determinants in southeast European countries during the period 1996-2002. The authors use GLS regression analysis on a pooled sample. Their analysis shows that the trade regime (openness) and density of infrastructure exert a significantly positive influence on FDI. However, the study does not find that market-seeking determinants (GDP, per capita GDP, GDP growth, population) have any significant or robust effect on FDI.

Kok and Ersoy (2009) investigate the determinants of FDI in 24 developing countries. They use OLS and cross-sectional seemingly unrelated regression (SUR) econometric techniques: the former for the period 1938-2005 and the latter for the period 1976-2005. They find that total debt service/GDP and inflation have a significant negative influence on FDI while per capita GDP growth, gross capital formation, trade openness, and the presence of telephone main lines have a positive effect on FDI.

Onyeiwu and Shrestha (2004) use fixed and random effects models to explore the determinants of 29 African countries for the period 1975 to 1999. This study identifies economic growth, openness, inflation, international reserves, and natural recourses as significant determinants of

FDI flows to Africa. The authors point out that these factors are conducive to FDI regardless of whether the impact of country- and time-specific effects on FDI is stochastic or fixed.

Estimating a cross-sectional econometric model, Demirhanand and Masca (2008) explore the determinants of FDI inflows in 38 developing countries for the period 2000-2004. They find that the positive and significant factors affecting FDI include income per capita growth rate, telephone main lines, and degree of openness. The inflation rate and tax rate have a negative sign and are statistically significant. Factors that emerge as insignificant in determining the inflow of FDI are labor cost and risk.

Ahmad and Malik (2009) analyze the factors that effect FDI, domestic investment, and growth, using a panel dataset for 35 developing countries for the period 1970-2003. Their findings indicate that the effect of FDI on economic growth is insignificant while the effect of domestic investment is positive and highly significant, implying that it has a complementary relationship with FDI. The authors argue that this complementary relationship indicates that the presence of domestic investment is an indicator of profit-making opportunities and the willingness of domestic investors to develop complementary industries that are important for successful long-term business ventures for foreign investors, e.g., the development of parts industries to support foreign automobile companies in developing countries.

Ahmad and Malik (2009) specify six determinants of FDI: (i) GDP, (ii) per capita income, (iii) domestic investment, (iv) openness, (v) exchange rate, and (vi) education. The effect of market size in this study emerges as insignificant while the effect of openness is positive and significant. The authors conclude that a small but open economy is more attractive to foreign investors than a large but relatively closed economy. Their analysis reports a negative and statistically significant coefficient on the real exchange rate, implying that real depreciation decreases the relative prices of goods in the host country and makes it more economical for MNCs to make a country their production base rather than an export target. Finally, the impact of the literacy rate is positive and statistically significant for attracting FDI.

In the empirical literature, FDI determinants have been examined at both micro- and macro-levels. Studies focus mainly on the following variables: market size, openness, exchange rate, cost of labor and infrastructure variables. Many variables such as remittances, official development assistance, dependency ratio, and military expenditures, remain, to our knowledge, unnoticed. At the same time, most studies do not incorporate the maximum possible number of developing countries in panel data estimation. The existing empirical literature on FDI also suffers from the problem of endogeneity because most studies use the OLS method, which provides biased results. Even though some studies control for cross-country fixed effects and random effects, these econometric techniques do not control for endogeneity.

This study fills the existing gaps in the literature by using the GMM econometric technique for the period 1970-2008. We also look for those country characteristics that are not emphasized in the existing literature for a large set of developing countries.

III. Methodology

In this section, we formulate a framework of analysis to determine the effect of various factors on FDI in the developing countries that constitute our sample. The underlying objective is to explain the rationale for FDI. It is generally believed that MNCs invest in those countries where they expect higher rates of return. We introduce a variety of host country characteristics that determine the profits of firms on FDI.

Market Size

The market size hypothesis argues that inward FDI is a function of the size of the host country market, usually measured by GDP and per capita income. We use GDP and per capita income as a proxy for market size. High demand, prospects of economies of scale, good economic health, and absorptive capacity are factors that give a “green light” to foreign investors. The combined effect of such factors can be captured by market size. Larger market size is expected to have a positive effect on FDI. This positive effect is supported in the literature by Reuber (1973), Schneider and Fry (1985), Wheeler and Mody (1992), and Zhang and Markusen (1999).

Growth of GDP

Market size exhibits existing demand in an economy while growth represents future potential. A high level of economic growth is a strong indicator of market opportunities. The growth of the host market is deemed significant for expansionary direct investment (Clegg and Scott-Green 1998). Growth is also important because higher rates of economic growth are usually associated with an increase in the profitability of corporations (Gold 1989). There is relatively little support in the existing literature for this determinant of FDI when compared to the market size variable (Goldberg 1972, Scaperlanda and Balough 1983, Culem 1988, and Clegg 1995).

Remittances

Barajas, et al (2009) evaluate different theories of the impact of remittances in developing countries. First, remittances are a source of physical and human capital accumulation because they finance directly the cost of investment and support the schooling of younger household members. Second, recipient households substitute unearned income (remittances) for labor income because remittances are an easy source of income, implying that remittances are inversely related to labor force participation. Third, in general, remittance flows stimulate household spending, especially on products that are produced by foreign companies. Moreover, the bandwagon effect works as a multiplier on the demand for various products. As we will control for domestic investment and the dependency ratio in explaining FDI, we expect the effect of remittances to occur through household general spending and human capital accumulation. Having said this, we expect remittances to have a positive effect on FDI.

Exchange Rate

The exchange rate affects FDI in several ways. Froot and Stein (1991) have discussed the relative wealth effect of exchange rates. A rise in the exchange rate in terms of the host country's currency over the home country's currency implies a depreciation of the former's currency. A real depreciation of the host country's currency favors the home country's purchases of host country assets, and therefore leads to an increase in inward FDI in the host country. Gushman (1985, 1987) and Culem (1988) emphasize the effect of exchange rate changes on relative labor cost. A real depreciation of the host country's currency allows home country investors to hire more labor for a given amount of the home country's currency, and is therefore associated with an increase in inward FDI in the host country. The findings of Klein and Rssengren (1994) support the significance of the relative wealth effect but fail to support the relative labor cost effect.

Balance of Payments Deficit

The expected sign of the coefficient of balance of payments is negative because it indicates that a larger deficit means that a country is living beyond its means. Foreign investors are likely to sense the danger of restrictions on free capital movement, which would make it difficult to transfer a firm's profits (Schneider and Frey 1985).

External Debt Burden

This shows external imbalances; a higher debt burden creates constraints not only in terms of new private lending but also in terms of FDI flows (Nunnenicamp 1991). Hence, it is expected to discourage FDI, and the coefficient on external debt is exposed to be negative.

Inflation Rate

Another important determinant of FDI is the inflation rate, which exerts a negative influence on the profitability of FDI because it increases the user cost of capital (De Mello 1997). A high rate of inflation results from imprudent fiscal and monetary policies, such as persistent budget deficits, excessive money supply and a poorly managed exchange rate regime. It also reflects a country's macroeconomic instability, which in turn discourages the flow of FDI (Calvo, et al 1996). In cross-country studies, inflation is used as a proxy to capture macroeconomic instability, which is strongly correlated with political instability.

Openness

A greater degree of openness encourages a higher flow of FDI, primarily because most MNCs are export-oriented. They tend to acquire the benefits of export expansionary policies and import machinery for production from their home country. We expect this variable to have a positive effect on FDI. Kravis and Lipsey (1982) report the positive impact of host countries' degree of openness on the location decisions of MNCs.

Military Expenditure

A large proportion of the budget reserved for defense expenditures may imply future uncertainty, lower development expenditures, and wasted resources. Such factors create an adverse climate for investment. Moreover, the weapons accumulation race may adversely affect foreign relations. Hence, we expect military expenditures to have a negative influence on FDI. In developing countries, sectors regarded as strategic and related to national defense or sovereignty are frequently targeted by protectionist policies. These polices tend to distort social and private returns to capital and hence reduce the efficiency of FDI (De Mello 1999).

Domestic Investment

This may be a substitute or complement for FDI depending on the investment climate of the host country and the types of FDI. However, the literature shows mixed results. When domestic investment increases, the marginal productivity of investment decreases; if the marginal productivity of FDI also decreases, then the relationship will be a substituting one. This can happen when domestic investment dominates the production sector. On the other hand, if the marginal productivity of FDI increases, then relationship will be complementary. This can happen when domestic investment dominates the infrastructure sector. Furthermore, if domestic investors and foreign investors compete for joint ventures then this relationship will be a substituting one (see, for example, Buffie 1993).

Credit Facilities

Better credit facilities improve the investment climate for domestic investors, implying that there could be less room left for foreign investors. Hence, we expect this variable to have a negative influence on FDI.

Official Development Assistance

Official development assistance expenditures are indicators of development activities. Such expenditures favorably determine infrastructure and also indicate a country's good terms with international institutions; this builds confidence among foreign investors. Luger and Shetty (1985) have presented suggestive evidence on this aspect.[3]

Communication Facilities

A society is taken as developed and industrialized if it has a sophisticated and widespread communication system. The presence or lack of communication facilities shapes the boundaries of nations, states, and local governments (Coughlin, Terza, and Arromdee 1991).

Dependency Ratio

A high dependency ratio implies a vacuum of skilled labor. In developing countries, higher dependency ratios present a great concern. A single person covers the living expenditures of a large family. Such persons are likely to overwork, leading to an adverse effect on their health and

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[3] See for more detail Luger and Shetty (1985).

productivity. We can expect the dependency ratio to have a negative influence on investment decisions.

Model

The model we have developed takes into account those factors that play an important role in the determination of FDI in developing countries. We have a single equation model:

$$FDI_{i\,t} = f\,(PCY_{it}, X_{it}, \ldots X_{nt}, \xi_{it})$$

where FDI_{it} represents the dependent variable, FDI, while X_{it} represent the vectors of exogenous variables. The subscript i (=1, ... n) represents the country and t (= 1, ...T) the period of time in years. The variable PCY_{it} represents per capita income. Notice that the vectors $X_{it,}$ generally include some overlapping variables. The specified equation for FDI is as follows:

$$FDI_{it} = f\,(GDP_{it}, PGDP_{it}, GROW_{it}, REM_{it}, EXCH_{it}, BOP_{it}, ED_{it}, INF_{it}, OPEN_{it}, ME_{it}, DI_{it}, CRED_{it}, OD_{it}, TP_{it}, DEP_{it,})$$

where

FDI = foreign direct investment as a percentage of GDP,

GDP = gross domestic product in constant prices in 2000,

PGDP = per capita GDP,

GROW = annual percentage growth rate of GDP,

REM = workers' remittances as a percentage of GDP,

EXCH = real exchange rate (obtained by multiplying the nominal exchange rate with US consumer price index (CPI) and then divided by domestic CPI),

BOP = balance of payments as a percentage of GDP,

ED = external debt as a percentage of GDP,

INF = inflation, consumer prices (as an annual percentage),

OPEN = openness measured as exports plus imports as a percentage of GDP,

ME = military expenditures as percentage of GDP,

DI = domestic investment as a percentage of GDP,

CRED = credit facilities available to domestic sector as a percentage of GDP,

OD = official development assistance as a percentage of GDP,

TP = number of telephones per 1,000 people,

DEP = dependency ratio measured as the percentage of nonworking population to the working population.

IV. Data and Estimation Procedure

Data for this study have been taken from World Development Indicators (WDI) 2009. A sample of 150 countries was selected, of which 72 were chosen, for which data on most of the variables were available for at least 16 years. All variables are measured in US dollars at constant prices.

Gross FDI is measured as a percentage of GDP and refers to the inflows of FDI recorded in the balance of payments financial account. The official exchange rate is measured as the number of local currency units per US dollar, period average. The official exchange rate refers to the actual principal exchange rate and is an annual average based on monthly averages determined by country authorities or on rates determined largely by market forces in the legally sanctioned exchange market. We converted the nominal exchange rate into the real exchange rate by multiplying the former by the US CPI and then dividing it by the domestic CPI.

The balance of payments is the current account balance, and includes the credit minus debit of goods, income, and current transfers as a percentage of GDP. Total external debt is measured as a percentage of GDP, and includes the debt owed to nonresidents repayable in foreign currency, goods, or services. Total external debt is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, use of International Monetary Fund (IMF) credit, and short-term debt. Short-term debt includes all debt with an original maturity of 1 year or less and interest in arrears on long-term debt.

The variable openness is measured as exports plus imports, divided by GDP. It measures the degree of trade liberalization. Military expenditures data from SIPRI are derived from the NATO definition, which includes all current and capital expenditures on the armed forces, including peacekeeping forces, defense ministries and other government agencies engaged in defense projects, paramilitary forces (if these are judged to be trained and equipped for military operations), and military space activities. Such expenditures include military and civil personnel, including retirement pensions of military personnel and social services for personnel, operation and maintenance; procurement; military research and development, and military aid (in the military expenditures of the donor country).

Gross domestic investment is measured as a percentage of GDP. It consists of outlays on additions to the economy's fixed assets plus net changes in the level of inventories. Fixed assets include land improvements (fences, ditches, drains, and so on), plant, machinery, and equipment purchases, and the construction of roads, railways, etc., including commercial and industrial buildings, offices, schools, hospitals, and private residential dwellings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales.

Credit to the private sector is measured as a percentage of GDP. It refers to financial resources provided to the private sector - such as through loans, purchases of nonequity securities, trade credits, and other accounts receivable - that establish a claim for repayment. In some countries, these claims also include credit to public enterprises.

Official development assistance and net official aid record the actual international transfer by the donor of financial resources or of goods or services valued at the cost to the donor, less any repayments of loan principal during the same period. Aid dependency ratios are computed using values in US dollars converted at official exchange rates.

Estimation Technique

The use of pooled time-series and cross-sectional data provide a large sample that is expected to yield efficient parameter estimates. In this study, we use the GMM estimation technique which has been developed for dynamic panel data analysis, and introduced by Holtz-Eakin, *et al* (1990), Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1997).

The GMM technique controls for the endogeneity of all explanatory variables, allows for the inclusion of lagged dependent variables as regressors, and accounts for unobserved country-specific effects. Following the standard convention in the literature, the equations are estimated by using the lagged first difference as an instrument (Ahmad and Malik 2009).

V. Empirical Results and Interpretation

In this section we report the empirical results based on pooled data for 72 developing countries for the period 1970-2008. We select a large set of developing countries for empirical investigation. The results of the estimation are presented in Tables-1 and 2.

Table-1: Parameter Estimates of GMM

Variables	Parameter Estimates
PCY	0.0001 (1.77)***
GDP	1.16E-12 (2.28)**
GROW	0.26 (2.76)*
BOP	-5.59E-11 (-3.16)*
ED	5.95E-05 (-0.03)
OPEN	0.008 (2.44)**
DI	-0.021 (-1.82)***
CRED	0.003 (0.85)
OD	1.50 (1.10)
TP	0.054 (3.22)*
INF	-0.0016 (-1.78)***
DEP	-7.63E-10 (-1.70)***
REM	0.044 (1.87)***
ME	-0.118 (-2.25)**
No. of Countries	72
R^2	0.60
J Statistics	7.41
D W	1.68

Note: The t-statistics are given in parentheses (*), (**), and (***) indicating statistical significance at 1%, 5%, and 10% levels, respectively.

The variables that are statistically significant in the GMM estimation include GDP, per capita income, GDP growth rate, remittances, the real exchange rate, inflation, military expenditures, trade openness, balance of payments, domestic investment, dependency ratio, and communication. Variables that are insignificant include external debt, credit available to the private sector, and official development assistance. Although insignificant, these variables obtain the correct signs in relation to FDI.

One of the most important determinants found to have a significant favorable effect on FDI in all the estimated equations is per capita GDP. It is the most commonly used proxy for market size. This finding emphasizes the necessity of a large market for the efficient utilization of resources and exploitation of economies of scale. A larger market offers higher demand and absorptive capacity in an economy and attracts foreign investors. MNCs are particularly attracted by large markets because they do not have to reship most of their products to parent countries. Once a foreign firm is established in an economy, it can take oligoplistic advantage of its large size, technical knowhow, and other facilities. These relative advantages result in higher profits. Thus, market size helps perpetuate FDI.

Unlike some empirical studies[4], economic growth is also highly significant in relation to FDI. Our results are thus consistent with prior expectations. Growth is important because higher rates of economic growth are usually associated with an increase in the profitability of corporations.[8] High economic growth rates in host countries, apart from the presence of a large domestic market, usually indicate credible and stable macroeconomic policies that attract foreign capital.

Remittances capture the market-seeking motivation of MNCs, and the variable emerges as positive and significant. Remittances are an easy source of income for recipient households and receivers spend this unearned income on various products, including those produced by foreign companies. Although remittances are also a source of capital accumulation, we have already controlled for the effect of domestic investment, which is negative and significant in developing countries over the study period. This finding indicates that the relationship between FDI and domestic investment is not complementary.

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[4] Our findings on the insignificant growth rate are in line with those presented by Clegg (1995) and Clegg and Scott-Green (1998). Findings on the significant growth rate are in line with Root and Ahmad (1979).

[8] See Gold (1989) p. 213.

The variable official development assistance is considered favorable for FDI in the literature. Our estimates, however, show that this association is insignificant but positive. The reason for its insignificance may be the low level of structural development in the least developed countries, which dominate the sample, and may be due to the lack of revenues and high expenditures for debt servicing and defense.

The effect of the balance of payments deficit is significant with a negative sign, perhaps because it implies that a country is living beyond its means. Furthermore, it indicates that a country is facing macroeconomic instability. In such countries, governments and government polices are not stable and consistent, causing foreign investors to hesitate when investing. The effect of external debt on FDI is negative but insignificant.

Another important determinant of FDI is the inflation rate, which is found to be negative and significant. This is consistent with De Mello (1997), who argues that inflation exerts a negative influence on the profitability of FDI because it increases the user cost of capital. A high rate of inflation results from imprudent fiscal and monetary policies, such as persistent budget deficits, excessive money supply, and a poorly managed exchange rate regime. It also reflects macroeconomic instability in a country that discourages the flow of FDI.

Communication facilities are measured in terms of the number of telephones. The effect of this facility on FDI is significant and has a positive sign. Telephones are the main source of communication in this globalized era and integrate markets within and across countries. A wide network of telecommunication facilities creates a market-friendly environment and exerts a positive influence on FDI inflows in developing countries.

The labor force variable is an important determinant of FDI. If we analyze only the size of the labor force, this may obscure the true results because the quality of the labor force is also important. Keeping this in view, we use the dependency ratio as a proxy for labor quality because a higher dependency ratio implies a lower quality of labor and vice versa. The effect of the dependency ratio is significantly negative in explaining FDI flows. This variable may reflect the general phenomenon of single person-dependent families in developing countries. Such situations exert a negative influence on the productivity of the labor force. Our empirical results are consistent with this phenomenon.

The effect of openness is highly significant with a positive sign. Trade openness identifies the magnitude of trade liberalization and is important because developing countries are used as a terminal. MNCs are attracted to countries with a location advantage, with the aim of exporting their products to a large market. Fewer trade barriers make the import of raw materials, such as plant machinery, convenient. On the other hand, MNCs can also easily export their intermediate and final products. Moreover, due to liberalization policies, MNCs can also take advantage of export promotion facilities. With these factors in mind, we can conclude that our positive relation between openness and FDI is theoretically sound.

Table-2: Parameter Estimates of GMM

Variables	Parameter Estimates
PCY	0.0001
	(1.63)***
GDP	1.26E-12
	(2.37)**
GROW	0.30
	(2.79)*
EXCH	-3.00E-05
	(-2.37)**
BOP	-5.59E-11
	(-3.19)*
ED	0.0007
	(-0.33)
OPEN	0.009
	(2.82)*
DI	-0.030
	(-2.17)**
CRED	0.002
	(0.51)
OD	0.98
	(0.65)
TP	0.048
	(2.60)*
INF	-0.0016
	(-1.78)***
DEP	-8.25E-10
	(-1.70)***
REM	0.030
	(1.79)***
ME	-0.131
	(-2.30)**
No of Countries	72
R^2	0.61
J Statistics	4.84
D W	1.75

Note: The t-statistics are given in parentheses (*), (**), and (***) and indicate statistical significance at 1%, 5%, and 10% levels, respectively.

In Table-2 we control for the real exchange rate, which is a key factor in investment decisions by foreign investors. This study finds that the real exchange rate has a negative and significant effect on FDI. The real exchange rate has been included to capture the relative wealth effect and relative labor cost effect; the former implies that a real depreciation of the host country's currency favors the home country's purchases of host country assets, while the latter implies that a real depreciation of the host country's currency allows home country investors to hire more labor for a given amount of the home country's currency.

This result is consistent with Froot and Stein (1991) and Ahmad and Malik (2009). The negative coefficient implies that a real depreciation decreases the relative prices of goods in the host country and makes it more economical for MNCs to make a country their production base. Here, we add another line of reasoning while interpreting real exchange rate depreciation: it also attracts MNCs with the motive of using developing countries as an export platform because real depreciation makes exports more competitive in the international market. This result supports Gushman (1985, 1987) and Culem (1988) who emphasize the effect of exchange rate changes on relative labor cost. Real depreciation of the host country's currency allows home country investors to hire more labor for a given amount of the home country's currency, and is therefore associated with an increase in inward FDI into the host country.

We apply the Wald test to the various null hypotheses involving sets of regression coefficients. The results are shown in Table-3. The p-value indicates that this analysis rejects the null hypothesis that the regression coefficients of all variables in the FDI equation are equal to zero. We cannot reject the null hypothesis that official development assistance does not affect FDI. The same exercise has been done for the trade openness variable in the model and the test results confirm the significance of trade openness in the model. Similarly, the null hypotheses that the external debt burden and macroeconomic instability do not affect FDI inflows in developing countries can also be rejected.

Table-3: Results of Wald Test on Parametric Restrictions

Null Hypotheses	Chi-Square Statistic	Computed Rejection Probabilities
Regression coefficients of all the variables in the FDI equation are equal to zero	1254.469	0.000
Regression coefficients of the market seeking variables in the model are equal to zero	87.65	0.000
Regression coefficient of the trade openness variable in the model is equal to zero	5.944	0.015
Regression coefficient of macroeconomic instability variable in the model is equal to zero	3.152	0.076
Regression coefficient of the official development assistance in the model is equal to zero	1.226	0.268
Regression coefficients of the financial burden variables (external debt burden, military expenditures and BOP deficits) are equal to zero	18.4858	0.0003

VI. Conclusion

The objective of this study was to determine those host country characteristics that are important in determining the location decisions of MNCs in developing countries. For this purpose we selected panel data for 72 developing countries for the period 1970-2008. The data were taken from the *World Development Indicators (WDI) 2009*. The GMM model was used to estimate the potential determinants of FDI based on panel data. A number of conclusions can be drawn from the study and are summarized below.

The host country characteristics that are statistically significant and attractive to MNCs are per capita income, GDP, GDP growth rate, remittances, trade openness, and communication facilities. Characteristics that exert a negative influence on FDI flows to developing countries include the real exchange rate, inflation, military expenditures, balance of payments, domestic investment, and the dependency ratio. Variables that are insignificant are external debt, credit to the private sector, and official development assistance. Although these variables are insignificant, they obtain the correct signs in relation to FDI.

The variable PGDP (per capita income), which can be used as a proxy for market size, turned out to be positive and significant. The coefficient of the growth rate is also significant and positive. The growth variable is important because higher rates of economic growth are usually associated with an increase in the profitability of MNCs. Remittances are used as a new variable representing market size and emerge as positive and significant in explaining flows to developing countries. Hence, most of the variables that were employed to capture the market-seeking motive of MNCs emerge as significant, implying that the presence of large markets is an important factor driving foreign capital into the developing world.

Trade openness in developing countries indicates the extent to which the borders of a country are free from restrictions on imports and exports; it is also conducive to attracting FDI. The impact of communication facilities is also significantly positive in explaining FDI flows. Such facilities are helpful in exploring access to new markets. The coefficient of official development assistance is positive although insignificant in explaining FDI flows.

The variables balance of payment (BOP) deficit and inflation have a negative impact on FDI inflows. High inflation rates and persistent deficits in a country's BOP mean that it is suffering from macroeconomic and financial problems. The government is thus likely to spend less on development activities and increase the debt burden and import duties, causing a negative effect on foreign investment.

Similarly, the coefficient of military expenditure is significant and has a negative sign. A country with high military expenditures will attract less FDI. High military expenditures may indicate that a country is spending less on economic development. This may lead to public discontent, cuts in development expenditure, and macroeconomic instability, as well as causing foreign investors to suspect hurdles to investment, leading to lower FDI.

The coefficient of domestic investment is negative and significant, implying that the relationship between domestic investment and FDI is not complementary. Arguably, domestic investment dominates the production sector instead of infrastructure, which is consistent with Buffie (1993) who argues that domestic investors and foreign investors compete for joint ventures. The coefficient on the dependency ratio is also negative and significant, perhaps because high dependency ratios adversely affect the productivity of the labor force, which in turn exerts a negative influence on FDI.

Finally, this analysis finds a negative and statistically significant coefficient of real exchange rates, possibly because real depreciation decreases the relative price of goods in the host country and makes it more economical for MNCs to make a country its production base and use it as an export platform.

The policy implications that we offer are:

- It is of critical importance that a country maintains a high and sustainable economic growth rate. The study shows that a sustainable growth patterns attract FDI.

- Developing countries can attract greater FDI inflows by removing artificial barriers and controls on exports and imports. An open and export-oriented policy can be promoted by lowering tariffs and allowing the free mobility of capital.

- Widening the net of communication facilities is also instrumental in attracting FDI inflows. To this end, subsidies could be provided to the telecommunications sector.

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Appendix

List of Countries

1	Angola	25	Fiji	49	Nicaragua
2	Algeria	26	Gabon	50	Niger
3	Argentina	27	Gambia, The	51	Nigeria
4	Belize	28	Ghana	52	Pakistan
5	Benin	29	Guatemala	53	Panama
6	Bolivia	30	Guyana	54	Papua New Guinea
7	Botswana	31	Haiti	55	Paraguay
8	Brazil	31	Honduras	56	Peru
9	Burkina Faso	33	India	57	Philippines
10	Burundi	34	Indonesia	58	Poland
11	Cameroon	35	Iran,	59	Senegal
12	Cape Verde	36	Jamaica	60	Sierra Leone
13	Chad	37	Jordan	61	South Africa
14	Chile	38	Kenya	62	Sri Lanka
15	China	39	Korea, Rep.	63	Swaziland
16	Colombia	40	Lesotho	64	Tanzania
17	Congo, Rep.	41	Madagascar	65	Thailand
18	Costa Rica	42	Malaysia	66	Togo
19	Cote d'Ivoire	43	Mali	67	Tunisia
20	Czech Republic	44	Mauritania	68	Turkey
21	Dominican, Rep.	45	Mauritius	69	Uganda
22	Ecuador	46	Mexico	70	Venezuela
23	Egypt, Arab Rep.	47	Mozambique	71	Zambia
24	El Salvador	48	Nepal	72	Zimbabwe

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An Efficiency Analysis of Punjab's Cotton-Wheat System

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Abstract

This study examines the technical, allocative, and economic efficiencies of the cotton-wheat farming system in Punjab, Pakistan. It also investigates the determinants of these efficiencies using a non-parametric data envelopment analysis (DEA) technique. Technical, allocative, and economic inefficiency scores are separately regressed on socioeconomic and farm-specific variables to identify the sources of inefficiency using a Tobit regression model. The mean technical, allocative, and economic efficiencies calculated for the system were 0.87, 0.44, and 0.37, respectively. Our results indicate that years of schooling and the number of contacts with extension agents have a negative impact on the inefficiency of cotton-wheat farming in Punjab.

Keywords: Cotton, wheat, economic efficiency, data envelopment analysis.

JEL Classification: C14, D61.

I. Introduction

Cotton and wheat are the most important crops grown in Pakistan. The current market share of cotton (among fibers used for apparel and furnishings) in the world is 56 percent (Ahmad 2008), and Pakistan is the fourth-largest cotton producing country in the world after the USA, China, and India. Cotton is Pakistan's major export-earning crop and it also provides raw material to the local textile industry. Cotton accounts for 8.6 percent of the value-added in agriculture and 1.9 percent of Pakistan's gross domestic product (GDP). Under the World Trade Organization (WTO)'s

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post-quota scenario[1], Pakistan has the potential to become a leading force in the worldwide cotton and textile market (Government of Pakistan 2007).

Wheat is the country's main staple food; 75-80 percent of households' food budget is spent on wheat alone (Hassan 2004). It is Pakistan's largest grain crop, and contributes 14.4 percent to the value-added in agriculture and 3.0 percent to GDP (Government of Pakistan 2007).

The recent food scarcity and rises in price have affected almost every country in the world, including Pakistan. The present food crisis is an eye opener for policymakers in Pakistan. Riots have erupted in several parts of the country due to the scarcity of food and price hikes. In order to obtain self-sufficiency in food production and earn foreign exchange, policymakers need to formulate policies both for the short and long term. Possible ways to enhance agricultural production include expanding the cultivated area, increasing cropping intensity, technological changes, and improvements in production efficiency. The latter option seems to be the most suitable in the short run.

In order to model production increases in efficiency, it is useful to look at analyses of firm level efficiency. Farrell (1957) proposes that the efficiency of a firm has two components: (i) technical efficiency, and (ii) allocative efficiency. Technical efficiency is the ability of a firm to produce a maximal output from a given set of inputs or the ability of a firm to produce a given level of output with the minimum quantity of inputs and available technology (Bukhsh 2006). Allocative efficiency is the ability of a firm to use inputs in optimal proportions, given the market prices of inputs and outputs. Economic efficiency is the multiplicative product of technical and allocative efficiency (Coelli, *et al* 1998).

Eight types of farming systems are practiced in Pakistan: cotton-wheat, rice-wheat, mixed crops, pulses-wheat, maize-wheat-oilseed, maize-wheat, orchards/vegetable-wheat and peri-urban around Quetta. Among these systems, the cotton-wheat system is of great importance for the economy of Pakistan. This system not only ensures food security to a large population, but is also a major source of foreign exchange earnings. The total agricultural area under the cotton-wheat farming system in Pakistan is 7.1 million hectares (ha) [Food and Agriculture Organization (FAO) 2004].

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[1] For decades, global trade in textiles and clothing has been subjected to quantitative restrictions imposed by many developed countries to protect their domestic textile industry. By 1 January 2005, under the WTO, all quotas on the import of textiles were eliminated and importing countries are no longer be able to restrict trade in textiles and clothing unless it can justify such restrictions under the provision of Article XIX of the GATT.

This study is designed to estimate the technical, allocative, and economic efficiency of cotton-wheat farming in Punjab, Pakistan. Punjab is the country's most populated and second-largest province in terms of area. The total agricultural area under the cotton-wheat system in Punjab is 5.5 million ha, or about 77 percent of the total agricultural area under cotton-wheat farming in Pakistan (FAO 2004).

The paper is organized as follows: our analytical framework is described in the second section. The sampling procedure and data are described in the third section. The fourth section provides the empirical models. The fifth section provides the results and discussion. Our conclusions are given in the last section.

II. Analytical Framework

A. Production Efficiency Estimates

According to Farrell (1957), efficiency is defined as the actual productivity of a firm relative to its maximal productivity. Maximal productivity (also called best practice) is defined by the production frontier (Lissitsa *et al.* 2005).

The principal approaches to estimating the production frontier are:

(i) The parametric approach through stochastic frontier analysis (SFA),

(ii) The nonparametric approach through data envelopment analysis (DEA).

Both approaches estimate the best practice frontier and calculate the efficiency of a firm relative to that frontier (Latruffe 2002).

Nonparametric or DEA models are based on mathematical programming techniques. Specifically, a linear programming technique that uses data on inputs and outputs is used to construct a best practice production frontier over the data points. The efficiency of each firm is measured by the distance between the observed data points and the frontier. Firms lying on the frontier are the most efficient within the sample while the remaining firms lying below the frontier are inefficient. Their inefficiency increases with the increase in distance from the production frontier.

Charnes, *et al* (1978) proposes an input-oriented DEA model with assumed constant returns to scale. DEA can be either input- or outputoriented (Coelli, *et al* 1998). In the first case, the DEA technique defines the frontier by seeking the maximum possible proportional reduction in input usage with output levels held constant. In the second case, the DEA method defines the frontier by seeking the maximum possible proportional expansion in output, with the same input levels (Lissitsa, *et al* 2005).

Coelli, *et al* (1998) suggests that the orientation be selected according to the quantities (output or inputs) the manager has more control over. As farmers have more control over inputs than output, an input-oriented DEA model is used in this study.

The DEA technique has the following advantages:

(i) It does not require the assumption of a functional form to specify the relationship between inputs and outputs (Krasachat 2003).

(ii) It does not require any assumption about the distribution of the underlying data.

(iii) It can readily incorporate multiple inputs and outputs.

(iv) It provides a means of decomposing economic efficiency into technical and allocative efficiency and also technical efficiency into pure technical and scale efficiency.

Estimation of Technical Efficiency

Technical efficiency scores can be obtained by running a constant returns to scale DEA model or a variable returns to scale DEA model. DEA was first developed by Charnes, Cooper and Rhodes under the assumption of constant returns to scale in 1978 (Coelli, *et al* 1998). Coelli, *et al* (1998) suggest that a constant returns to scale DEA model is only appropriate when all firms are operating at an optimal scale; this is not possible in agriculture due to many constraints. The use of a constant returns to scale DEA model when all firms are not operating at an optimal scale results in measures of technical efficiencies that are confounded by scale efficiencies. In order to avoid this problem, Bankers, *et al.* (1984) modifies the constant returns to scale DEA model into a variable returns to scale model by adding convexity constraints.

An input-oriented DEA model under the assumption of variable returns to scale was used to estimate technical efficiency in this study.

Assuming we have data on K inputs and M outputs of N farms, x_i is an input vector for the ith farm and y_i is an output vector for the ith farm. The KxN input matrix, X, and MxN output matrix, Y, represent the data of all for N farms. For each farm, we obtain a measure of the ratio of all outputs over all inputs, such as $u^{/}y_i/v^{/}x_i$, where u is an Mx1 vector of output weights and v is Kx1 vector of input weights.

To select optimal weights we solve the mathematical programming problem as specified by Coelli*, et al* (1998).

$$\max_{u,v} (u^{/}y_i/v^{/}x_i)$$

$$\text{subject to} \quad u^{/}y_j/v^{/}x_j \leq 1,\ j= 1,2,\ldots\ldots N, \quad u, v \geq 0$$

This problem involves finding the value of u and v, such that the efficiency measure of the ith farm $(u^{/}y_i/v^{/}x_i)$ is maximized, subject to the constraints that all efficiency measures must be less than or equal to 1.

One problem with this particular ratio formation is that it has an infinite number of solutions. To overcome this problem, we impose the constraints $v^{/}x_i = 1$ to the above problem.

$$\max_{u,v} (u^{/}y_i/v^{/}x_i)$$

$$\text{subject to} \quad v^{/}x_i = 1, \quad u^{/}y_j/v^{/}x_j \leq 1,\ j= 1,2,\ldots\ldots N, \quad u, v \geq 0$$

Using the duality problem in linear programming, we can derive an equivalent form of this problem:

$$\min_{\theta,\lambda} \theta,$$

$$\text{subject to} \quad -y_i + Y\lambda \geq 0, \quad \theta x_i - X\lambda \geq 0, \quad \lambda \geq 0$$

where θ is a scalar and represents the technical efficiency score of the ith farm. The value of θ must satisfy the restriction: $\theta \leq 1$. If θ is equal to 1, it indicates that the farm is on the production frontier and is a fully technically efficient farm. λ is a Nx1 vector of constants. The linear programming problem must be solved N times, once for each farm in the sample. A value of θ is then obtained for each farm.

The constant returns to scale DEA model assumes that all farms are operating at optimal level but this may not be possible for a number of reasons such as imperfect competition and financial constraints, etc. The use of the constant returns to scale specification when not all farms are operating at the optimal scale will result in a measure of technical efficiency that is confounded by scale efficiencies. In order to overcome this problem, Banker, *et al* (1984) modify the constant returns to scale DEA model into a variable returns to scale model by adding convexity constraints; this permits the estimation of technical efficiency devoid of scale efficiency effects.

The linear problem for the ith firm under the assumption of a variable returns to scale DEA model is given as:

$$\min_{\theta,\lambda} \theta,$$

$$\text{subject to} \quad \begin{aligned} -y_i + Y\lambda &\geq 0 \\ x_i - X\lambda &\geq 0 \\ N1'\lambda &= 1 \\ \lambda &\geq 0 \end{aligned}$$

where N1 is an Nx1 vector of ones and $N1'\lambda = 1$ is a convexity constraint that ensures that an inefficient farm is only benchmarked against farms of a similar size.

Estimation of Economic Efficiency

Economic efficiency is the ratio of the minimum cost to the observed cost. Following Coelli, *et al* (1998), a cost minimization DEA model was used to estimate the minimum cost as follows:

$$\min_{\lambda, X_i^E} X_i^E \, w_i$$

$$\text{subject to} \quad \begin{aligned} -y_i + Y\lambda &\geq 0 \\ X_i^E - X\lambda &\geq 0 \\ N1'\lambda &= 1 \\ \lambda &\geq 0 \end{aligned}$$

where w_i is a vector of input prices for the ith firm and x_i^E is the cost minimizing vector of input quantities for the ith firm, given the input prices w_i and output level y_i.

Economic efficiency = minimum cost/observed cost, thus

$$EE = w_i x_i^E / w_i x_i$$

Estimation of Allocative Efficiency

Allocative efficiency was estimated by dividing economic efficiency by technical efficiency:

Allocative efficiency = Economic efficiency/technical efficiency

B. Factors Affecting Production Inefficiency

There are two approaches to investigating the relationship between farm inefficiency and various socioeconomic and farm-specific factors. The first method is to compute correlation coefficients or conduct a simple nonparametric analysis. The second method is to measure inefficiency and use a regression model in which inefficiency is expressed as a function of socioeconomic and farm-specific factors. The second approach is also known as the 'two-step procedure' and is the most commonly used (Haji 2006). This approach was adopted in this study.

We have used DEA models to estimate technical, allocative, and economic efficiency. The method adopted by Featherstone, *et al* (1997) and Ogunyinka and Ajibefun (2004) was followed to calculate inefficiency indices by subtracting the efficiency estimates from 1. The technical, allocative, and economic inefficiency scores were separately regressed on socioeconomic and farm-specific variables to identify the sources of technical, allocative, and economic inefficiency, respectively.

Dhangana, *et al* (2000) shows that the inefficiency scores from DEA are limited to between 0 and 1. Therefore, the dependent variable in our regression model does not have a normal distribution. This suggests that ordinary least square (OLS) regression is not appropriate because it would lead to a biased parameters estimate (Krasachat 2003). We therefore use a Tobit regression model (Tobin 1958), as mentioned in Long (1997). This takes the form:

$$E_i^* = Z_i\beta + \mu_i$$

$$E_i = 0 \qquad if\ E_i^* \leq 0$$
$$E_i = E_i^* \qquad if\ E_i^* > 0$$

where E_i is an inefficiency score, β is a vector of unknown parameters and Z_i is a vector of socioeconomic and farm-specific variables. E_i^* is an index variable (sometimes called the latent variable) with $E = [E_i^* | Z_i]$ equals $Z_i\beta$, and μ_i is the error term with a normal distribution $\mu \sim N(0, \delta^2)$.

III. Sampling Procedure and Data

The data used in this study were generated by a cross-sectional survey using a multistage random sampling technique. A four-stage sample design was used to collect data from the field. First-stage units were districts, second-stage units were tehsils, third-stage units were villages, and fourth-stage units were farmers. During the first stage, Rahimyar Khan and Muzaffargarh districts were selected randomly from the cotton-wheat system in Punjab. Sadiqabad and Rahimyar Khan tehsils were selected from Rahimyar Khan district, and Muzaffargarh and Alipur tehsils were selected from Muzaffargarh district using a simple random sampling technique. Two villages from each tehsil were randomly selected, followed by 25 farmers from each village using a simple random technique. A total of 200 farmers, 100 from each district, were sampled from the cotton-wheat system. All selected farms were viewed as a random sample from the whole farming system. The data were collected for the crop year 2005/06 (kharif 2006 and rabi 2005/06). A comprehensively designed and pretested questionnaire was used to collect information from farm respondents.

IV. Empirical Models

The output variable used to estimate technical efficiency was total farm income (Y), which includes income from crops and livestock. The total income from crops was estimated by multiplying the output of each crop by the price received by the farmer; total income from livestock was obtained by aggregating the value of milk and live animals sold.[2] The inputs used in this study included land (X_1), tractors (X_2), seed (X_3), NPK (X_4), pesticide (X_5), labor (X_6), irrigation (X_7), fodder (X_8), and concentrates (X_9).

Following Coelli, *et al* (1998), an input-oriented variable returns to scale DEA model was used to estimate technical efficiency as follows:

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[2] Farmers receive different prices for commodities from local shopkeepers, vendors, and arhtiyas.

$\min_{\theta,\lambda} \theta,$

$$
\text{subject to} \quad
\begin{aligned}
-y_i + Y\lambda &\geq 0 \\
\theta x_i - X\lambda &\geq 0 \\
N1'\lambda &= 1 \\
\lambda &\geq 0
\end{aligned}
$$

θ represents the total technical efficiency of the ith farm.

λ represents Nx1 constants.

$N1' \lambda = 1$ represents a convexity constraint which ensures that an inefficient firm is only benchmarked against firms of a similar size.

Y represents the output matrix for N farms.

θ represents the total technical efficiency of the ith farm.

λ represents Nx1 constants.

X represents the input matrix for N farms.

y_i represents the total farm income of the ith farm in rupees.

x_i represents the input vector of $x_{1i}, x_{2i}, \ldots\ldots x_{9i}$ inputs of the ith farm.

x_{1i} represents the total cropped area in acres on the ith farm.

x_{2i} represents the total quantity of seed (kg) used on the ith farm.

x_{3i} shows the total number of tractor-hours used for all farm operations including plowing, planking, ridging, hoeing, fertilizing, spraying, and land leveling, etc. on the ith farm.

x_{4i} represents NPK nutrients (kg) used on the ith farm. It was observed that some farmers in the sample area also used farmyard manure. It was therefore more plausible to determine the quantity of NPK present in farmyard manure. These nutrients were calculated on the basis of chemical composition as given by Brady (1990).

x_{5i} represents the total quantity of pesticides (active ingredient) (g) used on the ith farm.

x_{6i} indicates the labor input consisting of family and hired labor, and was calculated as the total number of person-days required to perform various farming operations on the ith farm.

x_{7i} represents the total number of irrigation hours used on the ith farm.

x_{8i} represents the total quantity of fodder (kg) used to feed animals on the ith farm.

x_{9i} represents the total quantity of concentrates (kg) used to feed animals on the ith farm.

Following Coelli, *et al.* (1998), a cost minimization DEA model was used to estimate the minimum cost:

$$\min_{\lambda, X_i^E} X_i^E w_i$$

$$\text{subject to} \quad \begin{aligned} -y_i + Y\lambda &\geq 0 \\ X_i^E - X\lambda &\geq 0 \\ N1'\lambda &= 1 \\ \lambda &\geq 0 \end{aligned}$$

where

w_i is the vector of input price $w_{1i}, w_{2i}, \ldots\ldots\ldots, w_{9i}$ of the ith farm.[3]

X_i^E is the cost minimizing vector of input quantities for the ith firm.

N refers to the total number of farms in the sample.

w_{1i} represents the land rent of the ith farm in rupees.

w_{2i} represents the total cost of seed used on the ith farm in rupees.

w_{3i} represents the total amount paid for the use of tractors on the ith farm in rupees.

w_{4i} represents the total cost of NPK used on the ith farm in rupees.

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[3] Information on prices paid were collected from each farmer. Farmers pay different prices for inputs according to the availability of cash and inputs, the distance of the village from the market, and availability of transport facilities.

w_{5i} represents the total cost of pesticide/weedicide used on the ith farm in rupees.

w_{6i} represents the total cost of labor used on the ith farm in rupees.

w_{7i} represents the total cost of irrigation water used on the ith farm in rupees.

w_{8i} represents the total cost of fodder used to feed animals on the ith farm in rupees.

w_{9i} represents the total cost of concentrates used to feed animals on the ith farm in rupees.

Economic efficiency is the ratio between minimum cost and observed cost and was estimated using the following formula.

$$EE = w_i x_i^E / w_i x_i$$

Allocative efficiency was obtained by dividing economic efficiency by technical efficiency.

A question of great interest to policymakers is why efficiency differentials occur across farmers from the same farming system. These could be a reflection of the managerial ability and skill of a farm's operator and the interaction of various socioeconomic factors. The present study made an attempt to investigate the impact of various socioeconomic and farm-specific factors on the technical, allocative, and economic inefficiency of the cotton-wheat and rice-wheat systems in Punjab. In order to estimate the sources of technical, allocative, and economic inefficiency of farms, various socioeconomic and farm-specific variables were regressed on the inefficiency estimates of farms using a Tobit regression model.

The socioeconomic and farm-specific variables included in this study were: years of schooling of the household head, age of the farm operator, contact with extension agents, farm-to-market distance, access to credit, and tenancy status of the farm's operator.

In order to examine the impact of these socioeconomic and farm-specific variables on inefficiency estimates, we use the following Tobit regression model:

$$E_i = E_i^* = \beta_0 + \beta_1 Z_{1i} + \beta_2 Z_{2i} + \beta_3 Z_{3i} + \beta_4 Z_{4i} + \beta_5 Z_{5i} + \beta_6 Z_{6i} + \beta_7 Z_{7i} + \mu_i \quad if \quad E^* > 0$$

$$E = 0 \quad if \quad E_i^* \leq 0$$

where

i refers to the ith farm in the sample.

E_i is an inefficiency measure representing the technical, allocative, and economic inefficiency of the ith farm.

E_i^* is the latent variable.

Z_{1i} represents the education of the ith farmer in terms of years of schooling.

Z_{2i} represents the age of the ith farm's operator in terms of number of years.

Z_{3i} represents the number of times contact was made by the ith farmer with extension agents.

Z_{4i} represents the distance of the ith farm from the main market in kilometers.

Z_{5i} is a dummy variable with a value equal to 1 if the farmer has access to credit. Otherwise it is 0.

Z_{6i} is a dummy variable with a value equal to 1 if the renter is the farm operator. Otherwise it is 0.

Z_{7i} is a dummy variable with a value equal to 1 if the farm operator is a sharecropper. Otherwise it is 0.

β's are unknown parameters to be estimated.

μ_i is the error term.

V. Results and Discussions

A. Summary Statistics

A summary of the values of key variables included in our DEA models and Tobit regression model is given in Table-1. The table reveals that the average total income per farm is Rs40,349.1 with a standard deviation of Rs14,405.13. The average cropped area is 30.44 acres with a standard deviation of 24.75 acres. The large variability in the standard deviation values of total income per farm and cropped area indicates that sample farmers operate at different levels of farm size, which tends to affect their income level and cropped area. The average quantity of seed used per acre was 48.51 kg with a standard deviation of 10.14 kg, and average number of tractor-hours per acre was 4.99 with a standard deviation of 1.52 hours. The small values of the standard deviations of average quantity of seed used and tractor-hours per acre among sample farmers indicates a low level of variability in the use of these two inputs among farmers who are part of the cotton-wheat system.

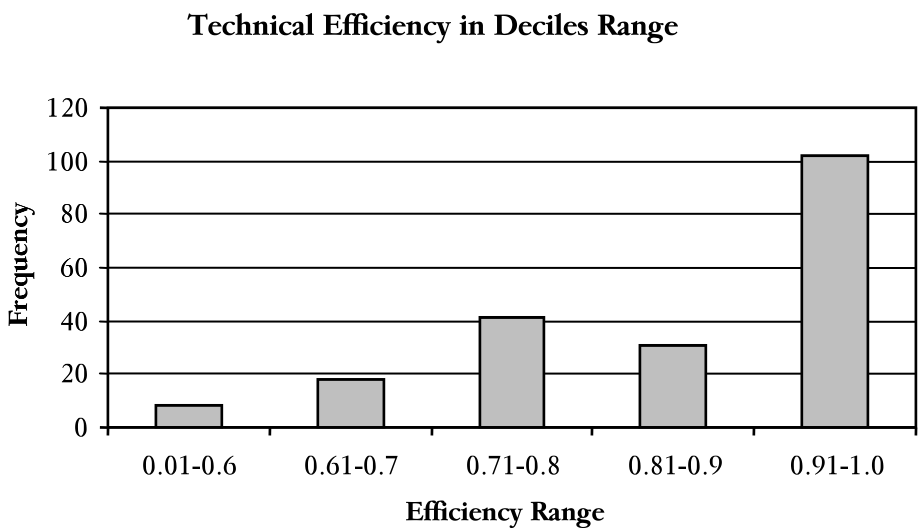
The average quantity of NPK used per acre was 162.44 kg with a standard deviation of 40.51 kg, indicating a large variability in the use of NPK among sampled farmers. It is generally assumed that the use of pesticides in the cotton-wheat system is high, and it is evident from Table-1 that the average quantity of pesticide used per acre is 732.52 g with a standard deviation of 565.99 g. A high standard deviation value indicates a large variability in the use of pesticides among farmers. The average use of labor per acre was 87.08 person-days with a standard deviation of 51.24 person-days, which showed that sampled farmers in the cotton-wheat system depend heavily on human labor to perform most farm operations, in turn indicating a large variability in the use of labor per acre in the sample area. The average number of irrigation-hours per acre was 41.89 with a standard deviation of 25.35 hours, which showed a large variability of irrigation-hours per acre among the sampled farms. The average quantity of fodder and concentrates used per animal was 15,746.79 kg and 539.22 kg, respectively, with large values of standard deviation. The large values of standard deviation for both inputs indicated a large variability in the use of fodder and concentrates per animal among the sampled farmers.

The average age of farm operators in the sample area was 32.17 years with a standard deviation of 11.38 years. The average level of education among farmers in the sample area was 6.67 years of schooling with a minimum of 0 and maximum of 14. The average number of times contact was made by farmers with extension agents was 13.5 with a standard deviation of 8.46. The average distance of sample farms from the nearest market was 12.19 km with a standard deviation of 3.59 km.

B. Efficiency Estimation

The technical and economic efficiencies of the cotton-wheat system were obtained by using DEA models. Allocative efficiency is the ratio of economic efficiency to technical efficiency; therefore, it was obtained by dividing the economic efficiency estimates by the technical efficiency estimates. The empirical results obtained from our DEA models are presented in Table-2. It is evident from the table that the mean technical efficiency of sample farms is 0.87, with a low of 0.41. The results of the study imply that if the average farmers operated at the same technical efficiency as the most efficient farms in the sample, they could reduce, on average, their input use by about 13 percent and still produce the same level of output. The results of the study also indicate that the majority of sampled farmers were fairly technically efficient in utilizing their scarce resources. It was found that 51 percent of sampled farms operated at a level of technical efficiency greater than 0.90, 15.5 percent of farms operate at a level of technical efficiency between 0.80 and 0.90, 20.5 percent of farms operate at a level of technical efficiency between 0.70 and 0.80, 9 percent of farms operate at a level of technical efficiency between 0.61 and 0.70, and only 4 percent of farms operate at a level of technical efficiency of less than 0.61. In other words approximately two thirds of the sampled farms operate at a level of technical efficiency greater than 0.8 while only 13% of sample farms operate at a level of technical efficiency less than 0.7. There are no significant technical efficiency differentials among farmers from the two districts. The mean technical efficiency level is 0.89 for farmers in Muzaffargarh district and 0.86 in Rahimyar Khan district.

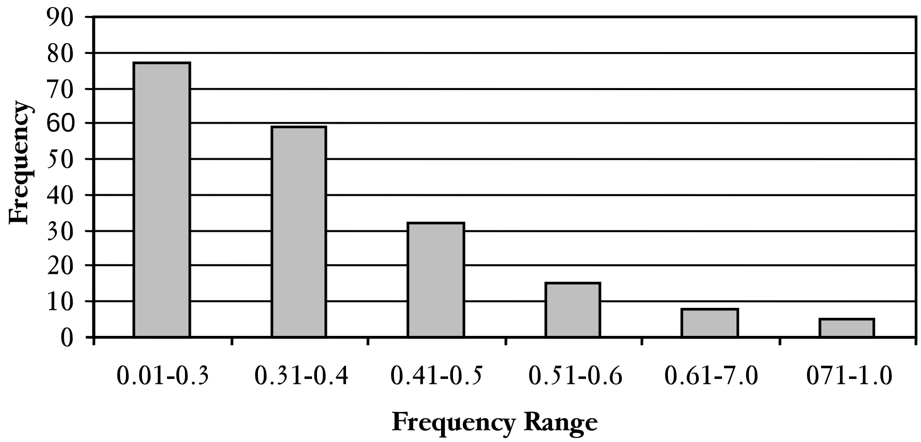
Figure-1: Frequency Distribution of Technical Efficiency of Cotton-Wheat System



The mean economic efficiency of sample farms is 0.37, with a minimum of 0.052. This indicates the existence of substantial economic inefficiencies in the study area. Our findings reveal that, if sample farms operated at full efficiency, they could reduce their cost of production by about 63 percent without reducing the level of output and with the existing technology. The results of the study also reveal that the economic efficiency of the majority of sampled farms falls within the range of 0.21 and 0.60. Out of 200 sample farms, only 2 percent of farms operate at a level of economic efficiency greater than 0.90, 2.5 percent of farms operate at a level of economic efficiency between 0.71 and 0.80, 4 percent of farms operate at a level of economic efficiency between 0.61 and 0.70, 7.5 percent of farms operate at a level of economic efficiency between 0.51 and 0.60, 16 percent of farms operate at a level of economic efficiency between 0.40 and 0.51, 29.5 percent of farms operate at a level of economic efficiency between 0.30 and 0.40, 28.5 percent operate at a level of economic efficiency between 0.21 and 0.30 and 10 percent of farms operate at a level of economic efficiency less than 0.21. In other words, our economic efficiency scores are dominated by inefficient farms. Only 2% (4 out of 200) of farms lie on the efficiency frontier. It is worthwhile to note that farmers in Rahimyar Khan are economically more efficient than farmers in Muzaffargarh. The mean economic efficiency level was 0.46 for farmers in Rahimyar Khan and 0.39 in Muzaffargarh districts.

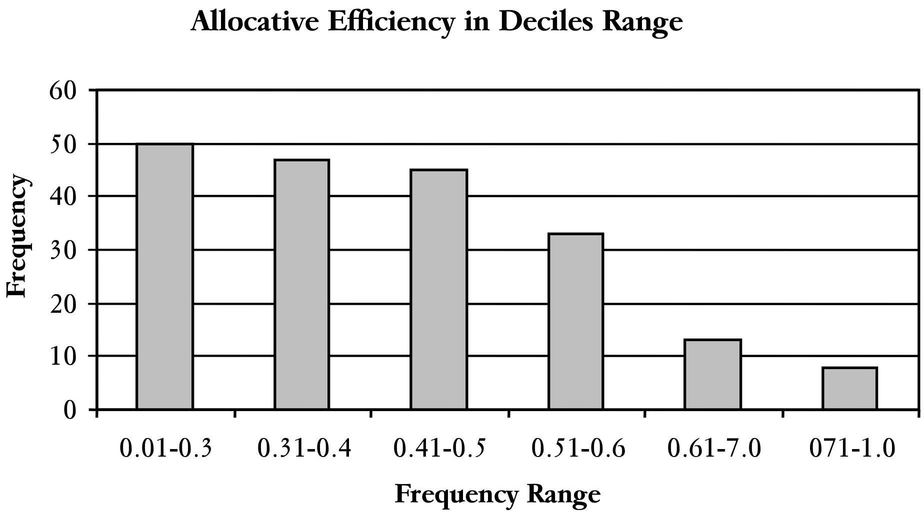
Figure-2: Frequency Distribution of Economic Efficiency of Cotton-Wheat System

Economic Efficiency in Deciles Range



The mean allocative efficiency level of sampled farms is 0.44 with a low of 0.052. Table-3 shows that the allocative efficiencies of the majority of sampled farms fall within the range of 0.21 and 0.6. Out of 200 sample farmers, 4 percent of farms operate at a level of allocative efficiency between 0.71 and 0.80, 6.5 percent of farms operate at a level of allocative efficiency between 0.61 and 0.70, 16.5 percent of farms operate at a level of allocative efficiency between 0.51 and 0.60, 22.5 percent of farms operate at a level of allocative efficiency between 0.41 and 0.50, 23.5 percent of farms operate at a level of allocative efficiency between 0.31 and 0.40, 17.5 percent of farms operate at a level of allocative efficiency between 0.21 and 0.30, and 7.5 percent of farms operate at a level of allocative efficiency less than 0.21. These results reveal that allocative efficiencies are dominated by inefficient farms. Only 2% (4 out of 200) farms are allocatively efficient.

Figure-3: Frequency Distribution of Allocative Efficiency of Cotton-Wheat System



The low level of economic and allocative efficiency among farms in the cotton-wheat system indicates that there is considerable room for an increase in agriculture output without additional inputs and with existing technology.

C. Inefficiencies Differentials among Sample Farmers

Socioeconomic and farm-specific factors are likely to affect the level of technical, allocative, and economic inefficiency of farmers. The present study attempts to investigate the sources of inefficiency of the cotton-wheat system in Punjab. In order to do this, technical, allocative, and economic inefficiency estimates are separately regressed on socioeconomic and farm-specific variables, respectively, by using a Tobit regression model.

Our results are presented in Table-4. The table shows that the number of years of schooling and number of times contact was made with extension agents are negatively related to the technical, economic, and allocative inefficiency of farms in the cotton-wheat system. These results imply that farmers with more years of schooling and more contact with extension agents are more efficient than their counterparts who are less educated and have fewer/no contacts with extension agent. Our results also indicate that farmers with better access to credit are technically less inefficient than those farmers who have poor/no access to credit. Our findings are consistent with those of Bravo-Uretta and Evenson (1994), Ali and Flinn (1989), Hassan (2004), Bozogolo and Ceyahan (2006), and Idiong

(2007). The obvious reason for this relationship is that credit availability improves liquidity and facilitates the purchase of inputs such as fertilizers, pesticides, and improved seed, etc. during peak seasons. The farm-to-market distance variable is used as a proxy for the development of road and market infrastructure. The results of the study shows that farms located closer to the market are technically less inefficient than those farms located away from the market. These results suggest that the technical inefficiency of sample farms would decrease significantly with the development of a road and market infrastructure. Table-4 also shows that sharecroppers are technically more inefficient that owner-operators. Pearson, *et al* (1991) argues that sharecropping contracts are often arranged so that the benefits of higher returns go to owners rather than tenants, which discourages tenants from increasing their productivity. The obvious reason for this relationship may be that insecurity and financial stringency dissuade sharecroppers from investing in activities such improvement in land and managerial capabilities.

VI. Conclusions and Recommendations

Despite the fact that agriculture has been growing at a reasonable rate, the pace of agricultural productivity is not adequate if it is to meet the increasing demand of the country's population. Per capita land and water availability is shrinking due to the rapid increase in population, and therefore sustainable growth in agriculture is required to ensure food security and sustainable economic development. Possible ways of enhancing agricultural growth include expanding the cultivated area, increasing cropping intensity, bringing about technological change, and improving production efficiency.

This study used the DEA technique to estimate the technical, economic, and allocative efficiency scores of the sampled farms. The average technical, economic, and allocative efficiency of sampled farms was estimated at 0.87, 0.37, and 0.44, respectively, in the cotton-wheat system. The DEA results indicate the existence of a substantial degree of economic and allocative inefficiency in the system. These results imply that if sample farms operated at full efficiency level, they could reduce their cost of production by about 63 percent without reducing the level of output with the existing technology.

Tobit analyses were used to identify the sources of inefficiency differentials among sample farmers. The results of the Tobit model showed that the number of years of schooling and number of times contact was made with extension agents had a negative impact on the technical, allocative, and economic inefficiency of the cotton-wheat farming system in Punjab. Access to credit had a negative and significant impact on technical inefficiency. Younger farmers were found to be technically less inefficient, while farms located close to the market were technically less inefficient than those located away from the market.

The most obvious implication of the results of this study is that sound policies are needed to promote formal education among rural households as a means of enhancing efficiency in the long run. This will enable farmers to make better technical decisions and help them allocate their inputs efficiently and effectively. In the short run, informal extension education could be effective, especially when targeted at those who have limited formal education. Policymakers should focus on enhancing farmers' access to information via the provision of better extension services. The government should allocate more funds to strengthening the extension department and expanding the net of extension services in remote areas.

Increasing age tends to lead to a decline in the efficiency of farmers. The study suggests that the government devise policies to attract and encourage younger people in farming by providing them incentives. This would enhance agricultural productivity and efficiency. Policymakers should also focus on the development of market and road infrastructure, and supply outlets should be located closer to the farm gate.

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Table-1: Summary Statistics of Variables of DEA Models and Tobit Regression Model

Variable	Mean Value	Standard Deviation	Minimum Value	Maximum Value
Total Farm Income (Rs/acre)	40349.10	14405.13	10321.43	89400
Farm Area (acre)	18.04	13.66	4	75
Cropped Area (acre)	30.44	24.75	5.87	148
Seed (kg/acre)	48.51	10.14	17.53	81.95
Tractor (hours/acre)	4.99	1.52	1.25	12.1
NPK (kg/acre)	162.44	40.51	59.97	278.7
Pesticide (gram/acre)	732.52	565.99	50.89	3151.15
Labour (man-days/acre)	87.08	51.24	26.03	353.67
Irrigation (hours/acre)	41.89	25.35	12	142
Fodder (kg/animal)	15746.79	5454.65	5823.53	32933.33
Concentrate (kg/animal)	539.22	357.27	63.8	2980
Land Rent (Rs/acre)	8613.64	1897.32	400	15816.10
Seed (Rs/acre)	1004.53	272.45	308.85	2023.42
Tractor (Rs/acre)	2660.12	922.89	905.4	6680
NPK (Rs/acre)	4427.74	1135.42	1684	8742.10
Pesticide (Rs/acre)	1545.89	837.34	183.33	5195.45
Labour (Rs/acre)	6686.27	3820.66	2223.09	24281.67
Irrigation (Rs/acre)	2255.46	2137.20	62.25	8886.43
Fodder (Rs/animal)	13283.26	4650.58	4950	27993.33
Concentrate (Rs/animal)	6633.70	3668.46	1200	20000
Age of Farm's Operator (years)	32.17	11.38	18	65
Years of Schooling	6.67	3.53	0	14
Contact with Extension Agents (No.)	13.50	8.46	0	48
Distance (km)	12.19	3.59	6	20

Table-2: Technical, Allocative and Economic Efficiency of Cotton Wheat System

Farmer's Number	Technical Efficiency	Allocative Efficiency	Economic Efficiency	Farmer's Number	Technical Efficiency	Allocative Efficiency	Economic Efficiency
1	0.761	0.306	0.223	26	1.0	0.206	0.206
2	0.861	0.404	0.348	27	1.0	0.137	0.137
3	0.635	0.43	0.273	28	0.829	0.198	0.164
4	0.779	0.403	0.314	29	0.935	0.232	0.217
5	0.903	0.3	0.271	30	0.634	0.107	0.068
6	0.767	0.271	0.208	31	1.0	0.786	0.786
7	1.0	0.426	0.426	32	1.0	0.334	0.334
8	0.9	0.418	0.376	33	1.0	0.215	0.215
9	0.725	0.45	0.326	34	1.0	0.226	0.226
10	1.0	0.29	0.29	35	1.0	0.32	0.32
11	0.872	0.462	0.403	36	1.0	0.482	0.482
12	0.897	0.687	0.616	37	0.967	0.202	0.195
13	0.888	0.281	0.252	38	0.659	0.312	0.205
14	0.729	0.371	0.27	39	0.947	0.286	0.271
15	0.91	0.522	0.475	40	1.0	0.301	0.301
16	1.0	0.78	0.378	41	1.0	1.0	1.0
17	1.0	0.283	0.283	42	1.0	0.241	0.241
18	1.0	0.323	0.323	43	0.984	0.242	0.238
19	0.687	0.396	0.272	44	0.822	0.294	0.242
20	0.805	0.165	0.133	45	1.0	0.251	0.251
21	0.937	0.298	0.279	46	0.652	0.44	0.287
22	0.975	0.333	0.325	47	0.677	0.307	0.208
23	0.907	0.518	0.47	48	0.941	0.437	0.411
24	1.0	0.429	0.429	49	0.59	0.645	0.38
25	0.709	0.524	0.372	50	1.0	0.717	0.717
51	0.894	0.443	0.396	76	1.0	1.0	1.0
52	1.0	0.182	0.182	77	1.0	0.581	0.581
53	1.0	0.239	0.239	78	0.967	0.581	0.561
54	0.871	0.415	0.361	79	1.0	0.717	0.717
55	0.745	0.475	0.354	80	0.824	0.515	0.425
56	1.0	0.337	0.337	81	0.66	0.547	0.361
57	0.411	0.339	0.14	82	0.88	0.412	0.362

58	1.0	0.184	0.184	83	1.0	0.429	0.429
59	1.0	0.233	0.233	84	1.0	0.378	0.378
60	1.0	0.264	0.264	85	0.794	0.471	0.374
61	1.0	0.069	0.069	86	1.0	0.536	0.536
62	1.0	0.211	0.211	87	1.0	0.645	0.645
63	0.983	0.273	0.269	88	0.784	0.305	0.239
64	0.888	0.226	0.2	89	0.895	0.312	0.28
65	0.624	0.339	0.21	90	1.0	0.337	0.377
66	0.992	0.4	0.397	91	0.785	0.553	0.434
67	1.0	0.427	0.427	92	0.936	0.287	0.269
68	0.76	0.302	0.229	93	1.0	1.0	1.0
69	0.489	0.736	0.36	94	0.992	0.317	0.314
70	1.0	0.398	0.398	95	1.0	0.25	0.25
71	1.0	0.381	0.381	96	0.693	0.603	0.421
72	0.767	0.356	0.273	97	0.896	0.16	0.143
73	1.0	0.236	0.236	98	0.771	0.158	0.121
74	0.84	0.266	0.224	99	0.914	0.281	0.257
75	0.741	0.404	0.299	100	1.0	0.686	0.686
101	11.0	0.467	0.467	126	0.855	0.414	0.354
102	0.631	0.601	0.379	127	0.858	0.389	0.333
103	1.0	0.429	0.429	128	0.749	0.442	0.331
104	1.0	0.369	0.369	129	0.733	0.478	0.35
105	1.0	0.631	0.631	130	0.587	0.395	0.232
106	0.477	0.411	0.196	131	0.766	0.494	0.378
107	1.0	0.325	0.325	132	0.916	0.581	0.532
108	1.0	0.149	0.149	133	0.725	0.466	0.338
109	1.0	0.178	0.178	134	1.0	0.61	0.61
110	0.777	0.699	0.519	135	0.78	0.457	0.356
111	0.803	0.509	0.409	136	1.0	0.172	0.172
112	0.753	0.348	0.262	137	0.892	0.435	0.388
113	1.0	0.54	0.54	138	0.791	0.373	0.295
114	1.0	0.456	0.456	139	1.0	0.338	0.338
115	0.802	0.515	0.413	140	1.0	0.576	0.576
116	0.756	0.366	0.277	141	0.566	0.608	0.344
117	0.873	0.411	0.359	142	1.0	0.367	0.67
118	1.0	0.45	0.45	143	0.683	0.589	0.402

119	0.743	0.577	0.414	144	1.0	0.712	0.712
120	11.0	0.472	0.472	145	1.0	0.052	0.052
121	0.947	0.3	0.284	146	0.615	0.096	0.059
122	1.0	0.344	0.344	147	0.773	0.221	0.171
123	1.0	0.254	0.254	148	0.785	0.579	0.455
124	1.0	0.358	0.358	149	0.935	0.286	0.68
125	1.0	0.768	0.768	150	0.807	0.408	0.329
151	0.84	0.611	0.513	176	1.0	0.503	0.503
152	0.921	0.557	0.512	177	1.0	0.316	0.316
153	0.76	0.398	0.302	178	1.0	0.366	0.366
154	0.726	0.505	0.367	179	1.0	0.422	0.422
155	0.674	0.612	0.412	180	0.656	0.566	0.371
156	1.0	0.598	0.598	181	1.0	0.598	0.598
157	0.796	0.42	0.335	182	1.0	0.67	0.67
158	0.887	0.51	0.452	183	0.604	0.564	0.34
159	1.0	0.361	0.361	184	0.56	0.509	0.285
160	1.0	0.604	0.604	185	0.773	0.61	0.471
161	1.0	0.51	0.51	186	0.71	0.7	0.497
162	1.0	0.367	0.367	187	0.762	0.38	0.29
163	0.663	0.457	0.303	188	1.0	0.364	0.364
164	0.648	0.528	0.342	189	0.863	0.538	0.465
165	0.727	0.538	0.391	190	0.651	0.446	0.291
166	0.827	0.496	0.409	191	0.827	0.453	0.375
167	1.0	0.249	0.249	192	0.75	0.438	0.328
168	0.898	0.56	0.503	193	0.922	0.471	0.434
169	1.0	1.0	1.0	194	0.719	0.319	0.229
170	1.0	0.519	0.519	195	1.0	0.5	0.5
171	0.71	0.343	0.244	196	0.88	0.404	0.356
172	0.745	0.75	0.559	197	1.0	0.292	0.292
173	0.742	0.409	0.304	198	0.896	0.441	0.395
174	0.807	0.231	0.186	199	0.652	0.356	0.232
175	0.787	0.352	0.277	200	1.0	0.493	0.493
				Mean	**0.874**	**0.442**	**0.367**
				Minimum	**0.411**	**0.052**	**0.052**
				Maximum	**1.0**	**1.0**	**1.0**

Table-3: Frequency Distribution of Technical, Allocative and Economic Efficiencies of Cotton-Wheat System

Efficiency Range	Technical Efficiency		Allocative Efficiency		Economic Efficiency	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0.01 – 0.10	-	-	3	1.5	4	2.0
0.11 – 0.20	-	-	12	6.0	16	8
0.21 – 0.30	-	-	35	17.5	57	28.5
0.31 – 0.40	-	-	47	23.5	59	29.5
0.41 – 0.50	3	1.5	45	22.5	32	16
0.51 – 0.60	5	2.5	33	16.5	15	7.5
0.61 – 0.70	18	9	13	6.5	8	4
0.71 – 0.80	41	20.5	8	4.0	5	2.5
0.81 – 0.90	31	15.5	-	-	-	-
0.91 – 1.0	102	51	4	2.0	4	2.0
Total	**200**	**100**	**200**	**100**	**200**	**100**

Table-4: Sources of Technical, Economic and Allocative Inefficiencies of Cotton-Wheat System in Punjab

	Technical Inefficiency			Economic Inefficiency			Allocative Inefficiency		
Variables	**Coefficient**	**Std. Error**	**Prob.**	**Coefficient**	**Std. Error**	**Prob.**	**Coefficient**	**Std. Error**	**Prob.**
Constant	0.034	0.070	0.627	0.727	0.070	0.000	0.744	0.056	0.000
Years of Schooling	-0.007	0.004	0.064	-0.007	0.004	0.085	-0.008	0.003	0.012
Age of Farm's Operator (years)	0.003	0.001	0.008	0.001	0.001	0.684	0.001	0.001	0.424
Contact with Extension Agents (No.)	-0.005	0.002	0.002	-0.010	0.002	0.000	-0.011	0.001	0.000
Farm to Market Distance (km)	0.007	0.003	0.058	-0.001	0.004	0.695	0.003	0.003	0.256
Access to Credit Dummy	-0.047	0.026	0.072	0.033	0.027	0.212	0.017	0.021	0.426
Renter Dummy	-0.041	0.026	0.11	0.016	0.025	0.521	0.019	0.020	0.354
Sharecropper Dummy	0.105	0.033	0.001	-0.020	0.033	0.539	0.022	0.027	0.414

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Competitiveness of Pakistani Fruits in the World Market

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Abstract

This paper examines the global competitiveness of Pakistan's fruit exports (dates, mangoes, and oranges), using revealed comparative advantage (RCA). It also analyzes domestic consumption trends among selected fruits grown by major exporters. Our results indicate that Pakistan has a comparative advantage in fruit exports. Comparing the movement in comparative advantage indices for Pakistan with those of its main exporters/competitors demonstrates that Pakistan has a relatively high comparative and competitive advantage in the production of dates and mangoes. The increasing trend of competitiveness in Pakistan indicates that there is potential for higher growth; given that fruit exports are a potential source of higher exports earnings, there is a need to strengthen competitiveness in this sector.

Keywords: Comparative advantage, competitiveness, exports, growth.

JEL Classification: F14, Q17, Q18.

I. Introduction

Pakistan's agro-climatic conditions provide a suitable environment for the production of various horticultural crops, as well as a strong comparative advantage in horticulture, as indicated by the sector's rapid growth in the absence of policy interventions. However, the perishability of horticultural products means that the sector requires an efficient processing and marketing infrastructure that is largely lacking in Pakistan (Khan 2000). As a result, the proportion of fruit exported in relation to total production is as low as 5.7 percent.

Faruqee (1995) suggests that trade policy in Pakistan should be based on comparative advantage according to the World Trade Organization

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(WTO)'s Agreement on Agriculture (AoA), under which member countries are required to utilize the benefits of comparative and competitive advantage in the international economy, increasing competition and forcing resources to be allocated more efficiently. Azhar (1995) points out that exploiting Pakistan's export potential of nontraditional commodities will require considerable streamlining in the areas of storage, transportation, and packing. Since globalization has significantly increased competition, compliance with international standards is necessary.

Citrus fruits, dates, and mangoes are Pakistan's most important export fruits, constituting about 78 percent of the total value of Pakistan's fruit exports (Government of Pakistan 2006/07). In the world market, Pakistan accounts for about 11 percent of date exports as the fourth-largest exporter, 5 percent of mangoes as the sixth-largest exporter, and about 1 percent of oranges (Food and Agriculture Organization [FAO] 2008). Given the importance of these fruits as world exports, it is important to investigate their competitiveness in the global market for Pakistan and its main competitors.

From the point of view of trade theory, competitive advantage is a more useful concept than comparative advantage. Competitiveness includes market distortions while comparative advantage assumes undistorted markets (Vollrath 1985, Vollrath and De Huu 1988). With the gradual reduction in trade barriers led by the process of globalization, more emphasis is now being placed on promoting export competitiveness (Prasad 2004). As a founding member of GATT and signatory to WTO, Pakistan has accepted both the opportunity for and challenge of trade liberalization (Akhtar 1999). This paper attempts to measure Pakistan's export competitiveness in selected fruits compared to major international exporters.

The paper is organized as follows. Section II describes the data and indicators used to measure competitiveness, while our results and discussion are given in Section III. Section IV concludes the paper.

II. Data and Methodology

In order to calculate the relevant indicators, we have used data on production, exports, and imports (FAOSTAT 2008) for Pakistan and major exporters of selected fruits in relation to total world trade for the period 1995-2005. To gain an idea of the changes in calculated indicators for this sample period, we use a series of three-year-averages: 1995-1997, 1998-2000, and 2003-2005.

We use revealed comparative advantage (RCA) to measure export competitiveness for Pakistan and four of the world's largest exporters of the selected fruits (this ranking was based on the volume of exports in 2005). Per capita (apparent) consumption was derived as production plus imports minus exports divided by country population.

Our analysis is based on Balassa's (1965) and Vollrath's (1991) RCA index of competitiveness. These indicators have been used by several sources to determine competitiveness and comparative advantage (Balassa 1989, Scott and Vollrath 1992, Frohberg and Hartmann 1997, Laursen 1998, Hsu and Wann 2001, Ferto and Hubbard 2003, Mahmood 2005. The study concentrates on the following representations: RCA and RCA#. RCA was developed by Balassa (1965), while the measure RCA# is an improved version constructed by Vollrath (1991) and used by Bender and Li (2002); it is considered a more sophisticated and comprehensive measure of international competitiveness. It is important to note that the main difference between Vollrath's RCA# and Balassa's original RCA index is that it prevents double-counting. Thus, using only export data, we define RCA and RCA#, respectively, as:

$$RCA_{ijt} = \left(X_{ijt} / \sum X_{ajt} \right) / \left(X_{iwt} / \sum X_{awt} \right)$$

$$RXA_{ij} = \left(X_{ij} / \sum_{l,l \neq j} Xil \right) / \left(\sum_{k,k \neq i} X_{kj} / \sum_{k,k \neq i} \sum_{l,l \neq j} X_{kl} \right) \quad (1)$$

$$RCA_{ij}\# = \ln RXA_{ij} \quad (2)$$

RCA_{ijt} is the index for product *i* in country *j* in year *t*, X_{ijt} represents the export of product *i* by country *j* in year *t*, X_{iwt} is the total world export of product *i* in year *t*, $\sum X_{ajt}$ is the total volume of exports in country *j* in year *t*, and $\sum X_{awt}$ is the total volume of world exports in year *t*.

The RCA index reveals a comparative advantage (disadvantage) in the export of commodity *i* by country *j* if the index's value is greater (less) than 1.

RXA_{ij} is the relative export advantage index, $\sum_{l,l \neq j} Xil$ is the total exports of the country minus the product considered, and $\sum_{k,k \neq i} \sum_{l,l \neq j} X_{kl}$ is the total exports of the world minus the country considered for analysis.

$RCA_{ij}\#$ is simply the logarithm of the relative export advantage index. A positive value indicates a comparative/competitive advantage, whereas a negative value indicates a comparative/competitive disadvantage.

III. Results and Discussions

Table-1 indicates the export competitiveness of dates for Pakistan and other major date exporters. Pakistan accounts for 11% of the world's total date exports, the UAE for 35%, Iraq for 19%, Saudi Arabia for 17%, and Iran for 15% (FAO 2008). For the period under investigation, the results reveal that Pakistan has a relatively high comparative and competitive advantage in the production of dates over other major date exporting countries. However, Pakistan's per capita apparent consumption decreased during 1995-97 to 2003-05 (Table-2). Competitiveness indicators demonstrated that Iran, Iraq, the UAE, and Saudi Arabia had falling RCA values. The trend in per capita consumption reveals that there was an increase in consumption in Iran, Saudi Arabia and UAE, but a decrease in consumption in Iraq.

Table-1: Competitiveness Indicators of Major Date Exporters

Period/ Country	Pakistan (4)		Iran (3)		Iraq (1)		Saudi Arabia (5)		UAE (2)	
Indicator	**RCA**	**RCA#**	**RCA**	**RCA#**	**RCA**	**RCA#**	**RCA**	**RCA#**	**RCA**	**RCA#**
1995-97	44.14	3.87	36.51	3.79	173.9	5.20	6.67	1.97	16.25	2.93
1998-00	69.62	4.35	25.3	3.34	8.38	2.15	4.99	1.68	19.85	3.29
2003-05	47.89	3.95	25.24	3.37	9.85	2.32	5.97	1.88	9.13	2.33

Source: Computation based on data from www.fao.org. Figures in parentheses indicate the ranking of the country in the world market for dates. RCA = revealed comparative advantage, RCA# = ln (RXA).

Table-2 Annual per Capita Consumption of Dates
(Unit: kg/person/annum)

Period/ Country	Pakistan	Iran	Iraq	Saudi Arabia	UAE
Indicator	Per capita Consumption	Per capita Consumption	Per capita Consumption	Per capita Consumption	Per capita Consumption
1995-97	3.8	11.3	34.7	31.4	84.1
1998-00	4.2	12.2	34.1	33.5	111.5
2003-05	2.9	12.1	24.0	38.6	164.5

Source: Computation based on data from www.fao.org.

Based on the competitiveness indicators provided in Table-3, the results reveal that Pakistan has a relatively high comparative and competitive advantage in the production of mangoes as against its main competitors. Pakistan's RCA values registered an increasing trend during 1995-97 and 2003-05. India, Brazil, and the Netherlands also increased their comparative advantage over the investigated period, while Mexico showed a significant decrease in its RCA value over the period investigated. Pakistan, Brazil, Mexico, and the Netherlands increased their consumption over the period investigated. The highest consumption was registered in Mexico. India decreased its consumption (Table-4) but increased its comparative advantage.

Table-3: Competitiveness Indicators of Major Mango Exporters

Period/ Country	Pakistan (6)		Brazil (3)		India (1)		Mexico (2)		Netherlands (4)	
Indicator	RCA	RCA#	RCA	RCA#	RCA	RCA#	RCA	RCA#	RCA	RCA#
1995-97	8.57	2.16	7.79	2.13	7.20	2.02	34.43	4.00	2.44	0.99
1998-00	23.07	3.18	11.2	2.52	6.57	1.93	22.93	3.50	2.65	1.08
2003-05	21.60	3.11	11.54	2.58	18.8	3.13	15.77	2.96	2.94	1.20

Source: Computation based on data from www.fao.org. Figures in parentheses indicate the ranking of the country in the world market for dates. RCA = revealed comparative advantage, RCA# = ln (RXA).

Table-4: Annual per Capita Consumption of Mangoes
(Unit: kg/person/annum)

Period/ Country	Pakistan	Brazil	India	Mexico	Netherlands
Indicator	Per capita Consumption	Per capita Consumption	Per capita Consumption	Per capita Consumption	Per capita Consumption
1995-97	6.6	3.4	11.3	12.7	0.6
1998-00	6.1	2.5	9.9	13.3	1.5
2003-05	7.3	4.6	10.6	12.8	1.8

Source: Computation based on data from www.fao.org.

The results presented in Table-5 indicate that Pakistan has a comparative advantage with an increasing trend in orange exports during the periods under analysis. However, Pakistan has the lowest comparative and competitive advantage relative to four major exporters of oranges except the US, which does not have a comparative advantage for the period investigated. South Africa and Morocco have increased their comparative and competitive advantage. Per capita consumption decreased in Pakistan, South Africa, Morocco, and the US, and increased in Spain (Table-6).

Table-5: Competitiveness Indicators of Major Oranges Exporters

Period/ Country	Pakistan (15)		Spain (1)		South Africa (2)		Morocco (4)		USA (3)	
Indicator	RCA	RCA#	RCA	RCA#	RCA	RCA#	RCA	RCA#	RCA	RCA#
1995-97	1.52	0.42	25.09	3.87	7.43	2.05	75.39	4.45	0.78	-0.14
1998-00	3.05	1.12	23.65	3.75	11.35	2.49	55.44	4.12	0.77	-0.15
2003-05	3.37	1.22	25.28	3.92	12.39	2.59	50.15	4.00	0.89	-0.03

Source: Computation based on data from www.fao.org, Figures in parenthesis are rankings of each country in world market in export of oranges. RCA=Revealed Comparative Advantage, RCA# =ln (RXA)

Table-6 Annual per Capita Consumption of Oranges
(Unit: kg/person/annum)

Period/ Country	Pakistan	Spain	South Africa	Morocco	US
Indicator	Per capita Consumption	Per capita Consumption	Per capita Consumption	Per capita Consumption	Per capita Consumption
1995-97	10.5	32.8	11.3	18.8	37.2
1998-00	9.2	34.2	13.4	20.6	37.3
2003-05	8.8	36.2	10.4	18.1	32.1

Source: Computation based on data from www.fao.org.

IV. Conclusion

The main objective of this paper was to examine the export competitiveness of dates, oranges, and mangoes for Pakistan and its main competitors during the period 1995-2005.

The results revealed that Pakistan has a higher comparative and competitive advantage in the production of dates and mangoes relative to its main competitors during the period analyzed. The results also revealed that Pakistan has the lowest comparative and competitive advantage relative to the world's four major exporters of oranges, except the US. However, Pakistan has significantly increased its comparative and competitive advantage over the examined period for all commodities under analysis. Among these commodities, dates have a higher advantage than oranges and mangoes for Pakistan. Based on the results, it was observed that Pakistan's main competitors in date exports have decreased their competitiveness, while for mangoes and oranges, their comparative and competitive advantage has increased slightly. Per capita consumption of mangoes has increased in Pakistan, while dates and oranges showed a decreasing pattern during the entire period under analysis. In oranges, all countries included in the analysis except Spain showed a decreasing consumption trend.

The increasing pattern of RCA and the decreasing trend in domestic consumption of dates and oranges in Pakistan indicates that there is potential for higher growth in these products and these products can be a source of higher export earnings, which advocates the need for strengthening the country's competitiveness in these exports.

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Income Tax Revenue as an Indicator of Regional Development in Pakistan

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Abstract

The objective of this paper is to highlight the use of income tax revenue as an indicator of regional development in Pakistan. Initially, we identify a dramatic shift in income tax revenue trends at the provincial level for the period 1992/93 to 2005/06. We develop a simple model of income tax revenue and estimate the relationship between growth of income tax revenue and gross regional product (GRP). Based on the estimated relationship, Punjab appears to have been the fastest growing province during the 1990s, while Sindh shows the greatest level of dynamism in the current decade. This is attributed to high growth rates, especially in large-scale manufacturing during the period, which has a larger sectoral share in Sindh's economy.

Keywords: Income tax, development, revenue.

JEL Classification: H20, R11.

I. Introduction

Subnational planning at the provincial or district level is difficult in Pakistan, given the absence of regionally disintegrated information on the size, composition, and growth of the economy. This is in contrast to other countries like India where estimates of the gross regional product (GRP) are made annually, helping to identify the extent of regional disparities and states that need more support in the federal structure.

It may be time for the Federal Bureau of Statistics to finalize a methodology for estimating annually the GRP of Pakistan's four provinces, and orient its primary data collection efforts toward enabling disaggregation.

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The provincial bureaus of statistics also have a major role to play in this regard.

The first serious attempt to estimate GRP was made by Bengali and Sadaqat (2006). A time series of value added by each sector of individual provinces was derived for the period 1973/74 to1999/2000. More recently, the World Bank has put forth estimates of Punjab's GRP for the period 1991/92 to 2001/02. However, no GRP estimates are available for the four provincial economies after 1999/2000.

The paucity of data on regional growth patterns has necessitated the search for proxy indicators, which are available on a regular basis and can be updated without needing to invest substantial resources in primary data collection. The caveat is, of course, that such proxies or indicators can only give approximate trends at the regional level.

This paper is organized as follows: Section II reviews the literature. Section III presents the methodology used to aggregate revenue from individual tax collection points to arrive at provincial totals. It also highlights the derived tax share of each province and patterns of growth for regional income tax revenues in Pakistan. Section IV develops a simple model of tax revenue and indicates how the relationship between tax revenue and the tax base can be quantitatively estimated. Section V indicates how the growth rate of a provincial nonagricultural economy can be derived from the growth rate of income tax revenue. Section VI presents the estimates of provincial growth for recent years and then determines whether they are consistent with other evidence available. Section VII concludes the paper and provides policy recommendations.

II. Literature Review

The objective of this paper is to highlight the use of income tax revenue as an indicator of regional development. Bauls, et al (2000) and Varts (2006) demonstrate how personal tax revenue can be used to gauge economic trends at the regional level. Krūzmētra (2006) and Svarinska (2004) use the tax and nontax revenues of municipalities as an indicator of regional development. Paiders (2008) points out that personal income tax revenue fails to capture the informal economy. However, we have chosen income tax revenue as an indicator because it spans a comprehensive tax base, the nonagricultural economy. Moreover, the Federal Board of Revenue (FBR) maintains information on revenues collected at every tax collection point, thereby enabling us to estimate revenues from each province.

III. Estimation of and Trends in Income Tax Revenue by Province

Data on income tax collection by individual regional tax offices/commissions and by medium/large taxpayer units is available in the FBR's database, which is maintained by the department for Fiscal Research and Statistics (FRS). These jurisdictions generally overlap with administrative boundaries at the division/district level. Previously, it was not possible to disaggregate tax collection data in Balochistan. This has become possible since the establishment of a regional tax office in Quetta.

The categorization of tax collection points by province is given in the Appendix. Aggregating collection by the respective units in each province yields estimates of provincial income tax revenue. This dataset is unique as there are no other economic variables for which data is available at a regionally disaggregated level in Pakistan. This is our main reason for using trends in income tax revenue as an indicator of regional development.

Table-1: Income Tax Revenue[1] by Province

Province	Level (Rs Million)		
	1992/93	**1999/2000**	**2006/07**
Sindh	27,525	54,208	148,752
Punjab	12,920	46,291	155,575
NWFP	1,022	4,838	4,881.69
Balochistan[2]	-	-	2,568.84
Pakistan	41,467	105,337	311,777

Source: FBR/CBR Year Books (various issues).

Table-1 gives estimates of income tax revenue by province for the period 1992/93 to 2006/07 (the FBR has not published the latest figures for 2007/08). Table-2 shows percentage income tax shares by province, indicating dramatic shifts for this period.

[1] At current prices.
[2] Information on income tax revenue is not available for any period prior to 2003/04.

Table-2: Provincial Shares in Income Tax Revenue

Province	Share (%)		
	1992/93	**1999/2000**	**2006/07**
Sindh	68.4	51.5	47.7
Punjab	29.0	43.9	49.9
NWFP	2.7	4.6	1.6
Balochistan	-	-	0.8
Pakistan	100.0	100.0	100.0

Source: FBR/CBR Year Books (various issues).

We note a significant increase in Punjab's tax share from 29 to almost 50 percent. Therefore, by 2006/07, the province's tax share corresponded roughly to its share of the country's population. Simultaneously, there has been a more or less corresponding decline in the tax share of Sindh, from 68 to below 48 percent, although even now the tax share is substantially greater than the population share. In 2006/07 the combined share of the two less populated provinces, NWFP and Balochistan, was very low at less than 2 percent.

This notable shift in tax shares leads us to explore whether or not provincial tax shares change due to changes in the relative size of the tax base or due to relatively higher tax buoyancy coefficients. This decomposition is essential if we are to establish a relationship between the growth of tax revenues and growth of provincial economies.

IV. A Simple Model of Income Tax Revenue

We specify that the level of income tax revenue is given by

$$t = \alpha\left(y - \bar{y}\right) \qquad \text{where } y > \bar{y} \tag{1}$$

$$t = 0 \qquad \text{for } y \leq y$$

where t = real per capita tax revenue and y = real per capita income (excluding agricultural income which is exempt from income tax). We take $\left(y - \bar{y}\right)$ as a measure of taxable capacity. $\bar{y}$ not only has the connotation of an exemption limit but also indicates the income generated by the informal segment of the economy, which is hard to tax and where the level of tax evasion is high. Equation (1) holds over time if α, the marginal rate of taxation of taxable income, remains constant. It may rise if the income tax structure is highly progressive. This is not the case in Pakistan as the major portion of revenue is generated from deductions at source in the form of withholding/presumptive taxes, which are generally proportional in nature. Also, the tax rate for levels of corporate income is the same.

The tax on nonagricultural GRP may rise as the share of taxable income rises in the regional economy. This implies that

$$\frac{t}{y} = \alpha\left(1 - \frac{\bar{y}}{y}\right) \tag{2}$$

Therefore as y rises, *t/y* can be expected to increase. It is also evident from (2) that the tax-to-GRP ratio is lower in provinces where the per capita income is lower.

There also exists the possibility that effective tax rates change over time when statutory rates are changed or the income tax net widened by imposing a new form of withholding or presumptive taxes. During the early to mid-1990s, the withholding tax regime was greatly expanded in Pakistan. Equation (1) is modified to capture this effect as follows.

$$t = \alpha\left(y - \bar{y}\right) + \beta T \tag{3}$$

where *T* takes the value of 1, 2, and so on in successive years during which the tax reform was ongoing. During the current decade, income tax rates have generally been revised downward. This can be estimated empirically by the following regression equation over time.

$$t = -\beta_0 + \beta_1 y + \beta_2 T \tag{4}$$

with $\bar{y} = \beta_0 / \beta_1$

Based on this, a pooled regression can be performed across the provinces in the following manner for the period in which information is available on both *t* and *y*.

$$t = -\beta_0 + \sum_{i=1}^{n} \beta_{0i} D_i + \beta_1 y + \sum_{i=1}^{n} \beta_{1i} D_i y + \beta_{2i} \cdot D_i T \tag{5}$$

where D_i = 1 for the *i*th province and 0 otherwise.

It may also be observed from (1) that

$$\frac{y}{t}\frac{dt}{dy} = \frac{1}{1 - \frac{\bar{y}}{y}}$$

Therefore, the tax buoyancy coefficient falls as y rises. At the lower limit of y of $\bar{y}$, it approaches infinity. This is, of course, on the assumption that $\bar{y}$ remains unchanged. However, if $\bar{y}$ rises or falls, the buoyancy coefficient also rises or falls correspondingly.

There are strong indications that the income tax buoyancy coefficient is higher in provinces with a lower per capita nonagricultural GRP. Table-3 provides observed buoyancy coefficients for the period 1992/93 to 1999-2000, for which estimates of each province's GRP are available from Bengali and Sadqat (2006).

The table shows that the tax buoyancy coefficient is highest in NWFP, with the lowest per capita GRP among the three provinces for which data is available. Beyond 1999-2000, while data is available on income tax collections by province, no estimates have been made of the GRPs of individual provinces.

Table-3: Income Tax Buoyancy Coefficient by Province, 1992-93 to 1999-2000

Province	Level of Real Per Capita GRP	Annual Growth Rate (%)		Tax Buoyancy Coefficient[3]
		Real Per Capita Tax Revenue[4]	Real Per Capita GRP[5]	
Sindh	4,851	0.1	-0.1	n
Punjab	3,002	11.0	1.9	5.8
NWFP	2,309	12.9	1.8	7.2
Balochistan[6]	-	-	-	-
Pakistan	3,194	4.7	1.4	3.4

Source: FBR/CBR Year Books (various issues), Bengali and Sadqat (2006).

The next section discusses the use of income tax revenue as an indicator of growth in regional economies.

V. Income Tax Revenue as an Indicator of Provincial Growth

The previous section has presented a simple model for explaining the evolution of income tax revenue at the provincial level in Pakistan. This has led to the revenue equation specified in equation (5). If this equation is reversed, then given t for a particular year, y can be determined from the equation. However, prior to doing this, we discuss the merits of using income tax revenue as a proxy for regional income or GRP.

A proxy indicator must have a number of properties. Most importantly, it should be broadly representative in character. Income tax is a broad-based tax and is collected from all sectors of the economy except agriculture. Developments in the withholding tax regime during the 1990s have significantly widened the tax net and cut into evasion through deductions at source. Therefore, trends in income tax collection are likely to capture fairly well the growth in underlying incomes in provincial economies, especially in nonagricultural GRP.

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[3] Estimated.
[4] At 1980/81 prices.
[5] In 1992/93, excluding agriculture.
[6] Information on income tax revenue in Balochistan is not available.

One problem, however, needs to be resolved. The presumptive income tax on imports, a significant source of revenue, is collected mostly at the stage of clearing import consignments at the port of Karachi. Therefore, most of the revenue from this source is declared as collected in Sindh, although this has little bearing on the level of economic activity in the province. For the purpose of using income tax revenue as an indicator of provincial growth, the former can only be used after having excluded the presumptive tax on imports.

Data on other taxes is also available at the provincial level, but their degree of representativeness is hindered by the problem either of a limited tax base or lumpiness. An obvious alternative proxy is the general sales tax levied on domestic transactions. Here, constitutional provisions restrict this tax to goods, which means that the services sector, which accounts for over half the value-added in the economy, falls outside the ambit of this tax. A number of industries that are export-oriented are also zero-rated from this tax. Therefore, GST coverage is limited to a relatively small part of the economy.

Other taxes, such as import duties and excise duties, have even more serious limitations in being used as indicators of regional development. Collections of the former are lumpy in nature and accrue mostly at Karachi even though import consignments may be destined for other parts of the country. Excise duties are very selective in nature and are only levied on a few industries or services. Various provincial taxes are also specific in terms of sectors such as property and motor vehicles, and cannot be used as broad-based indicators of regional growth. Overall, income tax is the most representative tax of the nonagricultural economy.

Beyond taxes, there are other, perhaps better, proxies of regional development. These could include information from censuses and surveys of population, housing, labor force and employment, living standards and household income and expenditure, although with surveys and censuses of value added in different sectors like manufacturing, agriculture, etc. These are valuable sources of information but may be too infrequently compiled or not disaggregated at the provincial level. Therefore, it is not possible to use these indicators to assess trends in provincial growth on an annual basis. As opposed to this, given that the FBR is compelled to generate information regularly for management purposes, tax collection at the level of the commission rate circle is available more or less up to date.

The recommended approach is one which relies on income tax revenue as the first, albeit approximate, indicator of provincial growth, supplemented whenever possible with information obtained from periodic censuses and surveys.

We now turn to the relationship between tax revenue and income:

Given that $t = -\beta_0 + \beta_1 y$ and $\hat{t}_0 = -\beta_0 + \beta_1 \hat{y}_0$

Therefore $\hat{y}_0 = \dfrac{t_0 + \beta_0}{\beta_1}$, $\hat{y}_1 = \dfrac{t_1 + \beta_0}{\beta_1}$

$$\hat{y}_1 - \hat{y}_0 = \frac{t_1 - t_0}{\beta_1}$$

$$\frac{t_1 - t_0}{\beta_1} \cdot \frac{\beta_1}{t_0 + \beta_0} = \frac{t_1 - t_0}{t_0 + \beta_0}$$

$$g_y = \frac{\dfrac{t_1 - t_0}{t_0}}{1 + \dfrac{\beta_0}{t_0}}$$

$$g_y = \left[\frac{1}{1 + \dfrac{\beta_0}{t_0}}\right] g_t \qquad (6)$$

where g_t = growth rate of real per capita income tax revenue and g_y = growth rate of provincial real per capita nonagricultural GRP.

We observe from (6) that if $\beta_0 = 0$ then $g_y = g_t$ otherwise $g_y > g_t$. Interestingly β_0 is the crucial coefficient, not β_1. We also find that the same growth rate of revenue implies faster growth of income where t_0 is higher (i.e., Sindh).

VI. Results

The coefficients, β_0 and β_1, can be estimated for each province from equation (5). The regression results of estimating equation (5) are presented in Table-4.

Table-4: Regression Results[7] (Dependent Variable is Real Per Capita Income Tax Revenue) 1992/93 to 1999/2000

	Coefficients	t-ratio
Constant	-221.092	-3.926
D_1[8]		
D_2[9]		
D_3[10]	-47.151	-4.503
D_4[11]	-50.079	-3.414
y, real per capita income[12]	0.115	7.117
D_1 y		
D_2 y	-0.016	-2.491
D_3 y		
D_1 T[13]	35.988	5.199
D_2 T		
D_3 T		
R^2	0.988	
Degrees of Freedom	26	
F-statistics	446.459	
D-W Statistics	1.380	

These results yield the following values of β_0 and β_1 for each province:

[7] Only results for significant variables.
[8] D_1 = 1 for Sindh; 0 elsewhere.
[9] $D_{2=}$ = 1 for NWFP; 0 elsewhere.
[10] D_3 =1 for Punjab; 0 elsewhere.
[11] D_4 = 1 for Sindh and Pakistan in 1999/2000, otherwise 0.
[12] Excluding agriculture.
[13] T=2 for 1992/93, 1993/94, 3 for 1994/95, and 4 for all other regions.

Table-5: Coefficients by Province

	β_0	β_1
Sindh	162.93	0.115
Punjab	256.72	0.115
NWFP	208.27	0.099

Based on these coefficients and equation (8), we finally obtain in Table-6 below the estimated growth rate of nonagricultural GRP in three provinces, Sindh, Punjab, and NWFP, respectively, for the current decade 1999/2000 to 2006/07.

Table-6: Annual Growth Rates (%) (1999-2000 to 2006-07)

	Real Per Capita Income Tax Revenue	Real Per capita Nonagricultural GDP
Sindh	7.1	5.3
Punjab	10.2	4.3
NWFP[14]	13.8	0.6
Pakistan	8.4	4.2

Source: FBR/CBR Year Books (various issues), Bengali and Sadqat (2006).

The conclusions we reach with regard to the growth rates of nonagricultural GRP for the three provinces are striking. Although Punjab has shown the highest growth rate of revenue, the growth rate of the underlying tax base (the nonagricultural economy) has been faster in Sindh. In fact, Sindh appears to have been the fastest growing province in Pakistan from 1999/2000 to 2006/07. It has a growth rate about 1 percentage point above the national growth rate. Punjab ranks next in terms of growth, with a growth rate very close to the national average. There is evidence that the economy of NWFP has stagnated, with very little growth during the last 7 years.

We attempt to test the validity of the above results by identifying which sectors of the economy have been relatively buoyant in Pakistan during the period 1999/2000 to 2006/07, and determining where these fast-

[14] Growth rates calculated from 1999-00 to 2004-05 due to unusual trend in tax revenues.

growing sectors are located. According to the *Pakistan Economic Survey* for 2006/07, the fastest growing sectors have been large-scale manufacturing and banking and insurance with an average annual growth rate of over 11 percent each, as compared to the overall growth rate of the nonagricultural economy of Pakistan of 6.7 percent. These two sectors have a relatively larger share in the economy of Sindh as compared to other provinces (Bengali and Sadaqat 2006). For example, in 1999/2000, the share of value-added in large-scale manufacturing in the nonagricultural economy was almost 21 percent in Sindh, 11 percent in Punjab, and 9 percent in NWFP. Therefore, unless there has been a major relocation of economic activity from Sindh during the last 7 years, it is likely that this province has shown the greatest dynamism because of buoyancy in sectors like large-scale manufacturing, and banking and insurance. Therefore, our results for the variation in provincial growth rates derived from tax data are consistent with the national sector's growth trends.

We also use post-partition data for the Pakistan economy for the period 1971/72 to 2007/08 to further validate our results for the long run. We introduce two dummy variables:

DD=1 for 1985-86 to 1992-93 otherwise 0
DD2= 1 for 2005-96 to 2007-08 otherwise 0

The regression results are as follows:

Table-7: Regression Results (Dependent Variable is Real Per Capita Income Tax Revenue)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-316.4613	43.27957	-7.312026	0.0000
Per capita income	0.058320	0.002775	21.01922	0.0000
DD	-207.5783	27.65288	-7.506569	
DD2	127.8589	51.09504	2.502373	0.0175
R-squared	0.962760	Mean dependent var.	571.1892	
Adjusted R-squared	0.959374	S.D. dependent var.	338.8576	
SE of regression	68.29973	Akaike info criterion	11.38749	
Sum squared resid.	153940.2	Schwarz criterion	11.56165	
Log likelihood	-206.6687	Hannan-Quinn criter.	11.44889	
F-statistic	284.3778	Durbin-Watson stat	1.386145	
Prob(F-statistic)	0.000000	Observations	37	

Based on the regression results, we develop a forecasting equation and estimate the level and growth of nonagricultural GDP as follows:

Table-8: Level and Growth of Nonagricultural GDP (Base Year 2000/01)

Years	Actual Nonagricultural GDP	Estimated Nonagricultural GDP
1971-2002	8058	8058
2007/08	26282	25602
Growth (%) (1971-2002 to 2007/08)	3.33%	3.26%

VII. Conclusion and Policy Recommendations

Estimates of the size, composition, and growth of the provincial economies of Pakistan are not generated by official statistics agencies. This has made subnational planning difficult. These estimates need to be generated on a regular basis.

Meanwhile, proxies or indicators have to be used to track regional development. The paper has proposed the use of real income tax revenue as one indicator of growth in the real nonagricultural economy of a province. The FBR generates information on the former on a regular basis.

Based on the estimated relationship between growth in revenue and economic growth, it appears that, while Punjab was the fastest growing province during the 1990s, Sindh has shown the greatest dynamism during the current decade. This is attributed to high growth rates, especially in large-scale manufacturing during the period, which has a larger sectoral share in the economy of Sindh.

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Appendix

Estimation of Income Tax Revenue by Province

The FBR has divided the Pakistan economy into the following five regions since 1992/93 for income tax collection: Southern Region, Northern Region, Eastern Region, Central Region and Corporate Region. In 2006/07, FBR divided Pakistan economy into Regional Tax Offices or Units. We identify these Commission rates, Regional Tax Offices or Units in each province as given below:

Regional Income Tax Offices, Commission Rates and Tax Payer Units by Province

Sindh	Punjab	NWFP	Balochistan
CIT, Companies-I, Karachi	CIT, \`A' Zone, Lahore	CIT, Peshawar Zone	MTU, Quetta
CIT, Companies-II, Karachi	CIT, \`B' Zone, Lahore	CIT, A Zone, Peshawar	RTO, Quetta
CIT, Companies-III, Karachi	CIT, \`C' Zone, Lahore	CIT, B Zone, Peshawar	
CIT, Companies-IV, Karachi	CIT, Companies, Lahore	CIT, Companies Zone, Peshawar	
CIT, Companies-V, Karachi	CIT, Companies-I, Lahore	RTO, Abbottabad	
CIT, Survey & Reg., Karachi	CIT, Companies-II, Lahore	RTO, Peshawar	
Special Zone, Karachi	Special Zone, Lahore		
CIT, \`A' Zone, Karachi	CIT, Companies-III, Lahore		
CIT, \`B' Zone, Karachi	CIT, Survey & Reg., Lahore.		
CIT, \`C' Zone, Karachi	MTU, Lahore		
CIT, \`D' Zone, Karachi	CIT, Sahiwal Zone, Sahiwal		
CIT, \`E' Zone, Karachi	CIT, Bahawalpur Zone		

CIT, `F' Zone, Karachi	CIT, Multan Zone
CIT, Hyderabad Zone	CIT, Faisalabad Zone
CIT, Sukkur , Sukkur	CIT, Faisalabad, Companies
MTU Karachi	CIT, Sargodha Zone
LTU, Krachi	CIT, Gujranwala Zone
RTO, Sukkur	CIT, Sialkot Zone
RTO, Karachi	CIT, Rawalpindi Zone
LTU, Karachi	CIT, Islamabad Zone
	CIT, Islamabad Companies
	CIT, Sur, & Reg, Islamabad
	LTU, Lahore
	LTU, Islamabad
	RTO, Faisalabad
	RTO, Multan
	RTO, Rawalpindi
	RTO, Gujranwala
	RTO, Islamabad
	RTO, Sialkot
	RTO, Lahore

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