Regional Volatility Transmission of Stock Markets in Asia

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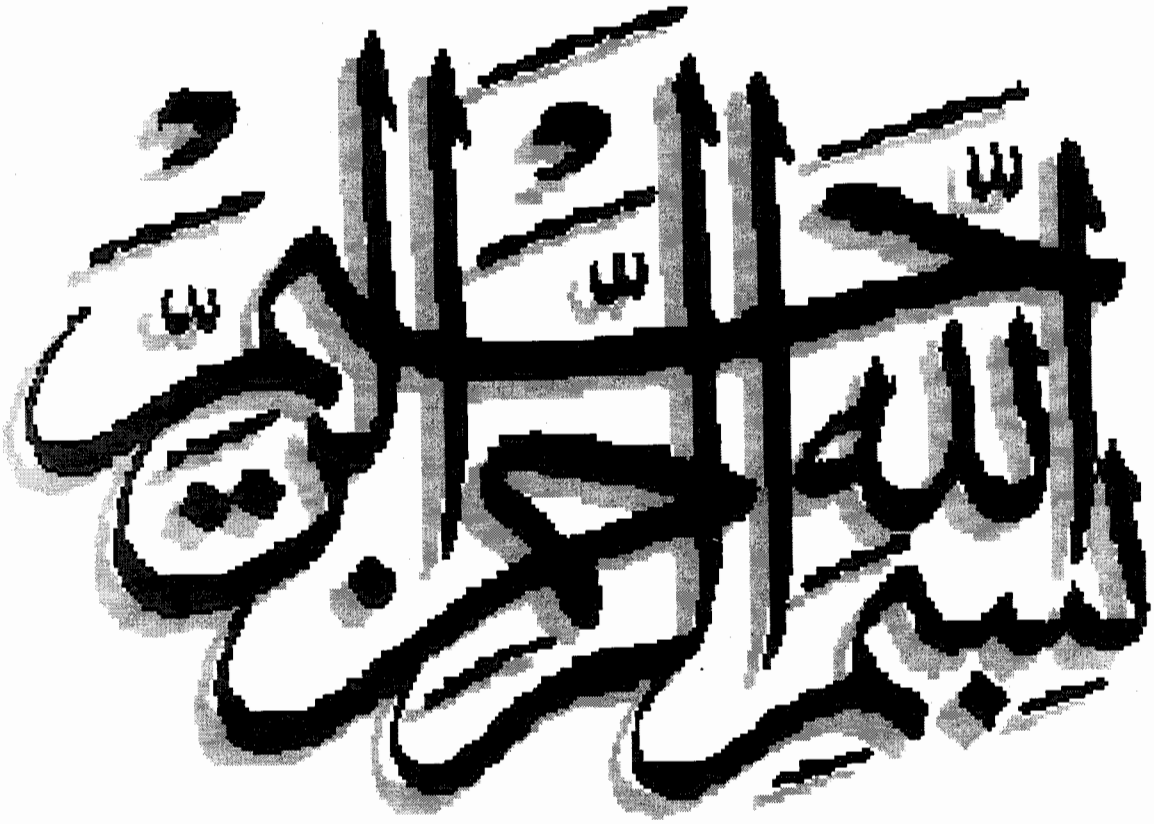
A dissertation submitted to the department of economics, International Islamic University Islamabad in fulfillment of the requirement for the degree of Master of Philosophy in Economics

International Institute of Islamic Economics
International Islamic University Islamabad
2010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CERTIFICATE

It is to certify that this thesis submitted by Ms. Sabeen Khurram Khan is accepted in its present form by the department of Economics, International Islamic University, Islamabad as satisfying for requirement for partial fulfillment of the degree of Master of Philosophy in economics.

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Dedication

Dedicated to all my loved ones

Acknowledgements

All praise be to **Allah SWT**, the most compassionate and the most merciful, who gave me the strength and courage to undertake the task.

I would like to express my gratitude to most competent, knowledgeable and cooperative supervisor *Dr.Abdul Jabbar* for his willingness, considerable time, dedication and supervision. Without his profound technical guidance, my research work might have remained an illogical and fruitless effort.

I am heartily thankful to Mr. Abu Faiz, Mr. Mansoor Shoukat, Mr. Farooq Rasheed Ms. Haleema Sadia, Ms. Hajra Ihsan, Ms. Mudassira Sarfraz, Ms. Kamila Shahana and Ms. Sumera Saeed for their continuous help and support. I would like to take this opportunity to convey special thanks to Dr Etzaz Ahmad, Dr Arshad Hassan and Dr. Atiq ur Rehman for giving me their precious time and invaluable guidance.

I am truly thankful to my Organization and to my office colleagues, especially Dr. Qasiar Abbas and Dr Nasr (Taya) for their continuous encouragement.

I am extremely thankful to the unconditional love and moral support from my parents, siblings and wonderful friends.

Lastly, I offer my regards and blessings to all of those who supported me in any respect during the completion of my dissertation.

CHAPTER 1

Introduction

International portfolio diversification has long been advocated as an effective way to achieve higher risk-adjusted returns than domestic investment alone. The main premise underlying this strategy is that international stocks tend to display lower levels of co-movement than stocks trading on the same market. To the extent that countries are subject to different shocks, then international diversification facilitates risk sharing among global investors. Idiosyncratic shocks (individual or unsystematic shocks) may be diversified away. Thus investors who pursue cross-country diversification strategies may eliminate country-specific risks but remain vulnerable to common shocks.Therefore the realization and magnitude of portfolio diversification benefits depend crucially on the relative size, frequency and persistence of idiosyncratic and common shocks[1].

International portfolio diversification has a unique aspect regarding portfolio risk reduction: returns of securities have less correlation with other countries than within a country. This is due to many factors e.g. economic, institutional, political, and even psychological. These factors affect security returns tend to move a great deal across countries, with low correlation among international securities. For example, any political crises in China will affect returns on most stocks in Hong Kong negatively, but will have little or no influence on stock returns in Finland. Likewise political turmoil in Russia may have an effect on Finnish stock returns (because of geographic

[1] Jorion (1985)

closeness and the strong economic relations between them), with little effect on Hong Kong stock returns. Moreover, business cycles also contribute to low international correlations among countries. Comparatively less international correlations mean that investors may reduce portfolio risk more, by diversifying internationally instead domestically. Since the level of gains from international diversification to reduce risk depends on the international correlation structure, it is valuable to study it empirically.

For both economists and investors it is particularly important to learn and measure quantitatively the relationships between local markets and world markets, discover new opportunities, analyze the risk of investing in local markets, and evaluate the scope of international portfolio diversification. Effectiveness of capital markets can also be examined by measuring how quickly markets assimilate important news from abroad.

Mundell (1961) in the literature of Optimum Currency Area also, discusses the inter linkage of economies for reviewing the suitability for creation of monetary union[2]. Level of integration, which can be estimated with volatility transmission, in the financial market is well thought-out as one main condition for Optimum Currency Area (Baele et al 2004). If all economies in a region are expected to face same nature of idiosyncratic shocks than single monetary policy will be helpful in reducing the severe effects of shocks. On the other hand, Goetzmann *et al* (2002) talked about the periods of amplified cross-boarders association of the last twenty years. They

[2] Monetary union is an area having one currency, one monetary policy and free flow of factor of production. EURO area is one of the examples

discussed that these periods are not only because of augmented co-movement only, but also due to an opening out of the investment opportunities.

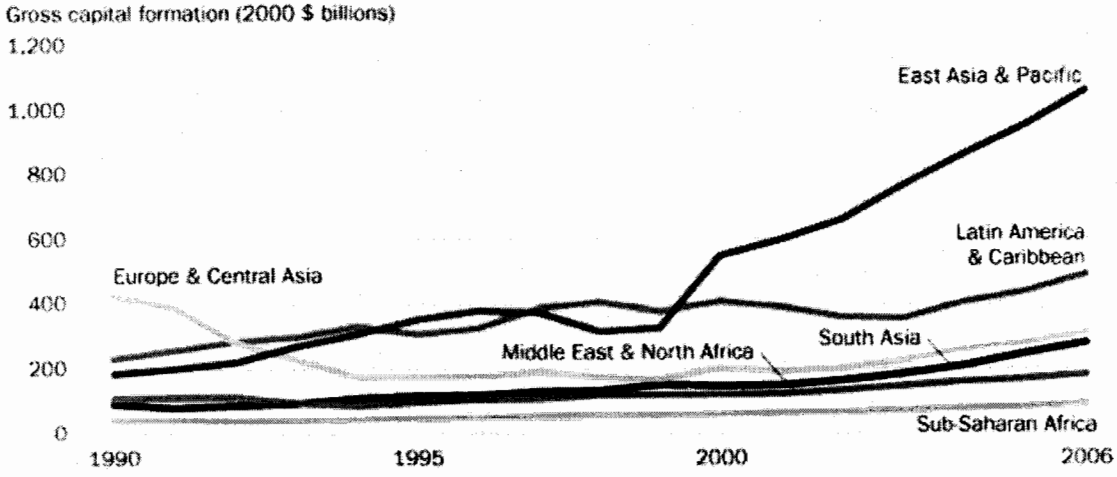
The issue of volatility transmission is also very important for policy makers and as well as the regulators. If the probability of transmission of shocks across various markets is high then more rapid collaboration among the authorities of these countries may be required. Piesse and Hearn (2005) found that integrated markets of same region progress more rapidly than the segmented ones. In other study Janakiranam and Lamba (1998) concluded that geographically and economically interrelated markets exert significant impact on one another. According to Hamao et al. (1991), strong interdependence among financial markets could fundamentally alter investor perceptions concerning the importance of foreign financial news, thereby permanently increasing the correlation in stock returns and volatility across markets.

This study focuses on four Asian stock markets namely, China, India, Pakistan and Sri Lanka. The study examines whether these markets are co integrated and is there any evidence of volatility transmission from four markets of developed world (USA, UK, Japan and Singapore). Questions may take place regarding why we selected these countries even though there are many emerging markets in the region and obviously in the world. This region which includes China, India, Pakistan, Sri Lanka and other countries is full of diversity, culture, in religion, having two nuclear powers etc. Number of demands has risen from time to time that more integration is required in this region for economic and political stability[3].Pakistan has its own strategic

[3] At the 12th SAARC summit, the Prime Minister of India has given proposal for closer economic

importance for all neighbor countries. Over the last decade, China's significance in the world has amplified many folds. It has been gaining significant consideration from both portfolio managers and individual investors, therefore turning its markets into increasingly important places for investments (A. Seddick Meziani). Therefore, with rapid growth of Chinese economy, more attention is being given in recent literature to the potential of Chinese financial markets. On the other hand, India is one of fastest growing economies of the day

Figure 1.1 Investments in Asia



Between 1990 and 2006 investment increased nearly six fold in East Asia and Pacific and three fold in South Asia.
Source: World Development Indicators 2008

Due to reforms in financial markets, a lot of capital has been transferred into the Asian region. But in spite of reforms, less than the potential capital has flown towards Pakistani and Indian markets. Political situation and governance issues may be partly responsible for this reluctant attitude by the foreign investors.

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relationship for overall economic development of the region. His proposal, not limited to, includes regional trade agreements, single currency and common borders.

The extensive depth of the issue of volatility transmission in financial markets and lack of empirical work on these countries motivates the present study to analyze the presence of opportunity of International Portfolio Diversification among these markets (China, India, Pakistan and Sri Lanka). By taking into consideration that the financial globalization phenomenon is happening of the day, it is also imperative to understand any volatility transmission from developed markets (USA,UK, Japan and Singapore) to these markets as well.

Pakistan has cordial relations with China since last many decades, while relations with India show completely different picture. Though both the countries Pakistan and India have worse relations with each other but they have close cultural and historic ties because they have common origin. Whereas, relations of China with India also demonstrate many ups and downs. This study also investigates volatility spillover between the stock markets of countries that are (political) friends of each other and countries that are not on friendly terms. The question is multi dimensional in its nature but this study will focus only on behavior of equity markets in investigating the research problem. It is conducted specifically to answer the question, is there any difference shown in behavior of Pakistani equity market with China while comparing with India?

In this study, we will look at the following issues:

(1) To examine whether volatility transmits among equity markets (China, India, Pakistan and Sri Lanka) of countries of same region

(2) To examine whether the political relations among the states can cast influence upon trends and behavior of the stock markets of the countries.

The organization of study is as follows: Chapter II discusses the mechanism of stock exchanges of specified countries (China, Japan, India, Pakistan, Singapore, Sri Lanka, United States, and United Kingdom); Chapter III reviews some of the selected research studies. Chapter IV explains the methodology used in this study. Chapter V provides a detailed discussion of results and finally chapter VI discusses the conclusion and recommendations.

CHAPTER 2

After 1997, when currency crisis in Thailand spread in East Asia, Europe and other developed economies like a disease then the nomenclature of "contagion" in financial term was used. Claessens and Forbes (2004) argue that prior to Asian financial crisis; contagion was commonly used for infectious disease. They further discuss that "A Lexis-Nexis search of major newspapers since mid-1997 finds that almost all articles using the term contagion referred to the spread of financial market turmoil across countries". Now Contagion has become a standard word for referring to transfer to economic shocks for policy makers, academician and other concerned people. So Contagion can be defined as "a significant increase in cross-market linkages after a shock to an individual country (or group of countries), as measured by the degree to which asset prices or financial flows move together across markets relative to this co movement in tranquil times" (Forbes and Rigobon, 2001). The same authors argued in 1999 that instead of using "contagion", it was safer to use "shift-contagion" because it would further cement the concept that the contagious effects were the results of shift in cross markets.

The World Bank[4] defines contagion as "a significant excessive co movements of economic and financial indicators which are not explained by fundamentals commonly explained by herding behavior". This definition also helps to understand the dynamic of contagion in very self explanatory way. The World Bank[5] explains the three basic links with which various economies are linked with each other. These can be financial links, Real links and Political links. Financial links exist when two

[4] http: //www1.worldbank.org/economicpolicy/managing%20volatility/contagion/definitions.html
[5] http: //www1.worldbank.org/economicpolicy/managing%20volatility/contagion/definitions.html

economies are connected through the international financial system. Real Links arise from the economic relationship among economies. The basic reasons for these links can be bilateral trade, mobility of production factors (as in USA and Canada). And the last are political links which arise through political relationships among countries. When a country is a member of a certain group, then, the decision made in that group becomes binding on that country also. For example decision made in World Trade organization is to follow by all member countries.

Financial development and integration is very seriously threatened by the phenomena of financial contagion. All such trade and financial linkages which are designed by various governments for growth and development can turn into deadly shocks due to contagious effects of financial crises. That is why it is crucially important for policy makers, researchers and people from academia to examine the potential extent of contagion impacting their economy.

Foreign portfolio investment has become one of very important source of foreign direct investment all over the world. Grubel (1968), Levy and Sarnat (1970) studies support empirically the supremacy of international portfolio diversification. Some other studies also found that these benefits are still there in spite of increasing integration across financial markets in both stock markets (Grauer and Hakansson, 1987; De Santis and Gerard, 1997) and bond markets (Levy and Lerman, 1988) Whereas, after the work of King and Wadhwani (1990) it is worrying issue for portfolio managers who diversify portfolio internationally to reduce risk, , they found that the Japan, UK and US stock market correlations increased after crash of stock market in 1987. Lee and Kim (1993) Longin and Solnik (1995) studies extended this

application to wider range of countries. If markets experienced increased co-movement for the turmoil period then these findings are important for portfolio managers, because then they may not get gains from international diversification. Studies like Forbes and Rigobon (2002) illustrated that in unstable episodes, when markets experiencing greater volatility, the correlation measure may bring incorrect conclusion about financial market contagion due to biasedness. For both economists and investors, it is particularly important to learn and measure quantitatively the relationships between stock markets. If stock markets move together then according to portfolio diversification models (e.g., Markowitz, 1952; Sharp, 1964) investing in these markets will provide no long-term gains to portfolio diversification. Therefore, it is important for both investors and academicians to know whether stock markets are interlinked. Stock markets play important role in development of a country.

The following parts discuss stock markets/exchange and brief introduction of specific stock exchanges included in this study

Stock Markets/Exchange

"A **Stock Exchange** is a Market Place that provides trading facilities for stock brokers and traders to trade stocks and other securities. It also provides facilities to issue and redeem securities and other financial instruments in addition to payment of dividends to stock holders. Securities that are traded on any stock exchange include shares issued by companies, derivatives, pooled investment products and bonds."[6]

[6] http://www.businessdictionary.com/definition/stock-exchange.html

For any security to be traded, it must be listed on a stock exchange. A central location is mandatory for any security to be in record among other activities at the exchange. However trading of shares have become totally automated and electronically handled at stock exchanges since the turn of the 21st Century as modern markets are more and more traded through electronic networks because of their high speed and cost of transactions is less. Members are allowed to trade on an exchange. In the primary market the initial offering of stocks and bonds to investors is done while, their trading is done in the secondary market. Various stock market factors that affect supply and demand in stock markets are adjusted by the. It is not compulsory to issue stock through the stock exchange itself or its subsequent trade on that exchange. This is known as over-the-counter trade, and is the common way in which derivatives and bonds are traded all over the world. Therefore, domestic stock exchanges are part of a world market for securities.

Historical Perspective:

Financial Markets have existed since the existence of mankind on earth. They were needed to facilitate transactions and act as a medium of commodities and services exchange between persons, tribes, communities, and countries. They were necessary as storage of value and mean of savings as well. Such exchange was necessary to reduce the risk that was encountered when caravans carrying cargo over long distances were faced with highway robbers.

Stock Markets were associated with risk in Pre-Islamic Arabia where Trade Caravans were subject to highway attacks, and merchants hired fighters to protect their cargo against the risk of highway robbers waiting on roads from Damascus to Yemen.

Merchants collaborated together to pay those fighters for their services. Later, when Islam prevailed and extended to Asia and Africa via Mombassa which became a Port in West Africa and knew the first type stock markets. Merchants met there in order to decide how much each had to pay for a cargo, and how much to invest. Cairo, Egypt was the first City to deal with risk insurance and stock markets in the 8th Century to help foreign trade and provide payment channels for contributors and parties of each trade and transaction.

Stock Exchange concepts began to be media of trade in Europe and America in the Nineteenth Century, and became a valuable mean for trade not only among persons of one country but extended beyond the borders of their country to other countries. During the Twentieth Century till our present time stock markets became numerous in the whole world, and many former Socialist Countries in Eastern and Central Europe adopted the same system.

2.1 Karachi Stock Exchange (KSE 100)

Karachi Stock Exchange (KSE) is Pakistan's largest and most liquid exchange showing average daily turnover of 525.15 million shares and has market capitalization of worth US $ 54.28 billion. 'Business Week' a magazine having international reputation declared the KSE as the world's best performing stock market in 2002. Since then the KSE entered the circle of the best performing markets in the world and is still maintaining this status. Since 1991, foreign investors are provided equal opportunity with local investors to invest in the secondary capital market on the Karachi Stock Exchange. New investors have been encouraged by introducing new policies and initiating privatization that has stimulated development of the KSE (663

companies were listed in 2006). Moreover, every company is allowed to be listed on one of the two markets of its own choice. The two markets are; the ready market and the 'over-the-counter' (OTC) market. The OTC market has flexible and easy terms and conditions for listing, a company with minimum of Rs 100 million can be listed on it, whereas a company intends to be listed in ready market is required to have a minimum paid up capital of Rs 200 million (about UK £ 1.8 m). The Karachi Stock Exchange trades the KSE-100 Index which is a highly-diversified index that includes top 100 largest capitalization companies' stocks from all sectors of Pakistan's economy. A constant change in the index indicates a good sign of the overall Exchange performance over a period of time. KSE-100 Index represented 88% of the KSE total market capitalization in 2005. There is a limited membership in the Karachi Stock Exchange as only 200 individual and corporate entities can register as members in the KSE. A foreign corporate entity may become member of KSE provided that the nominee member of the company is a Citizen of Pakistan. 162 members actively participated in the trading activities of the Exchange in 2005.

2.2 Shanghai Stock Exchange (SSE)

The Shanghai Stock Exchange (SSE) may rightly claim of being the first and largest stock exchange on mainland China. A total of eight hundred and seventy-eight (878) companies have been listed at SSE. Profit is not its motive, it is considered as a non profit institution being run under the auspices of China Securities Regulatory Commission. Two different kinds of stocks are listed at the exchange: A and B shares which are differentiated on the basis of currency in which they are traded. The A shares are trade in the local currency i.e. Renminbi yuan, whereas the B shares are bought and sold in U.S. dollars. Initially the area of trade of A shares was confined to

the native country but now along with B shares these are traded across the world. Out of total listed companies, 824 are of A-share type and the rest 54 are of B-share type.

2.3 Bombay Stock Exchange (BSE)

Bombay Stock Exchange (BSE) is the first and one of the most significant stock exchanges in India. In the growth and development of the capital market of the country, it has played a vital role. Among 22 Indian exchanges The Bombay Stock Exchange is the largest, having more than 6,000 listed companies. It is also the world's fifth largest exchange, possessing market capitalization of worth $466 billion. The Bombay Stock Exchange employs the BSE Sensex which is an index of 30 large stocks of 12 sectors. This index assesses the entire performance of the Bombay Stock Exchange, and is mostly followed across the world. According to the Sensex, the equity market of BSE has flourished considerably since 1990.

BSE maintains a market in derivatives which commands the status of being first market ever established in India. Stock futures and options, index futures and options, and weekly options are the derivatives listed on the exchange. The BSE contributes to the progress and development of the retail debt market. The debt market is attached much importance in India as the country is developing and is dependent on such type of investment for development and growth. The activities of the debt market in India were confined to wholesale market and banks and financial institutions were its participants. The Bombay Stock Exchange holds that a retail market has capacity to generate great opportunities for individual investors by better diversification.

2.4 Colombo Stock Exchange (CSE)

The Colombo Stock Exchange (CSE) is the biggest stock exchange of Sri Lanka. It had 20 business sectors and 243 listed companies on 31st May 2005. The worth of its market capitalization is more than 497 billion rupees (over US $ 4.9 billion) which is 24% of the GDP of the country. There are two indices existing in the CSE - The All Share Price Index (ASPI) and The Milanka Price Index (MPI). It got the membership of the World Federation of Stock Exchanges in 1998 and became its first member from South Asia. It is also considered a founding member of the South Asian Federation of Exchanges (SAFE).

The Colombo Stock Exchange functions under the Companies Act like a limited liability company without any profit motive. It shows a mutual ownership structure and has 15 members. Every member is a corporate body and has license to perform the duties of a broker. The Board of Directors formulate the policies of the CSE, these are 9 in number, one of them is nominated as chairman through election. Five out of nine are elected by the members and remaining four are nominated by the Minister of Finance.

The CSE has proved to be one of the top emerging stock markets, with a record annual growth of more than 30% in 2002-2004, and it posted an annual growth of 41.6% in the year of 2006. It showed a rapid growth in 2007, which witnessed that the stock exchange has achieved a historic milestone - ASPI crossed the 3000 mark for the very first time in its history. The improved infrastructure and sophisticated computerized trading platform assisted CSE in enhancing its competitive power and

efficiency through showing an extraordinary performance among the stock markets of the world. [7]

2.5 New York Stock Exchange (NYSE)

The "New York Stock Exchange (NYSE)" is the leading stock exchange in the world. It trades approximately 1.46 billion shares per day. The exchange trades stocks for some 2,800 companies, ranging from blue chips to new high growth companies. Each listed company is compelled to fulfill stringent requirements because the NYSE seeks to maintain its prestige of trading strong and best quality securities.

NYSE functions as a stock exchange with auction floor; the brokers and specialists are the major players plying on its floor. Investment firms or their clients hire the brokers to trade on their behalf. The broker deliver buy and sell orders to the specialist by moving on the floor. Each specialist stays at one location on the floor dealing in one or several stocks that is determined by trading volume. The specialist accepts buy and sell orders and manages the actual auction. The specialist has to ensure that there is a market available at all the times for their specified stocks. For this purpose they invest in the capital of their own firms in order to maintain the markets active and the liquidity of their shares. Specialists and brokers intend to stimulate investment activities by providing the investors with the competitive prices determined by demand and supply forces.

The Board of Directors consisting of six to twelve members manage the affairs of the NYSE. All Directors except for CEO who has to be involved in certain proceedings have no concern with the trading floor's activities. The regulation and operation of

[7] http://www.cse.lk/body.htm

exchange are kept separate from each other. The election of Board of Directors is held annually and the members of the Board of Directors elect the Board of Executives, which has 12 to 22 representatives belonging to the many member firms. These Executives provide Directors with suggestions and advice in order to make them aware of the situation prevalent in the exchange.

2.6 London Stock of Exchange (LSE)

The London Stock Exchange being one of the world's largest exchanges has much importance in Europe. It has above 3,000 listed companies and 350 companies of different other countries. LSE possesses more international character than any other exchange. It has two stock markets: the Main Market and the Alternative Investment Market (AIM). The Main Market comprises of prestigious companies with impressive performance, and it has very strict listing requirements. About 1,800 of the LSE's listed companies trade on the Main Market, and over 3,500 billion is its market capitalization. The new enterprises and small companies having huge growth potential are traded in Alternative Investment Market. It has more than 1,060 companies listed and 37 billion market capitalization.

The LSE is fully electronic and automatic-based market, although different systems are employed to trade different shares. The SETS (Stock Exchange Electronic Trading Service) automated system is used to trade most liquid shares. It implies that with the matching of buying and selling price the order is automatically implemented. The LSE employs SEAQ (Stock Exchange Automated Quotations System) system for the securities which are traded less regularly and market makers intend to keep their shares liquid. These market makers have to hold the shares of a particular company

and set the bid and check prices in order to get sure that there is a market for their stocks.

The LSE established a new exchange in 2003, equity derivatives and is called EDX London. The EDX traded an average of 382,599 contracts each day, in 2004. It aims to be the world's largest derivatives market. FTSE 100 Index represents share index of the 100 highly capitalized companies which are listed on the LSE. That index was started on January 3, 1984 with a base level of 1000 and its highest value reached 6950.6, on December 30, 1999. FTSE denotes "Financial Times Stock Exchange".

FTSE 100 holds about 80% of the Market Capitalization of the whole London Stock Exchange. The FTSE 100 is used most widely as a UK stock market indicator despite the comprehensiveness of the FTSE All-Share Index. The FTSE All-Share aggregates the FTSE 100, FTSE 250 and FTSE Small-Cap. The ingredients of the index are calculated quarterly; if the companies in the FTSE 250 Index are placed in the top 90 on the basis of their market capitalization, then they are promoted.

FTSE group has set out many requirements which are to be met by component companies which include having a full listing on the London Stock Exchange with a British Pound or Euro denomination price, and meeting certain tests on nationality, free float, and liquidity. Most of the companies listed on this index usually attach the abbreviation plc at the end of their name, showing the status of being public limited company. Companies without their primary listing on the London Stock Exchange are rendered ineligible for membership of the FTSE 100 Index and are excluded.

2.7 Japan Stock Market (TSE)

The "Tokyo Stock Exchange (TSE)" was founded on 15 May, 1878 as a Kabushiki Kaisha. Its administrative body consists of nine directors, eight executives and four auditors. The TSE divides Stocks listed on it into 3 sections. The first section comprises of large companies, and the second section comprises of mid-sized companies. The third section comprises of the "Mothers" and it accommodates the newly-started companies showing high-growth. The TSE had 1,721 First Section Companies, 489 Second Section Companies and 156 Third Section Companies in March, 2006. The main indices tracking the TSE are the Nikkei 225 index of companies selected by Japan's largest business newspaper called Nihon Keizai Shimbun, the TOPIX index based on the share prices of first section companies, and the J30 index of large industrial companies maintained by Japan's major broadsheet newspapers. 89 domestic and 19 foreign securities companies participate in TSE trading. On 15 June 2007, the TSE paid $303 million to acquire a 4.99% stake in Singapore Exchange Ltd [8]

Pre-war history of Tokyo Stock Exchange:

It started trading on June 1, 1878. The exchange was merged with ten other stock exchanges located in major cities of Japan to establish a single Japanese Stock Exchange in 1943.The newly formed exchange was closed and was recognized in 1944 after the bombing of Nagasaki.

[8] http://www.tse.or.jp

Post-war history of Tokyo Stock Exchange

The Tokyo Stock Exchange was reopened under Securities Exchange Act, on 16 May, 1949 with current Japanese name. The TSE showed marvelous performance during the period of 1983 to 1990, in 1990 its market capitalization formed over 60% of the stock market capitalization of the world before it suffered a serious setback and it fell in value and ranking but still it is the world's third largest exchange on the ground of market capitalization. The TSE trading floor was closed on 30 April, 1999, and it was switched over to electronic trading for all the transactions. A new facility which is called TSE was launched on 9 May, 2000. In 2001, the TSE reshaped itself as a stock company: before this, it was functioning as an incorporated association and its members were considered as shareholders. The exchange quickly increased its order capacity to five million trades a day. In July 2008 the London Stock Exchange (LSE) and the TSE announced a new joint venture Tokyo-based market, which will be based on the "LSE'S Alternative Investment Market (AIM)."

2.8 Singapore Stock Exchange (SGX)

Singapore Stock Exchange is attached much importance because it holds the central position in financial sphere of the Asia-Pacific and has become one of the major exchanges in the region. It has around 659 listed companies and market capitalization of $398.4 billion. It has international character as 40% of its market capitalization comes from companies of other countries. The SGX listed companies are divided into the SGX Main-board and the SGX SESDAQ (Dealing and Automated Quotation System). Only those companies are listed with the Main-board, which fulfill certain requirements like market capitalization, operating track record and pre-tax profit. New companies are listed on SESDAQ as it does not impose any quantitative requirement.

The SESDAQ listed companies, after two years and meeting other requirements, are allowed to apply to get listed on the Main-board.

The Singapore Exchange is an automated exchange it uses the Central Limit Order Book (CLOB). Brokers send their orders online and on the matching of buying and selling price, the order is automatically executed by the system and brokers are issued a notice. The validity of orders remains for a day and if till the end of day the orders are not executed, these would be cancelled. Shares are traded in lots of 1000. The Singapore Exchange is also famous for trading in a wide variety of derivative securities via SGX-DT. It is considered pioneer in Asia in offering equity index futures and now it has started offering the world's widest range of Asian index futures.

As discussed above, Stock Exchanges play significant role in the development of countries. Country without having well developed capital markets can't progress rapidly and consistently. In today's world, geographic location of a stock exchange does not matter because nowadays, issuer can raise capital wherever it is cheapest while, investor can invest everywhere to get the highest achievable return with lowest possible transaction costs. It means that possible opportunity set for both have expanded. These are interesting challenges for "stock exchanges" all over the world. One who realized the needs of today and prepared himself to meet these challenges is getting benefits from it, rather wasting the opportunities.

CHAPTER 3

Literature Review

After the Asian Financial Crises of 1997, many studies have been done to investigate different transmission channels and find out their consequences. Some of the most important related studies have been discussed in this chapter. As discussed earlier this study used two methodologies (GARCH and VAR) to check the presence of volatility transmission of Pakistani stock markets with its neighboring countries' stock markets. Hence, for better understanding, this chapter has been divided into two parts.

The first part deals with studies which used GARCH and other methodologies to check presence of volatility transmission among different financial markets all over the world while; the other part deals studies while used COINTEGRATION techniques for testing co integration among different financial markets.

3.1 Literature Review of GARCH and other Methodologies

Khan and Sajid (2007) examined the financial markets interlinkages of South Asian economies by analyzing strand of interest rate. They analyzed integration vis-à-vis United States by obtaining monthly statistics of interest rate from 1990 to 2006. They have employed the methodology of uncovered interest rate parity hypothesis. Results showed that low level of market integration had been present in the region.

Chi, Nihon and Young (2006) examined the extent of financial integration that subsists in East Asian markets by employing International Capital Asset Pricing Model methodology. They utilized three market portfolios to check for interlinkages,

which included, the weighted average equity index of all appraised countries, the "Japanese market index" and the "US market index" The investigation illustrated that the extent of financial efficiency and the amalgamation of appraised countries was elevated and enhanced radically all through 1991 to 2005, and with reference to the world's leading market the USA, they were much more financially amalgamated within the region and with the Japan one of the leading market of Asia.

Johansson and Ljungwall (2006) glanced at the relationships among various stock markets within China. They concluded that there were considerable overrun impressions in both mean and variance amid those two markets. However, the stock market in Mainland China is linked to a lesser extent to the other two markets. For accounts that asymmetric volatility affects a "Vector Auto Regressive multivariate conditional volatility model" is used to check the mean and volatility processes of various stock markets. They concluded that China and Hong Kong are affected by mean spillover effects from Taiwan, while both Taiwan and Hong Kong illustrated the signs of a response relationship in this volatility process. The Mainland China market is much less inter-reliant with the other two markets, whereas Taiwan and Hong Kong showed clear bidirectional spillover effects. Furthermore volatility persistence is strong in all three markets.

Simon Neaime (2006) examined opportunity of portfolio diversification in the emerging North African (MENA) stock markets. He argued that monetary calamities stretch through the fiscal drifts and links increase the chances of a regional financial crisis. The study used a dynamic model to gauge the repercussion of financial assimilation in regional and international levels. Conditional volatility in stock

markets has been checked in this study by employing GARCH, TARCH, GARCH M and VAR analysis. Their result suggested that geographically close countries are more strongly and financially tied with others by transmitting crises to one other.

Qayyum and Kamal (2006) examined the volatility spillover between the Foreign exchange and stock exchange markets of Pakistan. On the basis of the week-wise data of Karachi stock index 100 and exchange-rate from July 1, 1998 to May 31, 2006, they investigated the sample by employing Bi-variate EGARCH and Engle-Granger co-integration techniques. They concluded that strong affiliation and volatility transmission present between these markets in Pakistan.

Piesse and Hearn (2005) have conducted research study with the purpose to examine integration of emerging equity markets in Sub-Saharan Africa and their role in the development of markets, economic growth and development of the region. The researchers have taken ten national equity markets that communally tower over the SSA region.For the sake of examining volatility transmission the extent of the price volatility transmission within the markets has been taken as the base for markets integration. They employed EGRACH model to examine intra-market volatility, volatility asymmetry and inter-market volatility transmission. After the interpretation of data, the conclusion derived is that the integrated equity markets are progressing and doing better economically than those that are segmented and isolated.

Kawai (2005) investigated due to convincingly high level of economic incorporation of East Asia, that has come about through liberalization, structural reforms and through free trade pacts, the Asian financial crisis occurred. However, there is a need

to do more in the areas of free trade and currency steadiness. He moreover states that there are firm political basis for East Asian countries to carry on the expansion of free trade pacts in the area to provide these countries a greater degree of bargaining power in the global economy.

Chaudhry T.(2004) conducted a research with the purpose to examine the trends of mean returns and volatility spillover of the markets of political friends and foe countries. He took three pairs of countries which have strained political relations among themselves like India and Pakistan, Israel and Jordan, and Greece and Turkey. And he also examined the spillover between the markets of these countries and the USA because the USA enjoys friendly relations with all these countries. He employed nonlinear GARCH-t model for this purpose. The results showed that the mean returns and spillover are not subjected to the friendly relations and distance between the countries.

Khalid and Rajaguru (2004) investigated the connectives between the South Asian Financial Markets employing Multivariate GARCH Model on the daily exchange rate data from January 01, 1996 to December 31, 2003. This study focused on India, Pakistan, Sri Lanka, and Bangladesh from South Asia. In order to analyze linkages from developed economies, they have also included China, Japan, Saudi Arabia Belgium, Germany, Singapore, Honk Kong, United Arab Emirates (UAE), and the United Kingdom (UK). Authors found that no irrefutable evidence is obtained from investigation to refuse the null hypothesis of financial linkages among south Asian currencies.

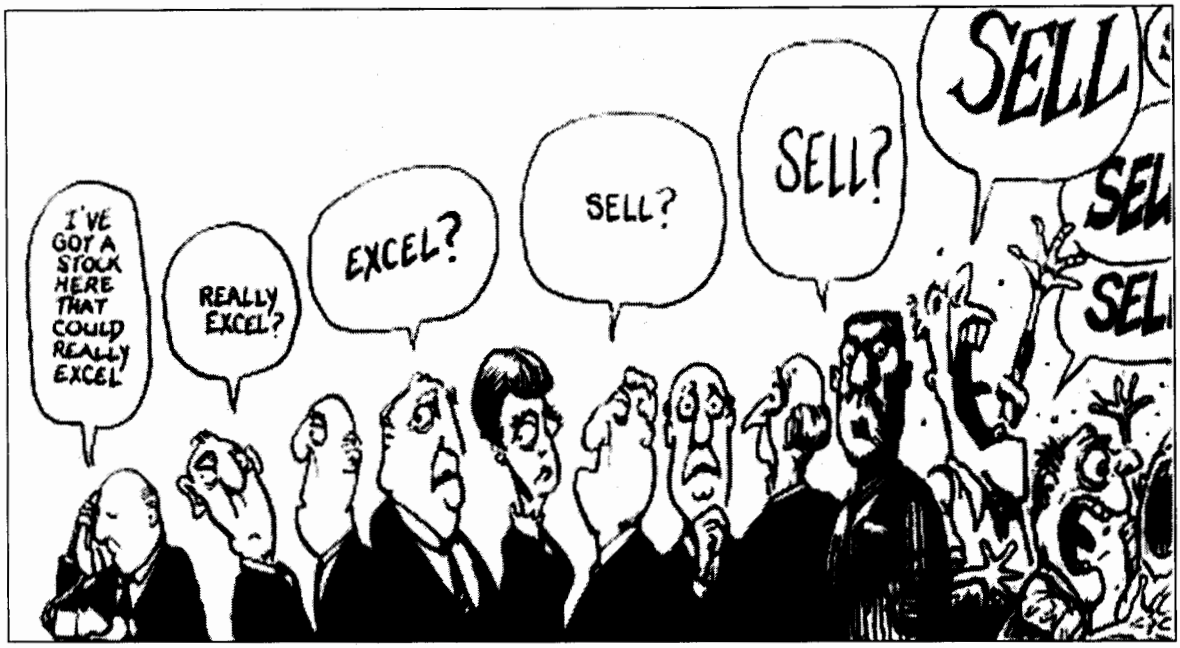
On the other hand, Gerard *et al.* (2003) used an ICAPM (International Capital Asset Pricing Model) approach and a GARCH (1, 1) process to study the integration of East Asian stock markets with the US and world markets. The study concluded that East Asian Markets are strongly integrated.

Corsetti et al (2000) concludes that shocks are transferred from one country to the other through the major role of trade. They investigated the effect of devaluation to retain viability with special allusion to globalized macro-economies and claimed that the import and export of elasticities is the factor that defines the success of competitiveness devaluation.

According to Calvo (1999) in the upcoming markets, information is quite costly for exclusive investors in comparison with the financial institution. This is one of the reason due to which clear and well-defined classification can be made between 'informed investors' and 'uninformed investors'. Uninformed investors observe the actions of informed investor and without defining the cause of their decision; the uninformed investors copy those decisions. Duplication of informed investor can heed to serious diminution in markets.

It is also stated that if expenses information for market participants are high, then chances are there they may be more oriented towards being free-riders and thus would espouse the herd behavior. As a result, there will be a rise in the instability and that will lead to crisis transmission across markets

Figure 3.1 Reflections of Herd Behavior and Panic in Stock Markets



Kaminsky et al (1998) argued that usually inflation rate, real effective exchange rates, aggregate credit expansion to private and public sectors help to anticipate the probability of happening of financial crises. Their experimental evidence is restricted only to currency crises. They used monthly data of twenty industrial and developing countries for the period of 1970 to 1995.

Kanas (1998) designed the connections between the U.S. market and six European stock markets, that is, the U.K., Germany, France, Switzerland, Italy and Netherlands. By analyzing the daily data, over the period of 1983 -1996, he argued that the U.S. stock market had no co-integration with any of the mentioned European stock markets. He also found the existence of the probable long-run remunerations from diversifying in U.S. stocks and stocks in any of the six European stock markets.

Mike K. P. So K. Lam and W. K. Li (19997),studied the instability of the seven Asian markets using the ARV approach. The countries examined in this specific study are Thailand, Malaysia, Singapore, Hong Kong, Philippines, South Korea and Taiwan. Time period of this study is from 1980-1991. The two steps procedure suggested in Harvey and shepherd (1993) has been used to estimate ARV model. They establish that the stocks to volatility are transient in the whole time period in all the seven Southeast Asian indices. They also concluded that STII Index of Singapore is the least volatile while TWSI Index of Taiwan has the greatest volatility throughout twelve years of study.

Karolyi (1995) investigates the short term studies of returns and instability for stock traded on the New York Stock Exchange (NYSE) and Toronto Stock Exchange (TSE). They utilize the multi-variate GARCH techniques to capture the mechanism by which stock returns innovation in one market have an impact not only on its own conditional market return but also on volatility of the other market. They argue that integration between these markets have changes over time and after 1980 magnitude of shocks from NYSE have had less impact on TSE returns.

Inference about magnitude and persistence of return innovation depends on how cross markets dynamics in the conditional volatilities are modeled.

Taylor and Tonks (1989)"checked whether "the U.K stock market is linked (integrated) with the stock markets of the U.S., Germany, Netherlands and Japan. Using monthly data on stock price indices of these countries for the periods, April 1973 to June 1986, they found stock price index of the U.K. was not co-integrated with the stock price index of the U.S., Germany, Netherlands and that of Japan. They

suggest that there is no long-term gain from diversification for the U.K investors after the abolition of exchange control."

3.2 Literature Review of Co integration Analysis

There are number of studies that explore the relationship between regional markets all over the world. Only few studies have been conducted to explore the long run relationship among equity markets of South Asia. The possible reason is the historical and geo political situation of the region which is marred with conflicts and credibility deficit. However now these countries have started realizing that a better economic and trade cooperation can help to alleviate the poverty of region[9].

Elfakhani Said, Arayssi Mahmoud and Smahta Hanin A. (2008) conducted the research on the equity markets of some Arab countries and the USA with the purpose to examine whether the international diversification was possible inspite of the rapid growth of globalization. They gathered the data from these markets for the period of 1997 to 2002. They employed ADF and JMA tests to examine the co-integration and diversification among the markets. The results of the tests showed that the markets of Kuwait were co-integrated with the markets of Jordan, Tunisia and Saudi Arabia and the markets of Tunisia and Jordan were co-integrated. Thus they provided opportunities of diversification to the investors. And only the markets of Morocco, Kuwait and Jordan were co-integrated with that of the USA.

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[9] Arshad Hassan (2007)

Azad Sohel A.S.M. (2007) conducted the research to examine whether any contagion effect existed between three major stock markets of South Asia like China, Japan and South Korea. He also checked if these markets are individually and jointly efficient. He used random walk hypothesis to find out individual efficiency of markets and for joint efficiency of markets he depended on contagion and co-integration. The results of the research presented that the hypothesis of individual market was failed in case of Chinese markets but it remained successful in case of the markets of Japan and South Korea. Test for co-integration failed in all the markets however the test for contagion was not rejected

Glezakos, Merika, and Kaligofiris (2007) investigated the long run and short run relationships among Greek stock exchanges and major world equity markets. They employed Co integration Analysis and Granger Causality Technique to check long run equilibrium relationship by taking monthly data of 10 equity markets. They found significant relationship of USA stock market with all other markets. They also noticed the strong influence of Germany and DJ index on the Athens stock exchange.

Choudhry and Lin (2007) in their study tried to find the Asian crisis affect and dominance of Japan and US stock markets on Far East countries markets. The affect of Asian crisis 1997-98, crash of Thai baht and deprecation of currencies in region is analyzed by researchers. The data from January 1988 to December 2002 is taken from eight countries and USA. Empirical investigations are carried out by applying fractional unit root test and the Johansen multivariate co integration test. The co integration of markets of Far East countries is found in both post and pre periods of

Asian crisis. The domination of US and Japan stock markets is also found on the markets of these countries

Aggarwal and Kyaw (2005) examined the integration of three equity markets before and after the NAFTA agreement. The data set is taken 7 years before NAFTA and after from 1988-2001. The data is taken on daily, weekly and monthly bases. The NAFTA agreement increase trading liberalization and minimize barriers between USA, Canada and Mexico. Last studies failed to find the co integration of financial markets in NAFTA region. But this analysis tried to find this integration on different frequencies. Aggarwal and Kyaw used co integration test for trends in methodology. They concluded study with result that the formations of NAFTA increase the integration of stock market between USA, Canada and Mexico, in post NAFTA time, removal of trade barriers and restriction integrate the region.

Aggarwal *et la*(2005) tried to find the integration of European stock market by using Co integration Analysis and Haldane and Hall(HH) Kalman filter methodology. The formation of European block after long times of cold wars and conflicts; was important for region to compete with American and Asian economies in era of globalization. This study checked how much European markets are integrated. Different analysts tried to find the result of equity markets integration in Europe but because of different bank centered, market controlled and mixed system in countries create difficulties for general decision. The data from 1983-2002 is taken from full set of European equity markets on daily bases and checked its convergence with UK, USA and Germany markets. The conclusion showed that the European markets integration increased with passage of time after taking actions from euro zone.

Lamba (2005) examined the short and long run relationship between the stock markets in the South Asian region and other major developed markets. The main emphasis of this research is whether South Asian stock markets have any short and long run relationships with each other and the impact of Asian financial crisis and September 11, 2001 attacks on these stock markets. Co integration and vector error correction mechanism has been used to examine the existence of these relationships. Author selected India, Pakistan and Sri Lanka to represent the South Asian markets. The countries which were taken from the developed markets was based on the financial and economic influence of the developed markets on these South Asian markets are France, Germany, Japan, UK and US. The data on daily stock prices from July 1997 to December 2003 was taken

To investigate the presence of long run relationship Johansen's and Juselius Cointegation model has been used. The results indicate that there is existence of at least one co integrating equation among South Asian countries and major developed market. While for India the results were conflicting then he used 1% significance level and he found one co integration equation.

He also found that US, UK and Japan have strong influence on Indian stock market and this influence continued even after the September 11, 2001. On the other hand Pakistan and Sri Lanka are found to be isolated from the other major developed markets during the whole period covered in the sample size. However, when the interdependence of South Asian countries was checked, he concluded that these countries are coordinating with each other but at very slow rate.

Suchismita and Mukherjee (2005) analyzed the correlation among Indian stock market and major stock markets of Asia in current years and also the relationship among Asian stock markets and with US stock market. After liberalization of the Indian capital market, its integration with the other Asian financial markets has been increased through different ways like foreign portfolio investment and AGR/GDR method. They investigated the relationship between two developed stock markets namely US and Japan and other seven Asian financial markets India, Hong Kong, Malaysia, Korea, Singapore, Taiwan and Thailand. The daily data set used for six and a half year commencing from 1st January 1999 to 30th June 2004 and all the stock prices were converted into US dollars with a base at 1st January 1999 and this is done to include the effect of exchange rate. The authors used Co integration and Granger Causality test technique to investigate the correlation among stock markets, The results of the bivariate co integration indicate that there is no evidence of bivariate integration of Indian stock market with any one of the Asian stock market or US stock market .On the other hand, when all the markets were considered, authors found evidence of single co integrating equation among all markets and DJIA but there is evidence of no co integration between S&P 500 and all markets. But when all the Asian markets were taken into account including Japan, there is an evidence of a single co integrating equation.

Causality results of this study illustrate that US market has strong influence on all markets but S&P 500 returns do not have any strong impact on Japanese market. Whereas Japanese market returns seem to have led all the markets including US stock indices. Existence of bi-directional causality is observed between Indian and Japanese and Korean stock returns.

On the whole, the results of this study show that Indian stock markets were strongly integrated with Singapore, Malaysia, South Korea, Taiwan and Thailand but, co integrated at very low rate with US S&P Index.

Suchismita (2005) examines the presence of long run relationship of the Indian equity market with the Asian equity markets and the US by using multivariate cointegration analysis and granger causality test. Results indicate that the Indian equity market is not found isolated from Asian equity markets. Moreover the US equity market is found integrated with Indian equity market. The Indian equity market is also found exerting some influence on Asian equity markets. The Indian equity market appears to belong to the group of Asian markets co integrated within them and with the US equity market. However, the level of integration among Indian and Asian markets is generally low so possibility of portfolio diversification still exists and there is no threat for capital flight in case of financial crisis in the region.

Narayan, Smyth and Nandha (2004) examined the linkages between the equity markets of Pakistan, Sri Lanka, India and Bangladesh. They used Granger Causality Approach and Multivariate Co integration Framework. In the long run , stock prices of Sri Lanka, India and Bangladesh Granger cause stock prices in Pakistan. They also found uni directional Granger Causality is flowing from Pakistan equity market to Indian equity market. While this happens from Pakistan to Indian and Sri Lankan equity market in short runs. Unidirectional causality is also observed between equity prices in Sri Lanka to equity prices in Indian equity markets. However, equity market of Bangladesh is found exogenous.

They also investigated the linkages of the Pakistani equity market with international equity markets These linkages are very important for Government of Pakistan who wanted to attract foreign investments and also to international investors who sought to maximize return via diversification.. They have explored the linkages of Pakistan equity market with seven most influential markets USA, UK, Japan, France, Hong Kong, Singapore and Germany. For this purpose Correlation analysis, Co integration analysis, and Error Correction Model have employed to check the integration by using weekly country indices from January 1988 to December 1993. They found Pakistan equity markets has low correlation of returns with other markets. Thus it is an attractive prospect to international investor for optimizes return by diversifying risk. They also concluded that Pakistani equity market is not integrated with other markets.

Hassan (2003) investigated the long run relationship between share prices in gulf region through applying the co integration technique developed by Johansen (1988, 1991, 1992) and Johansen and Juselius (1990).By using vector error correction mechanism, this study also analyzed the existence of short run dynamics of prices by applying intertemporal Granger causality. The data used in this study was collected from the Arab Monetary Fund. The focus was mainly on GCC countries including Kuwait, Bahrain, Oman and Saudi Arabia. From these four countries three countries were selected on the basis of availability of weekly data on share prices.

The results of the ADF indicated that the variables are integrated of order one at level whereas co integration test result suggest that Kuwait and Bahrain, both possess a long-term and constant relationship. For the existence of short run relationship, Granger-causality test is used. The results point out that except Oman which causes

Kuwait, the variables is not related in short run at any significance level. So, the short run changes in Kuwait and Bahrain are affected only because of their trend values.

On the basis of the results obtained from this study one can conclude that investors from Gulf countries can have a potential benefit if they invest in other stock market. In turn these countries will have a greater efficiency of removing the ownership constraint at least for the Gulf Countries (GCC) citizens. In order to achieve their objectives, GCC will need to work on the liberalization of their domestic stock market and coordinate with the stock market of other GCC countries to establish a single stock market in the region.

Dekker *et al* (2001) dealt with the short-term dynamics and proved that the influence of US market on daily stock price movements at several Asian markets is much more than the Japanese market. He made use of a generalized VAR (Vector Autoregressive Approach) approach. In this paper nine Asian equity markets have been taken to investigate the transmission of equity returns and volatility among them. Six of these markets are emerging markets (Malysia, Indonesia, Taiwan, The Philippines, Thailand and Korea) while remaining three are regarded as developed (Japan, Singapore and Hong Kong). Data has been taken from 1988 to 2000.

Roca (1999) examines the co integration among financial markets of Australia, Japan, USA, UK, Hong Kong, Korea, Singapore, and Taiwan. He employed Johansen Co integration Technique by using weekly stock prices to check interlinkages among these equity markets. He also used Granger Causality Test to investigate the direction of causality. Results showed that Australian markets have significant long run

relationship with USA and UK markets. However there is no evidence of existence of co integration between Australian and other equity markets.

Masih and Masih (1997) also investigate the association and causation among various US stock indices in relation of stock market crash of 1987. They choose five major indices including DOW JONES from US, the NIKKEI from Japan, the FTSE from Britain, the CAC7 from France, and German stock index the DAX8. They employ a series of econometrics methodologies including Granger causality and error correction mechanism for determine the short term relationship among these five indices. They also employ the Vector Autoregressive (VAR) model and impulse-response functions and conclude that not all but some scrip from stock markets of Thailand granger cause the volatility in the Philippine financial markets.

Kasa (1992) explores common stochastic trends in the stock markets of the U.S., the U.K., Japan, Germany and Canada. By using monthly and quarterly data from 1974 to 1990, and implying Johansen co-integration technique, he found a single common stochastic trend driving these countries' stock markets. He concludes that integration in these financial markets exists. In other words, the stock markets of these countries move together.

In the above discussion we reviewed different studies regarding presence of volatility transmission among different countries regionally and globally. We have also discussed different methodologies used by researchers in their studies to investigate this issue. Only few studies discussed this matter for some countries of this region. in this respect. That's why we aimed to study comprehensively the regional volatility

transmission within stock markets of Pakistan, China, India and Sri Lanka and also with major developed stock markets (USA, UK, Singapore and Japan) by using two different methodologies (GARCH and VAR) to strengthen our results.

CHAPTER: 4

Methodology

Transmission of information and movement of prices across equity markets can be examined by using two broader approaches.

(i) GARCH Approach

(ii) .VAR Framework

This study uses these methodologies and to test the long run association among the equity markets of Pakistan, China, India and Sri Lanka via,(a)Bivariate Exponential GARCH Methodology and

(b) VAR Framework

Univariate time series model attempts to predict and forecast the future on the basis of its own previous information. That is why these are commonly called a-theoretical models. Financial econometrics literature generally discusses two types of classifications in this regards. One is autoregressive process (AR) and other is moving average process (MA).

An AR process can be defined as the current value of variable w depends upon its own past values. That is

$$w_t = \alpha_0 + \alpha_1 w_{t-1} + \alpha_2 w_{t-2} + \ldots\ldots\ldots\ldots + \alpha_p w_{t-p} + \varepsilon_t$$

Whereas according to MA process, value of variable w is a function of its current and past error terms which are white noise.

$$w_t = \beta_0 + u_t + \phi_1 u_{t-1} + \phi_2 u_{t-2} + \ldots\ldots\ldots\ldots + \phi_q u_{t-q}$$

If both AR and MA process are combined, then the output is an ARMA model which shows that w is a function of its own historic values and also of its white noise error terms.

$$w_t = \lambda + \sum_{i=1}^{p} \alpha_i w_{t-i} + \sum_{i=1}^{q} \phi_i u_{t-i} + u_t$$

Where $\lambda = \alpha_0 + \beta_0$

Financial models are generally linear in their means but non linear in their variances. Policy makers, regulators and people from academia remain more interested in risk. It might be due to saying that "take care of risk; profit will take care of itself.

Risk is generally measured with the help of as volatility in financial markets. n finance volatility is the most important and widely discussed area. Different reasons can be attributed towards this importance. When investors find the price fluctuations over a very short period of time which may be as short as a day or few hours, they may be not in a position to have any logical reasoning for this. Most financial and economic literature is based on the risk averse nature of investors. Risk averse is one who always avoids taking risk. So if risk is increased, the reduced level of economic activity is likely to happen.

There are some other reasons responsible for importance of volatility. It is changeable of some underlying variable for example stock prices, exchange rate etc. More variable will fluctuate over a period of time, more volatility will said to be. There are

various reasons with which volatility can be associated with. Policymakers, regulators and academia have always tried to identify and provide rectification for such lacuna causing volatility. But in recent history, we have been witnessing another category of volatility which does not arise from domestic reasons but results of transmission of shocks across regions and international stock markets. It has acquired an important place in literature of international finance, international economics and international financial architecture.

This study also relates to the transmission of shocks which transfer from one market to another. Various methodologies have been suggested through literature. We have decided to employ more than one methodology as per the need of analysis such as bivariate EGARCH to check volatility transmission from one market to an other market and Johansen methodology to check the long run relationship. Additionally, descriptive statistics have been provided to augment the analysis.

One of the most important conditions to analyze any financial time series is to check its stationarity. If financial data is non-stationary then regressing a variable on other variables generally results in spurious or twaddle regression. Financial time series like stock prices are said to have random walk phenomena which predicts that price of today is a function of price of yesterday and a random shock. This concept makes forecasting of financial data a wasteful exercise. In the same way, various autoregressive moving average (ARMA) models assume time series to be stationary. Therefore first of all we test the financial time series for stationarity. To test the stationarity of data, unit root tests proposed by Dickey and Fuller (1979) and Phillips and Perron (1988)are used .The Augmented Dickey-Fuller test investigates the

presence of unit root in an autoregressive model. A simple AR (1) model is yt = $\rho y_{t-1} + u_t$, where y_t is the variable under study, t is the time period, ρ is a coefficient, and u_t is the error term. The regression model can be written as $\Delta y_t = (\rho - 1)y_{t-1} + u_t = \delta y_{t-1} + u_t$, where Δ is the first difference operator. This test assumes that the errors are statistically independent and have a constant variation. This assumption is very strict and may not be true for some data whereas, Phillip-Perron test is more flexible and, therefore is also used.

In Phillip-Perron test the error terms can be weakly dependent and heterogeneously distributed. If two series are non stationary then there is a possibility that a linear combination of these may be stationary. If it happens then these series are called co-integrated. Financial time series are not generally following normal distribution. Therefore we use Jarque-Bera test for normality and acquire the statistical values for kurtosis and skewness as well.

As mentioned earlier, two major methodologies have been employed to investigate the volatility transmission and Co-integration which are

4.1Bivariate Exponential GARCH

4.2 Co-integration Analysis

ARCH/GARCH Models

A frequently observed pattern of fluctuation in high frequency data especially in stock prices is that, there are cycles of relatively low and high volatility. The periods of low volatility and high volatility are commonly known as 'Calm' and 'Wild' periods respectively. This phenomenon of wide swings across time periods is also known as

volatility clustering. Volatility clustering is a common phenomenon in financial time series. That is, a large shock, or residual, in one direction tends to be followed by another large shock either in the same or in the opposite direction. Equally, small shocks tend to be followed by further small shocks. Thus, stock markets are characterized by periods of high volatility and periods of low volatility. This is particularly true at high data frequencies, perhaps daily or weekly returns, but is less clear at lower frequencies.

In another study Engle (1982) discussed the concept of autoregressive conditional heteroskedasticity (ARCH) model, allowing the variance of the residuals to be a function of their history. In the period of calmness, small u_i^2 is followed by small u_i^2 and in the period of wildness large u_i^2 is followed by large u_i^2. As lot more often the small u_i^2 followed by large u_i^2 .Therefore the correlation between u_i^2 and u_{i-1}^2 is likely to be positive and significant.

Thus it is clear that in contrast of assumption of disturbance term to be constant, the constant variance assumption of homoskedasticity seems invalid. So these variance errors will not be homoskedastic but heteroskedastic. Engle (1982) argue that in high frequency data large and small disturbance errors appear in group therefore error term variances can be shown as a function of their lagged values. The Author calls it Autoregressive Conditional Heteroskedasticity (ARCH). As an investor or policy maker, we might be interested in investigating the returns and variance of financial assets over observable period of time rather than long run estimate of variance. Engle

shows that it is possible to describe the conditional mean and conditional variance of a financial asset using information set of previous period;

$$z_t \equiv E(y_t / \varphi_{t-1}) \equiv E_{t-1}(y_t)$$

$$\sigma_t^2 \equiv E_{t-1}[y_t - z_t]^2$$

Where y_t is the return of financial asset in time t conditional on the information set φ_{t-1} at time t-1. E represents the expected value in statistics.

Consider the simple model

$$Y_t = \alpha + \beta' X_t + u_t \qquad \text{Where } u_t \square iidN(0,\sigma^2)$$

Where Y_t is the rate of return and X_t are the regression parameters. A typical ARCH model can be written as follows:

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{i=1}^{q} \beta_i \varepsilon_{t-i} + \varepsilon_t$$

Conditional Mean Equation;

$$x_t = \lambda + \sum_{i=1}^{p} \alpha_i x_{t-i} + \sum_{i=1}^{q} \phi_i u_{t-i} + u_t$$

$$\lambda = \alpha_0 + \beta_0$$

Error Decomposition $\varepsilon_t = v\sqrt{h_t}$

OR $\varepsilon_t^2 = v^2 h_t$

where 'v' is the part of variance which is homoskedastic and h_t is the conditional variance which is heteroskedastic. This conditional variance h_t can be shown as ARCH Equation, i.e.

$$h_t = \gamma_0 + \gamma_1 \varepsilon_{t-1}^2 + \gamma_2 \varepsilon_{t-2}^2 + \ldots\ldots\ldots + \gamma_r \varepsilon_{t-r}^2$$

$$h_t = \gamma_0 + \sum_{i=1}^{r} \gamma_i \varepsilon_{t-i}^2 \qquad \text{Where } \gamma_0 \text{ and } \gamma_i \text{ are non negative.}$$

Engle (1982) has also derived a Lagrange Multiplier (LM) based principle to test the hypothesis of $\gamma_0 = \gamma_1 = \gamma_2 = \ldots\ldots\ldots = \gamma_r = 0$.

Another useful variant of ARCH methodology suggested by Bollerslev (1986) is the generalized ARCH or GARCH model. Bollerslev (1986) argues that conditional variance in financial series is not only the function of its lagged error term but also the function of its lagged conditional variances.

$$h_t = \gamma_0 + \sum_{i=1}^{r} \gamma_i \varepsilon_{t-i}^2 + \sum_{i=1}^{s} \theta_i h_{t-i}$$

Therefore, GARCH (1, 1) process would be

$$h_t = \gamma_0 + \gamma_1 \varepsilon_{t-1}^2 + \theta_1 h_{t-1}$$

So GARCH model helps to explain the conditional variance with the help of past squared error term and conditional variance lag value. Which also means that conditional variance at time "t" would be a function of long run variances ε_{t-i}^2 and also variances conditional on past information set (short run) or observed shocks i.e. h_{t-i}.

Although ARCH/GARCH model provide the new dimension in literature, still these models are not able to investigate and examined the most obvious phenomenon of financial time series. One of which is the asymmetric behavior across financial time series. It is a prominent feature of stock prices that good news seems to have less effect than bad news on volatility. This phenomenon of reduction in volatility if stock prices increase and increase in volatility in case of fall in stock prices is known as "Leverage Effect". Glosten, Jaganathan and Runkle (1994) presented their model to incorporate the Leverage Effect in GARCH family and called it Threshold GARCH (TGARCH).

$$h_t = \gamma_0 + \gamma_1 \varepsilon_{t-1}^2 + \eta_1 d_{t-1} \varepsilon_{t-1}^2 + \theta_1 h_{t-1}$$

Where d_{t-1} is a dummy variable that is equal to 1 if ε_{t-1} is less than 0 and is equal to '0' in case of ε_{t-1} is equal to or greater than zero.

4.1 Bivariate Exponential GARCH

A problem with GARCH models is the non negative condition for all estimated coefficients. Nelson (1991) proposed another variant, which we will use, in ARCH/GARCH family of model which does not require the non negativity of coefficients but also captures the leverage effect.

$$\log \sigma_t^2 = \gamma_0 + \sum_{i=1}^{s} \theta_i \log \sigma_{t-i}^2 + \sum_{i=1}^{r} \gamma_i \frac{|\varepsilon_{t-i}|}{\sqrt{\sigma_{t-i}^2}} + \sum_{i=1}^{r} \upsilon_i \frac{\varepsilon_{t-i}}{\sqrt{\sigma_{t-i}^2}}$$

Where γ_0, θ_i, γ_i and υ_i are the coefficients to estimate. When υ_i <0, positive or goods news results in less volatile situation in comparison with negative or bad news.

Considering up to one lag only, the EGARCH can be written as

$$\log \sigma_t^2 = \gamma_0 + \theta_1 \log \sigma_{t-1}^2 + (\gamma + \upsilon)\frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} \qquad \text{If } \varepsilon_{t-1} > 0$$

$$\log \sigma_t^2 = \gamma_0 + \theta_1 \log \sigma_{t-1}^2 + (\gamma - \upsilon)\frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} \qquad \text{If } \varepsilon_{t-1} < 0$$

As the basic focus of this study is to examine the transfer of volatility across markets, therefore above EGARCH methodology will be used. But to see the effect of transmission, we will add conditional volatility factor of other countries in the above equation. The resulting EGARCH model is known as bi-variate EGARCH model. This model will be estimated for each pair of countries to examine the effect of transmission of volatility across pair of countries. We can write the above bi-variate EGARCH model as follows;

$$\log \sigma_{t,m}^2 = \gamma_0 + \theta \log \sigma_{t-1,m}^2 + \gamma \frac{|\varepsilon_{t-1,m}|}{\sqrt{\sigma_{t-1,m}^2}} + \upsilon \frac{\varepsilon_{t-1,m}}{\sqrt{\sigma_{t-1,m}^2}} + \delta \sigma_{t-1,n}^2$$

m is the primary country and n is the country whose transmission is to be estimate. The coefficient δ will measure the extent of volatility transmission between both countries.

4.2 Johansen Co integration analysis (long run relationship analysis)

This study intends to examine the volatility spillover among the financial markets. This volatility spillover generally supposed to exist among the markets already having long term relationships. The co integration models are usually used to find out the long run equilibrium among various variables. Although there are various techniques

through which we can check co-integration, but the bi variate nature of this study provides directions to focus the discussion on the Johansen's methodology. The null hypothesis is that "no relationship exists among the series". If long run equilibrium is present then these series are called co integrated. Johansen (1988, 1991), and Juselius (1992) apply the maximum likelihood process to establish the occurrence of co integrating equation in number of non stationary time series. It greatly depends on the relationship between the rank of a matrix and its characteristic roots.

To understand Johansen's method have a look at the following general autoregressive representation for the vector Y, which contains n variables, all of which are I(1),

$$Y_t = \mu + B_1 Y_{t-1} + B_2 Y_{t-2} + \ldots\ldots\ldots\ldots\ldots + B_k Y_{t-k} + \varepsilon_t \qquad \{4.1\}$$

where μ is a (n x 1) vector of constants, k is the maximum lag, ε_t is assumed to be a (n x1) vector of Gaussian error terms, and A is a (n x n) matrix of coefficients.

The above vector autoregressive process can be retransformed as:

$$\Delta Y_t = \mu + \Pi_1 \Delta Y_{t-1} + \Pi_2 \Delta Y_{t-2} + \ldots\ldots\ldots\ldots\ldots + \Pi_{k-1} \Delta Y_{t-(k-1)} + \Pi Y_{t-k} + \varepsilon_t \qquad \{4.2\}$$

Where

$$\Pi_i = - [I - B_1 - B_2 - \ldots\ldots\ldots - B_i] \qquad i = 1, 2, 3\ldots\ldots\ldots, k-1$$

$$\Pi = - [I - B_1 - B_2 - \ldots\ldots\ldots - B_k]$$

Here the three variables in Y_t. The ΠY_t is giving information regarding the nature of co integration among three variables.

The main objective of Johansen's test is to test the rank of.Π. And in doing so there can be three cases.

C-I: Rank (Π) = n i.e. full rank which means that its rank is equal to the number of linearly independent rows and that should equal the number of rows.So all elements/variables of W_t are stationary.

C-II: Rank (Π) = 0 (i.e., Π is a null matrix), this implies that the variables in Π are not co integrated as there are no linear combinations of the variables in Π which are stationary. Thus there is no long-run relationship between the variables in Y_t. Equation {4.2} in this case reduces the to traditional VAR model in first differences, i.e.

$$\Delta W_t = \mu + \Pi_1 \Delta W_{t-1} + \Pi_2 \Delta W_{t-2} + \ldots\ldots\ldots\ldots\ldots\ldots + \Pi_{k-1} \Delta W_{t-(k-1)} + \varepsilon_t \qquad \{4.3\}$$

C-III: Rank (Π) = r, $0 < r < n$, this implies that ΠW_{t-k} is I(0), that is the variables in W_t are co integrated. Equation {4.2} thus takes the error-correction. The rank r in this case determines the number of distinct co integrating vectors that exist between the variables in Y_t.[10]

They have suggested two likelihood ratio tests for the detection of the number of co integrated vectors. One of them is known as maximal Eigen value test which is used

[10] See Asteriou Revised Edition 2006, chap 17, p 319-326

to evaluate the null hypothesis that there are at most r co integrating vectors versus the alternative of r + 1 co integrating equations. The maximum eigen value statistic is defined as;

$\lambda max = - T ln (1 - \lambda r+1)$

Where λ r+1,...,λn are the n-r smallest squared canonical correlations (Eigen values from Π matrix) and T = the number of observations.

The second test is based on the trace statistic rather than co integrated factors which tests the null hypothesis of r co integrating vectors versus the alternative at least r co integrating vectors[11]. This statistic is defined as

$\lambda trace = -T \Sigma ln (1 - \lambda i)$

Schwarz Information Criterion (SIC) is used to select the number of lags required in the co integration test. If Johnston and Juselius test of co-integration provides the evidence on the basis of rejecting null hypothesis that both the stock series are co-integrated in the long run, then we can say that the two stock series observed equilibrium relationship is due to driven by same set of factors and will expect to be continued into the future. To test multivariate co integration, the approach used is Vector Autoregressive (VAR). This assumes all the variables in the model are endogenous. By inserting Vector Error Correction Term we capture the short-run divergence of prices from their respective equilibrium values.

[11] See Asteriou Revised Edition 2006, chap 17, p 319-326

4.3 VECTOR Error Correction Mechanism (short run analysis)

If the variables are co integrated, then residuals from the equilibrium regression can be utilized for the estimation of error correction model and to assess the long run and short run effects of the variables and have a look to the insight of adjustment coefficient, which actually is the coefficient of the lagged residual term of the long run relationship.

The coefficient (statistic) of the error correction term, which is also the coefficient of adjustment speed, shows how strongly the deviation from equilibrium feed back into the system. If it is significant it shows long run causality of variables and vice versa.

There are many reasons of the importance of VECM.It measures the correction from disequilibrium of the period. Due to formulate in term of first difference which trend eliminates from the variables and resolve the problem of spurious regression. These models fit into general to specific approach to econometric modeling which best fits the given data set. Two co integrated variables implies that there is some adjustment process which prevents the error into the long run relationship. So concept of co integration and the error correction mechanism (VECM) are closely related.

CHAPTER 5

Empirical Results

Before we check the linkages among the stock markets, the market index series is examined whether they are stationary using the Augmented Dickey and Fuller (ADF) (1979, 1981) and Phillip Perrron (PPP) (1988) tests on the market index levels and their first differences. No stock index was found to be stationary at levels. However rejection of hypothesis of non stationarity in first differences for all markets implies that the variables are integrated of orders one.

This study intends to investigate portfolio diversification opportunities and volatility transmission with respect to Pakistan, China, Sri Lanka and India. United States of America, Japan, Singapore and United Kingdom have also been taken to check transmission of volatility from developed countries to each of the selected Asian countries. From every country, one stock market index has been chosen as a proxy for their stock market performance. From Pakistan; KSE 100 index has been included in the sample, From China; SSE, from Sri Lanka; CSE Sensitive index and from India; BSE 200 index has been included. From United States of America, Japan, Singapore and United Kingdom we will use S&P 500 index, NIKKIE 225 index, STI 100 index, and FTSE 100 index respectively. All the indices are denominated in local currency units. In this study we used daily data starting from July 1, 1997 to December 31, 2009.

Line graphs have been used and provided below to show the price movement of above eight major stock exchange indices over the time period ranging from July 1, 1997 to

December 31, 2009. It is already explained in chapter 4 that financial time series do not generally follow normal distribution. These series show negatively skewness and highly kurtic i.e. leptokurtic. To see the actual position regarding normality, kurtosis and skewness, major descriptive statistical figures have been provided below. The eight stock indices have been checked for normality using jarque-bera test. The null hypotheses regarding the normality of data have not been accepted.

PAKISTAN

Figure 5.1 **KSE100, Karachi Stock Exchange**

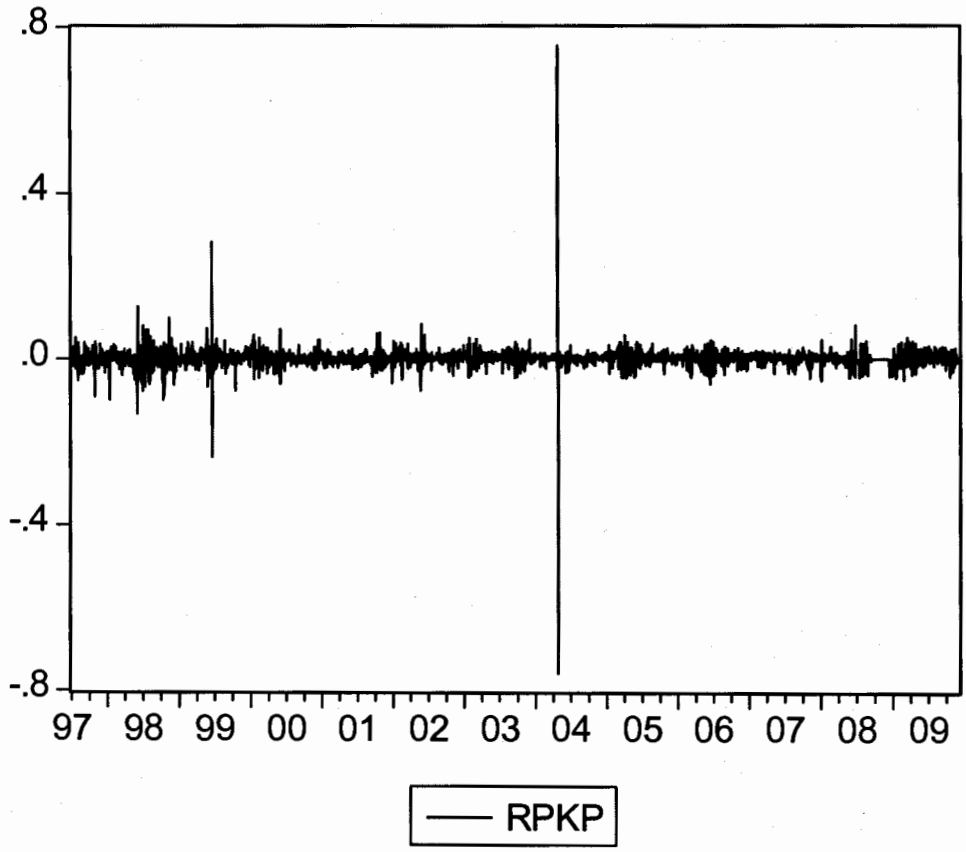
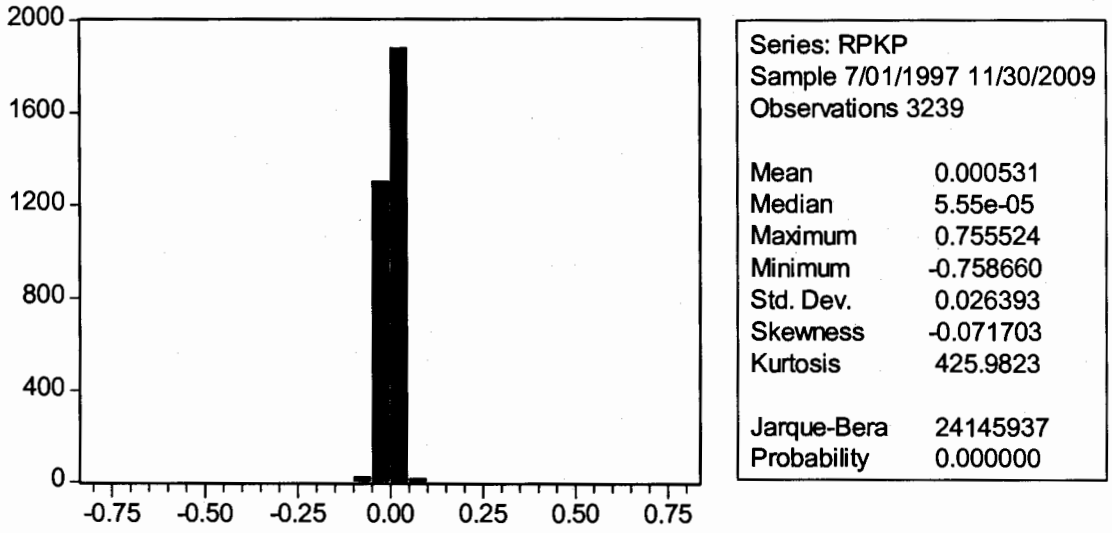


Figure 5.2 **KSE 100, Histogram for Pakistani Stock Returns**



China

Figure 5.3 **SSE 100 Shanghai's Stock Exchange**

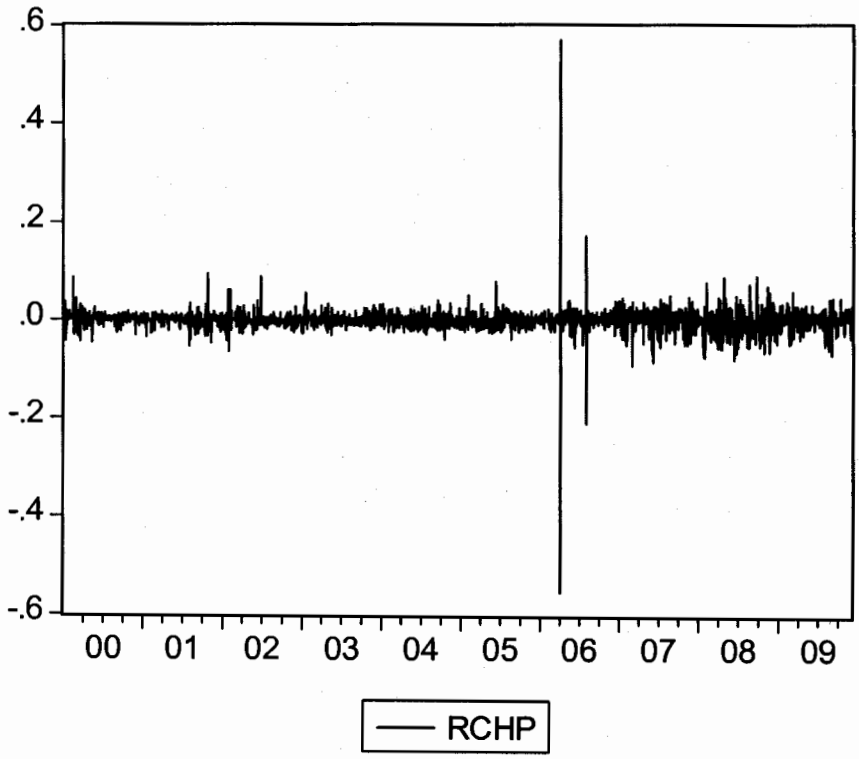
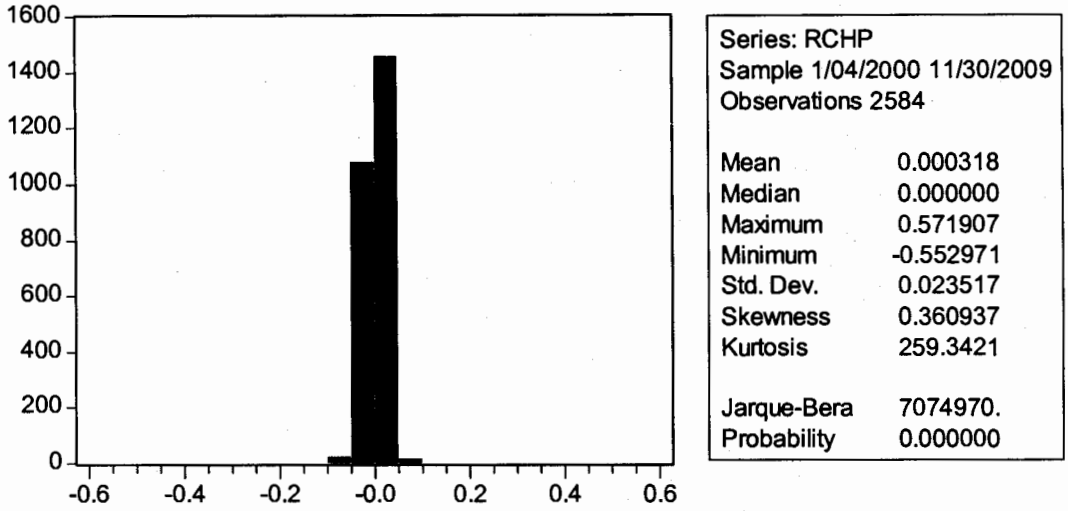


Figure 5.4 **SSE 100, Histogram for Shanghai's Stock Returns**



India

Figure 5.5 **BSE200, Bombay Stock Exchange**

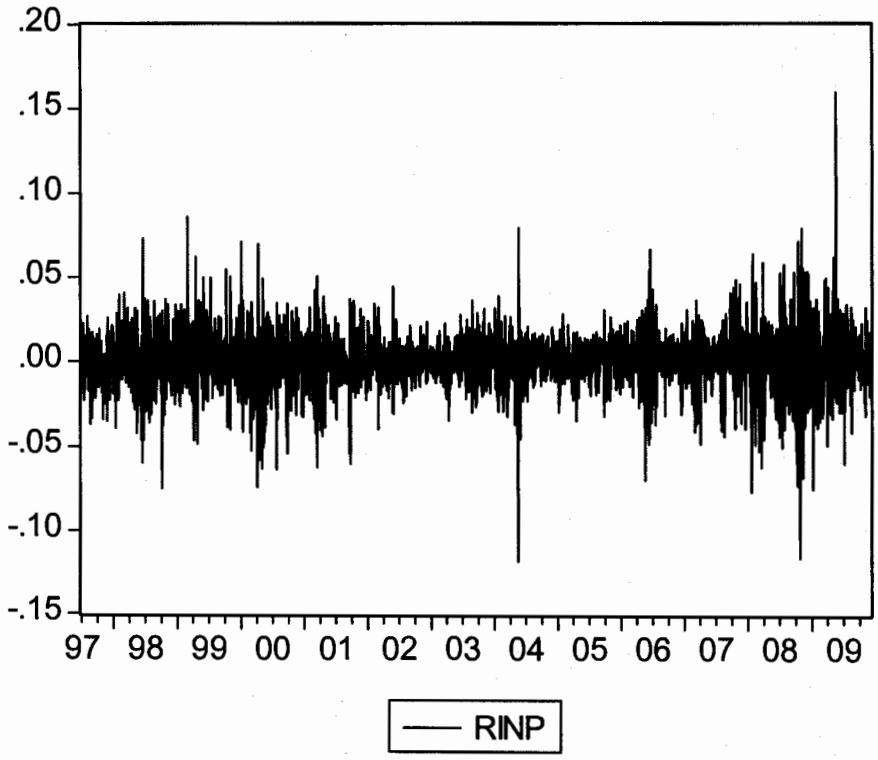
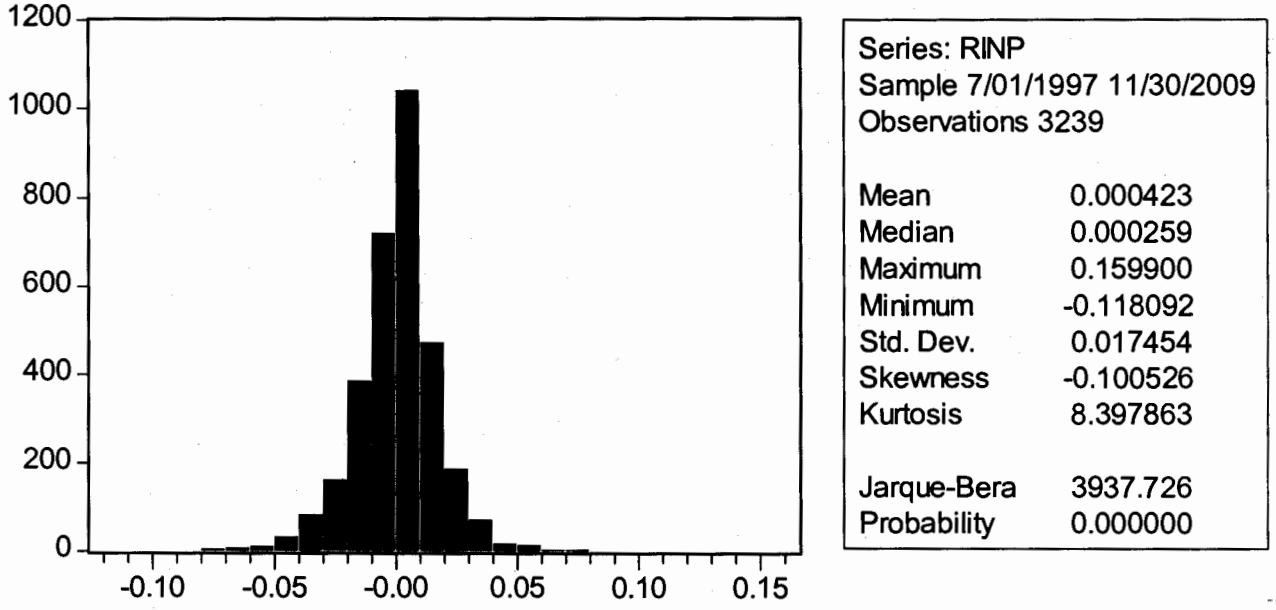


Figure 5.6 **BSE200, Histogram for Indian Stock Returns**



Sri Lanka

Figure 5.7 **CSE, All price Index, Colombo Stock Exchange**

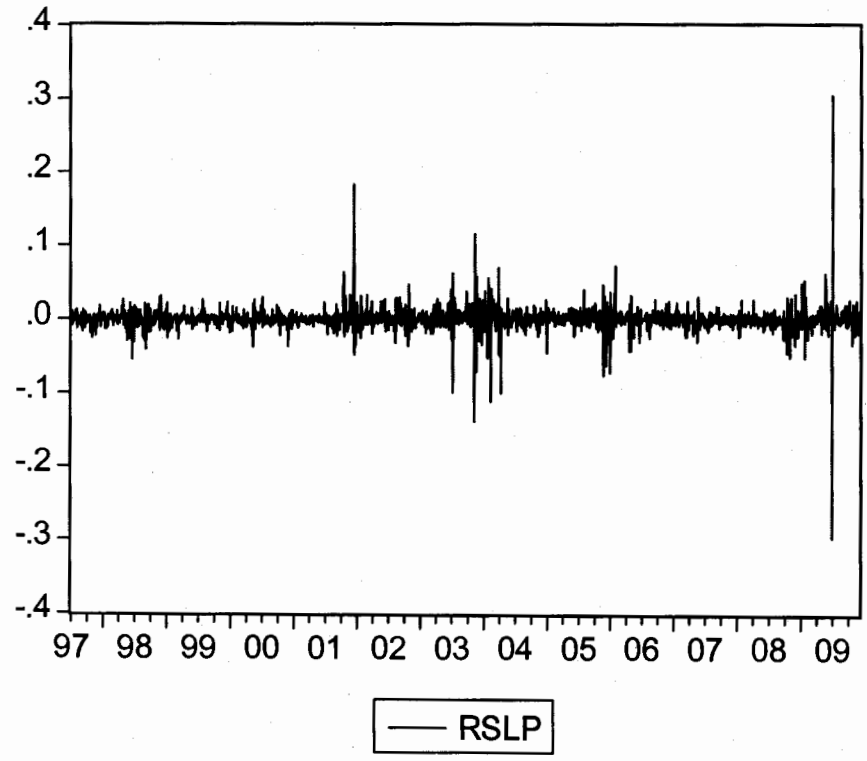
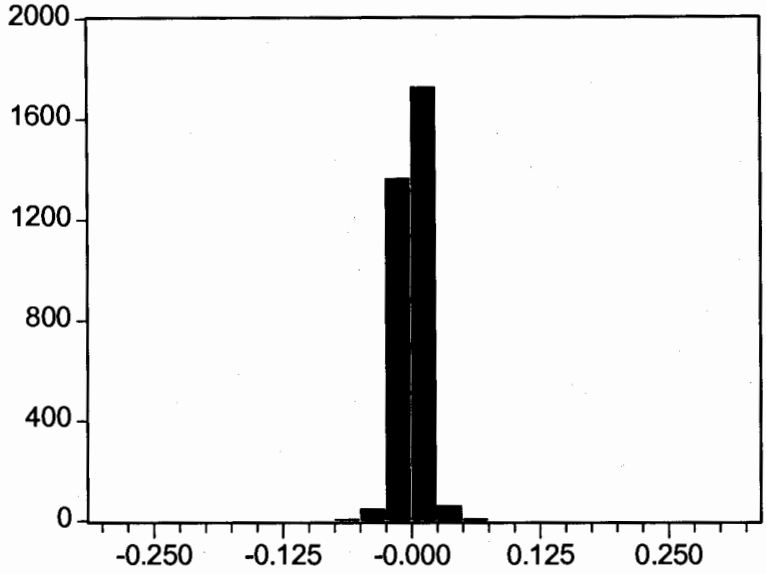


Figure 5.8 **CSE, Sensitive Index Histogram for Colombo Stock Returns**



Series: RSLP	
Sample 7/01/1997 11/30/2009	
Observations 3239	
Mean	0.000400
Median	0.000000
Maximum	0.305353
Minimum	-0.296767
Std. Dev.	0.014463
Skewness	0.337844
Kurtosis	134.0848
Jarque-Bera	2319080.
Probability	0.000000

USA

Figure 5.9 **S & P 500 , New York Stock Exchange**

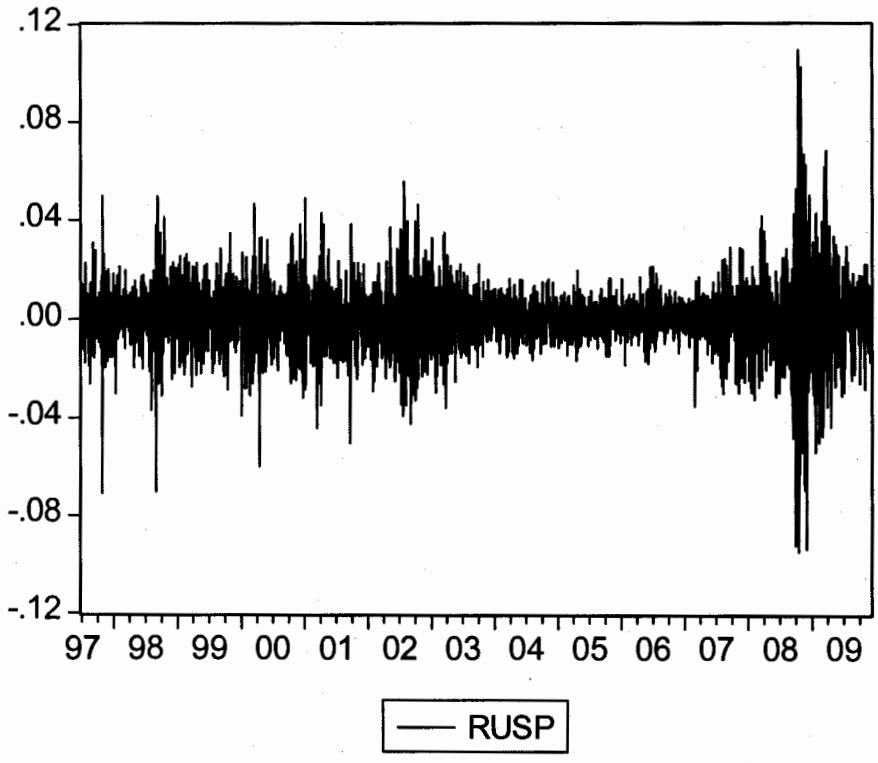
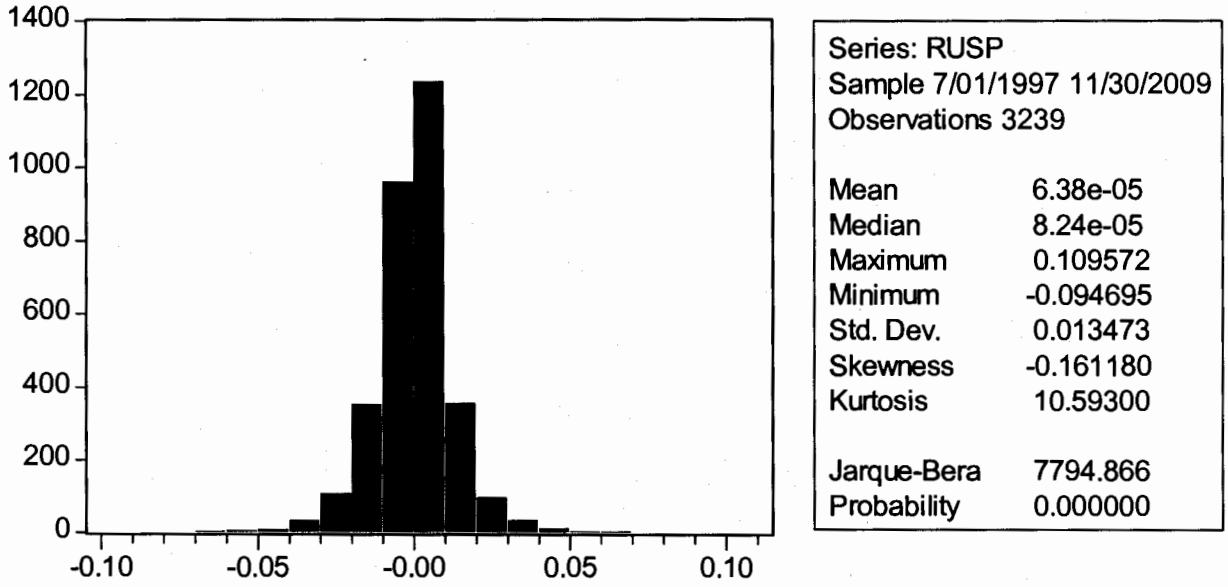


Figure 5.10 **S & P 500, Histogram for New York Stock Returns**



Japan

Figure 5.11 **Nikkei 225, Tokyo Stock Exchange**

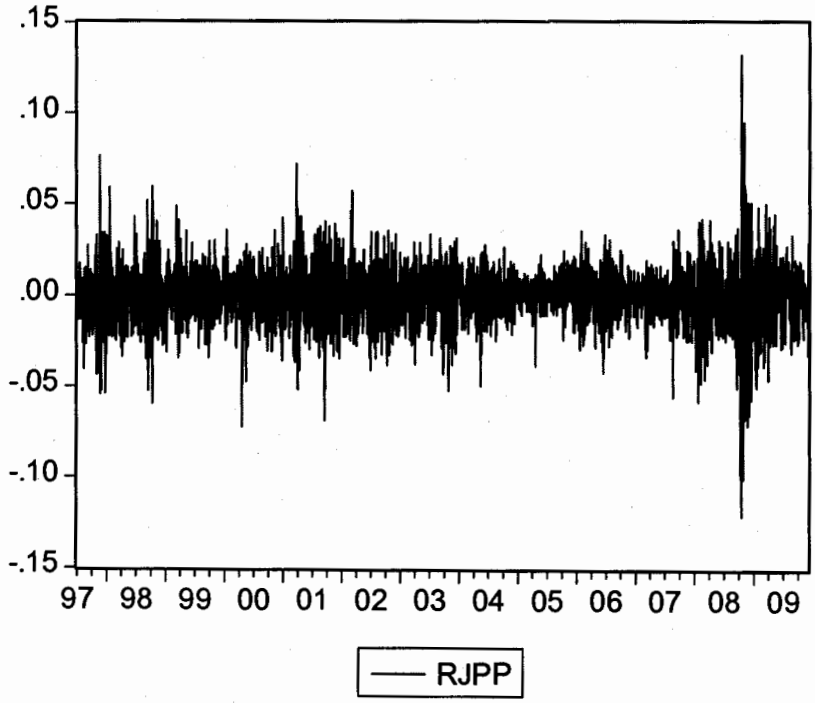
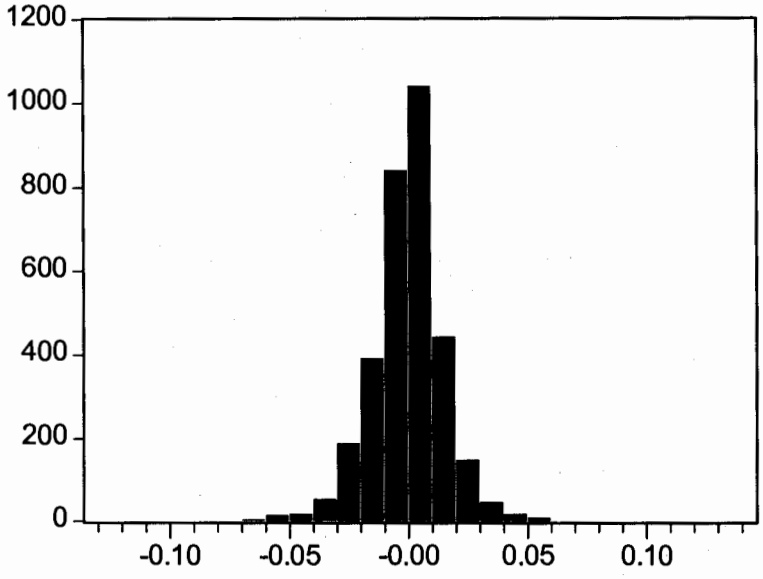


Figure 5.12 **Nikkei 225, Histogram for Tokyo Stock Returns**



Series: RJPP	
Sample 7/01/1997 11/30/2009	
Observations 3239	
Mean	-0.000238
Median	0.000000
Maximum	0.132346
Minimum	-0.121110
Std. Dev.	0.015880
Skewness	-0.223494
Kurtosis	8.934373
Jarque-Bera	4779.763
Probability	0.000000

Singapore

Figure 5.13 STI Index Singapore Stock Exchange

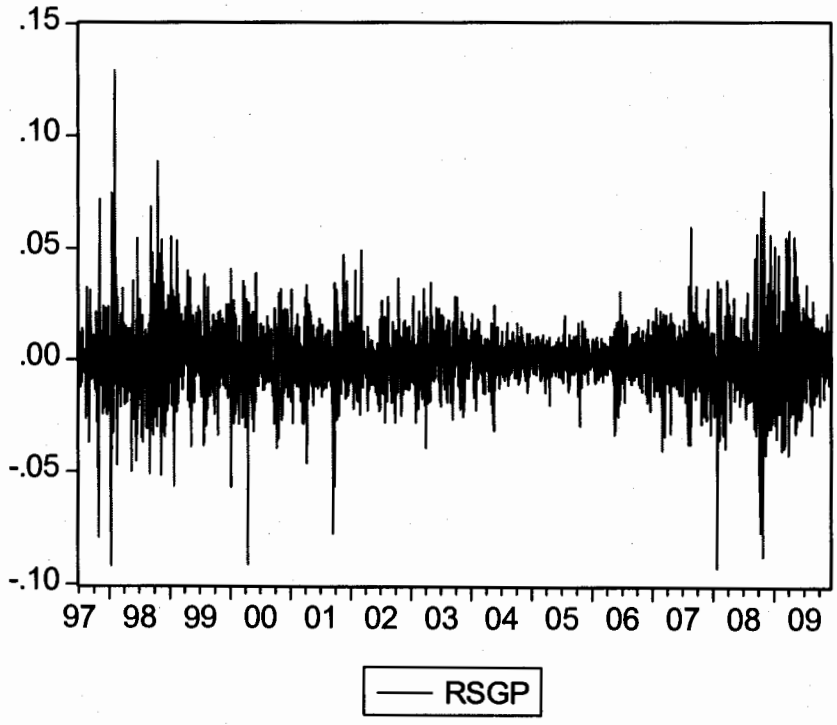
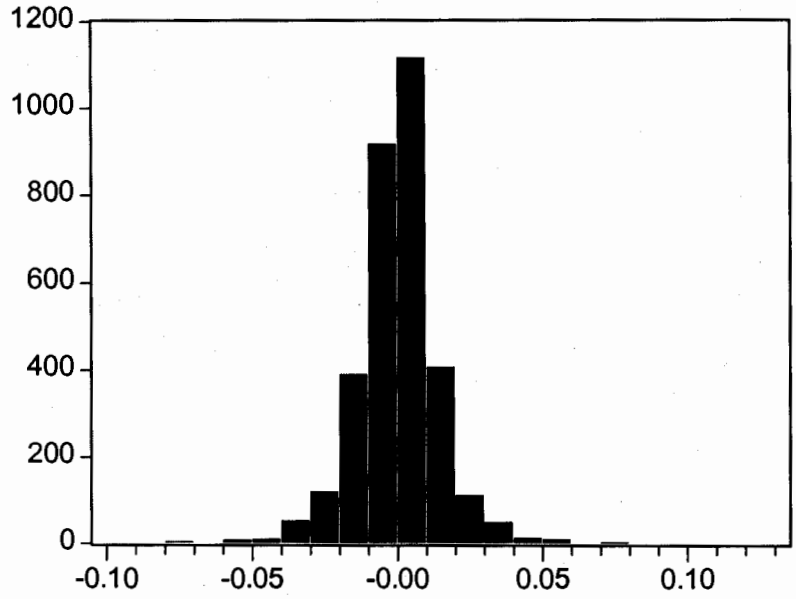


Figure 5.14 **STI, Histogram for Singapore Stock Returns**



Series: RSGP	
Sample 7/01/1997 11/30/2009	
Observations 3239	
Mean	9.92e-05
Median	0.000000
Maximum	0.128738
Minimum	-0.092155
Std. Dev.	0.014863
Skewness	-0.009274
Kurtosis	9.747201
Jarque-Bera	6143.987
Probability	0.000000

United Kingdom

Figure 5.15 **FTSE 100, London Stock Exchange**

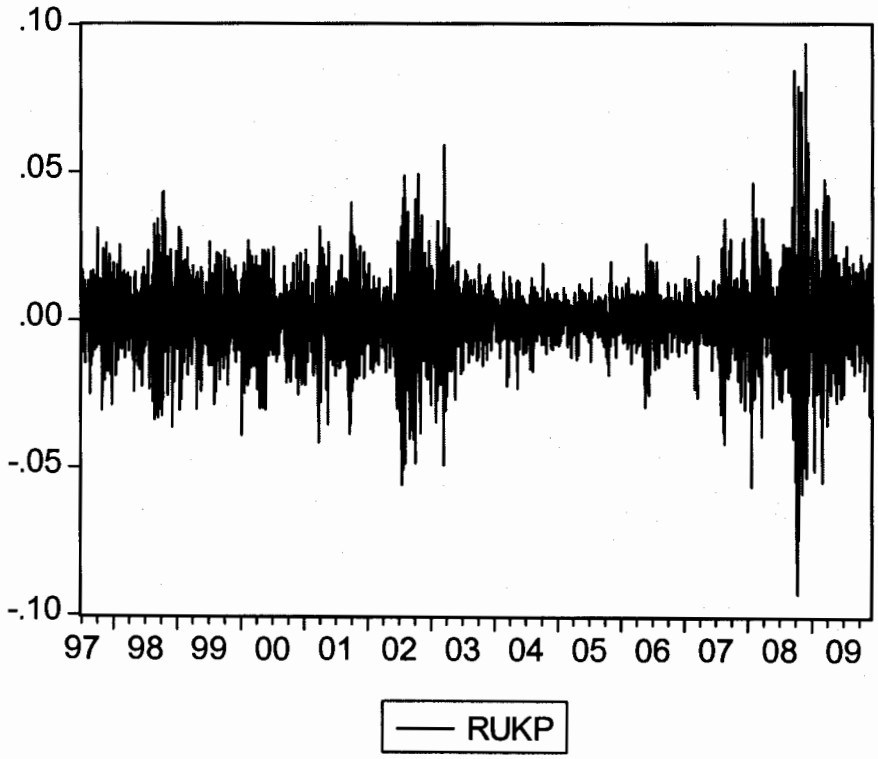
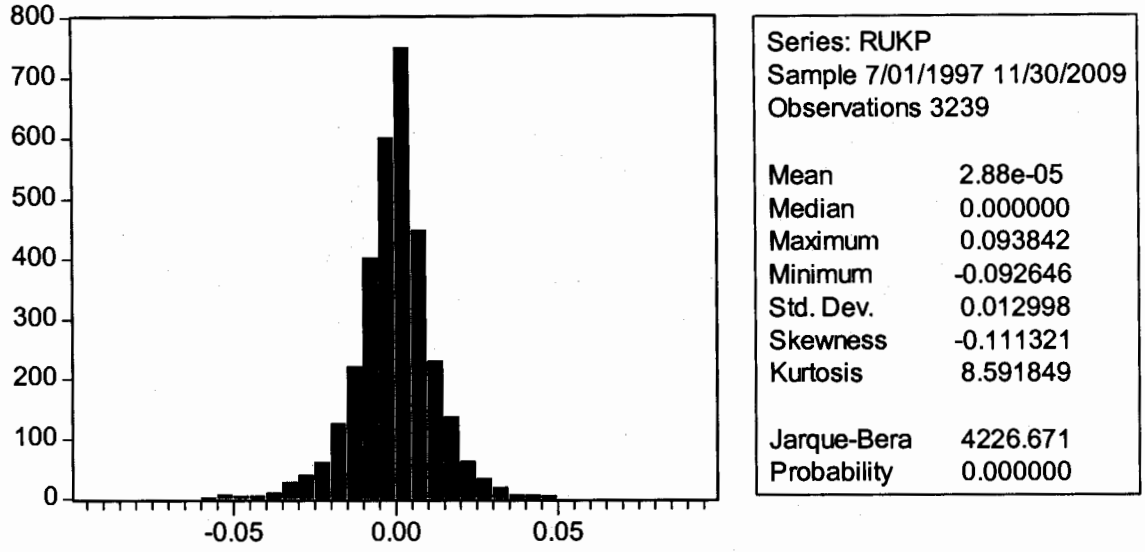


Figure 5.16 **FTSE 100, Histogram for London Stock Returns**



It is already mentioned that when we have to analyze financial time series data then it must be stationary. We can make it stationary by taking its log or first difference. The stationarity of all eight indices has been checked by two methods, Augmented Dickey Fuller and Phillips Perron test. None of the stock indexes is found to be stationary at levels.

Table 5.1 **Stationary Test Values at Level and Log of Indices**

Series	**ADF**	**ADF**	**PP**	**PP**
	Level	First Difference	Level	First Difference
CHP	0.828830	-43.09940	-0.945474	-66.32394
INP	0.049854	-54.05917	-0.058476	-53.32821
JPP	1.959729	-43.16012	-1.815428	-58.81821
PKP	0.539333	-51.29117	-0.632939	-57.51432

SGP	1.375362	-52.18591	-1.332477	-52.27581
SLP	0.153182	-56.54483	0.033418	-56.75710
UKP	1.851296	-26.17919	-2.060613	-59.52923
USP	2.220997	-44.62410	-2.274364	-62.33124

According to MacKinnon critical values, all stats are significant at 1%.

Stock Returns process determination using ARMA models

As discussed in chapter 4, by using ARMA model the first difference of log (i.e. stock returns) of all 8 indices have been taken, to find an appropriate lag length used for AR and MA process. Then every stock return series has been estimated without taking any lag of AR and MA process. After that the correlogram has been checked for existence of any type of serial correlation. To examine the existence of serial correlation Auto Correlation Function (ACF) and Partial Autocorrelation Function (PACF) have been used. If serial correlation is present in any of the series then one AR process or MA process have been added and again checked for the presence of serial correlation. We did this process in continuation until we found the correlogram without any serial correlation. This absence showed that every type of effect from previous AR and MA terms has been properly incorporated into the ARMA model. Other famous criteria to choose appropriate lag length are Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SIC). From the above mentioned information criteria the model with lower value is better. The results for ARMA process of all eight indices are as follows:

Table 5.2 ARMA MODEL for Pakistani Stock Returns

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000491	0.000433	1.133482	0.2571
AR(1)	0.887260	0.052853	16.78730	0.0000
MA(1)	-0.878086	0.053917	-16.28602	0.0000
MA(2)	-0.260556	0.022525	-11.56757	0.0000
MA(3)	0.247104	0.018465	13.38223	0.0000

On the basis of ACF and PACF, we decided to take autoregressive terms in this process. For Pakistani stock returns is ARMA (1, 3) process.

Table 5.3 ARMA Model for Indian Stock Returns

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000422	0.000301	1.403184	0.1607
AR(1)	0.365060	0.026928	13.55704	0.0000
AR(2)	-0.940032	0.026754	-35.13631	0.0000
MA(1)	-0.358372	0.032877	-10.90041	0.0000
MA(2)	0.909447	0.032683	27.82622	0.0000

On the basis of ACF and PACF, and also using AIC and SBC criterion we take autoregressive terms in this process. Therefore the Indian stock returns is ARMA (2,2) process.

Table 5.4 ARMA Model for Chinese Stock Returns

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000286	0.000354	0.808249	0.4190
AR(1)	0.373747	0.207881	1.797893	0.0723
AR(2)	-0.164044	0.071485	-2.294795	0.0218
MA(1)	-0.643427	0.207474	-3.101239	0.0019
MA(2)	0.270081	0.073323	3.683418	0.0002

On the basis of ACF and PACF, and also using AIC and SBC criterion we take autoregressive terms in this process. Therefore the Chinese stock returns is ARMA (2,2) process.

Table 5.5 ARMA Model for Sri Lankan Stock Returns

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000380	0.000325	1.168582	0.2427
AR(1)	0.939427	0.041466	22.65530	0.0000
MA(1)	-0.936277	0.044784	-20.90651	0.0000
MA(2)	-0.029785	0.024074	-1.237217	0.2161
MA(3)	0.043350	0.018087	2.396723	0.0166

On the basis of ACF and PACF, and also using AIC and SBC criterion we take autoregressive terms in this process. Therefore the Sri Lankan stock returns is ARMA (1, 3) process.

Table 5.6 ARMA Model for USA Stock Returns

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.44E-05	0.000196	0.277756	0.7812
AR(1)	0.483044	0.125111	3.860915	0.0001
MA(1)	-0.570500	0.117392	-4.859786	0.0000

On the basis of ACF and PACF, and also using AIC and SBC criterion take different autoregressive terms in this process. Therefore the USA stock returns is ARMA (1,1) process

Table 5.7 ARMA Model for UK Stock Returns

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.88E-05	0.000188	0.152938	0.8785
AR(1)	-0.490313	0.098639	-4.970764	0.0000
MA(1)	0.458993	0.097923	4.687302	0.0000
MA(2)	-0.070677	0.019380	-3.646928	0.0003
MA(3)	-0.147204	0.017480	-8.421191	0.0000

On the basis of ACF and PACF, and also using AIC and SBC criterion take different autoregressive terms in this process. Therefore the UK stock returns is ARMA (1,3) process

Table 5.8 ARMA Model for Japan's Stock Returns

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000234	0.000244	-0.959010	0.3376
AR(1)	0.636477	0.166004	3.834101	0.0001
MA(1)	-0.682510	0.157308	-4.338697	0.0000

On the basis of ACF and PACF, and also using AIC and SBC criterion we take different autoregressive terms in this process. Therefore the Japan stock returns is ARMA (1,1) process

Table 5.9 ARMA Model for Singapore Stock Returns

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.97E-05	0.000283	0.352629	0.7244
AR(1)	0.450943	0.003861	116.8049	0.0000
AR(2)	-0.985376	0.003982	-247.4498	0.0000
MA(1)	-0.370878	0.017867	-20.75788	0.0000
MA(2)	0.953638	0.008645	110.3107	0.0000
MA(3)	0.089286	0.017645	5.060117	0.0000

On the basis of ACF and PACF, and also using AIC and SBC criterion we take autoregressive terms in this process. Therefore, the UK stock returns is ARMA (2,3) process

Univariate Exponential GARCH Estimation

Nelson (1991) proposes the Exponential GARCH (EGARCH) model with the objective to take care of the shortcomings that occurred while using the original GARCH estimation. In particular, to allow for asymmetric effects between positive and negative asset returns. As mentioned earlier, the original EGARCH is again reproduced below to understand the coefficients provided in the table 5.10.

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i u_{t-i}^2$$

Exponential Garch helps to capture the impact of Leverage Effect

$$\log \sigma_t^2 = \gamma_0 + \sum_{i=1}^{s} \theta_i \log \sigma_{t-i}^2 + \sum_{i=1}^{r} \gamma_i \frac{|\varepsilon_{t-i}|}{\sqrt{\sigma_{t-i}^2}} + \sum_{i=1}^{r} \nu_i \frac{|\varepsilon_{t-i}|}{\sqrt{\sigma_{t-i}^2}}$$

Table 5.10 Univariate EGARCH Coefficients from Variance

		γ 0	γ 1	υ_1	Θ
Pakistan	EGARCH(1,1)	-2.663880 (0.0000)	0.804289 (0.0000)	-0.365014 (0.0000)	0.739310 (0.0000)[12]
China	EGARCH(1,1)	-6.817311 (0.0723)	0.821501 (0.0000)	-0.455377 (0.0000)	0.197053 (0.0000)
India	EGARCH(1,1)	-0.502159 (0.0000)	0.217991 (0.0000)	-0.089741 (0.0000)	0.959491 (0.0000)
Sri Lanka	EGARCH(1,1)	-0.423977 (0.0000)	0.368463 (0.0000)	-0.063383 (0.0000)	0.979094 (0.0000)
USA	EGARCH(1,1)	-0.197618 (0.0000)	0.089416 (0.0000)	-0.121868 (0.0000)	0.985758 (0.0000)
Japan	EGARCH(1,3)	-0.131342 (0.0000)	0.063851 (0.0000)	-0.030580 (0.0000)	2.121768 (0.0000)
Singapore	EGARCH(1,1)	-0.176364 (0.0000)	0.120885 (0.0000)	-0.059095 (0.0000)	0.990171 (0.0000)
UK	EGARCH(1,1)	-0.186183 (0.0000)	0.099064 (0.0000)	-0.100051 (0.0000)	0.987923 (0.0000)

[12] Prob. value

The above table is representing the results of the Univariate EGARCH Model for all eight stock markets. The coefficient υ_1 is testing the asymmetric relationship. It shows that market is more volatile while falling in comparison to period of boom with similar magnitude. This is known as Leverage Effect. It creates the phenomenon that good news creates less volatility than bad news of the same magnitude. All indices of eight markets are showing the presence of leverage effect. This effect seems very strong in China showing coefficient of -0.455377, in Pakistan showing coefficient of -0.36501 and -0.08974 is for India. While in Japan Leverage Effect seems to be the least at -0.030580.

The coefficient θ is very important from GARCH model. It basically shows the persistence of volatility. A significant value of θ_1 shows that any shock to the market, will protract the conditional forecasted variances, whether from good news or bad news. For China this coefficient seems to be least showing that less conditional volatility persists there. For all other stock indices this coefficient is very high that means, high conditional volatility persist there.

The graphs of these conditional volatilities have also been extracted from EGARCH Model. Figure 5.17 to 5.24 are giving over view of variation in these stock indices over time. From theses graphs we can see mix result regarding volatilities situation in all these eight countries.

Figure 5.17 **KSE 100, Conditional Volatility**

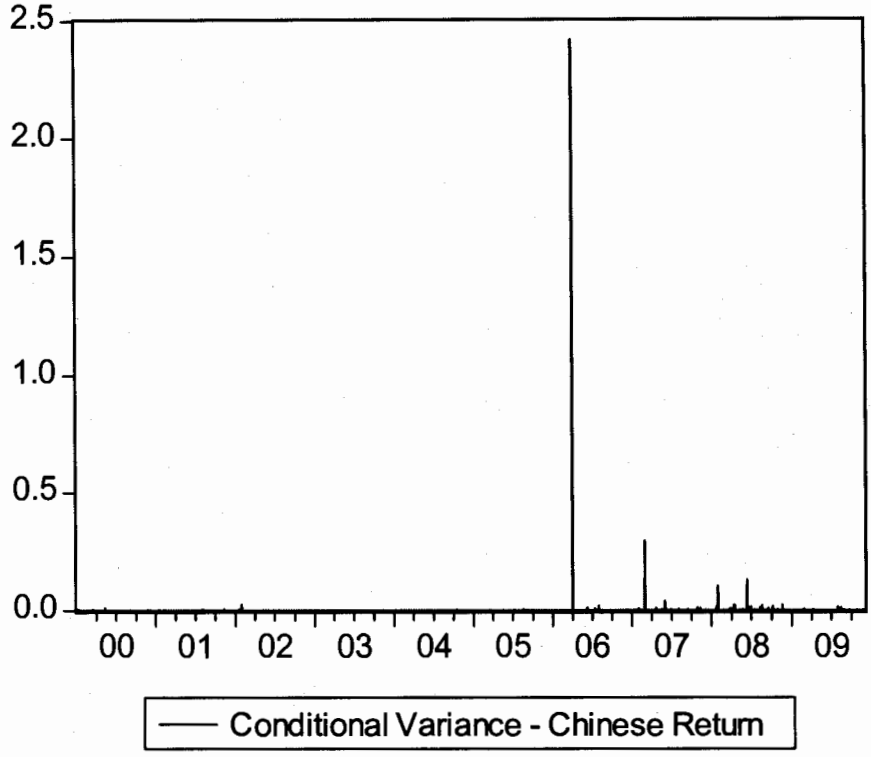


Figure 5.18 **SSE, Conditional Volatility**

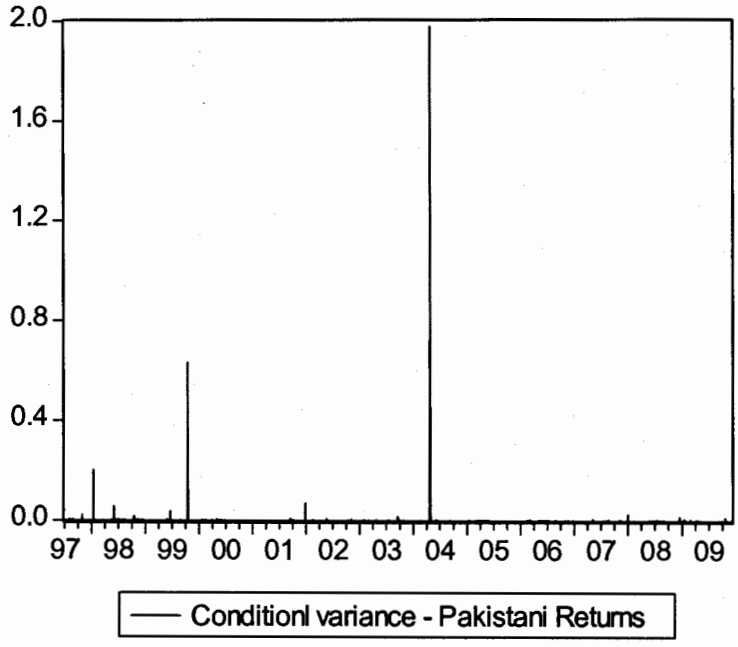


Figure 5.19 **BSE 200, Conditional Volatility**

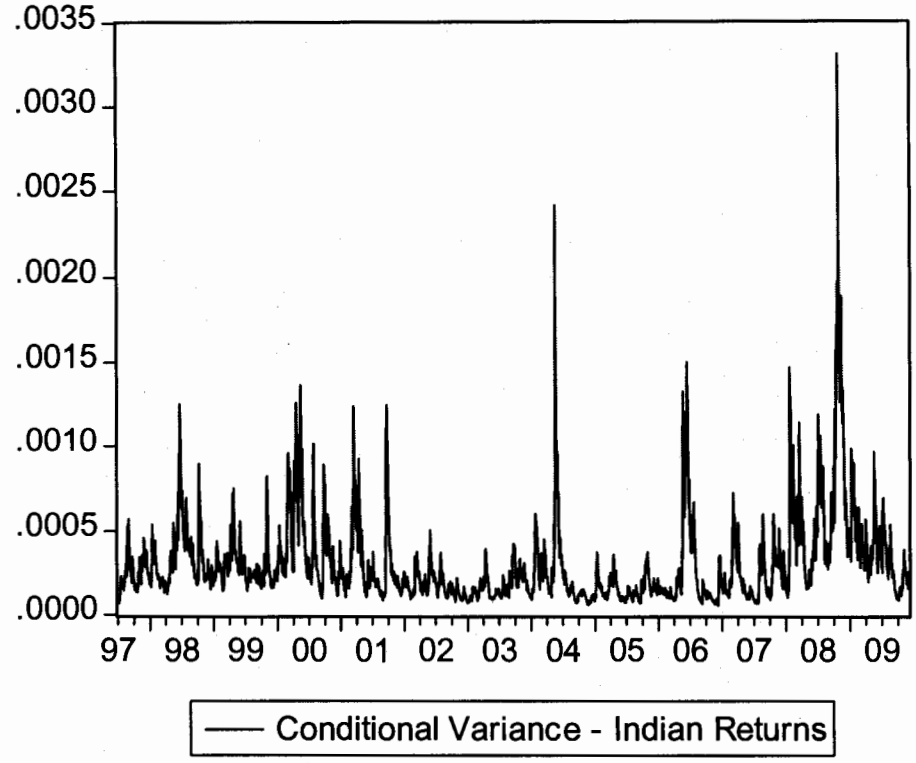


Figure 5.20 **CSE , Conditional Volatility**

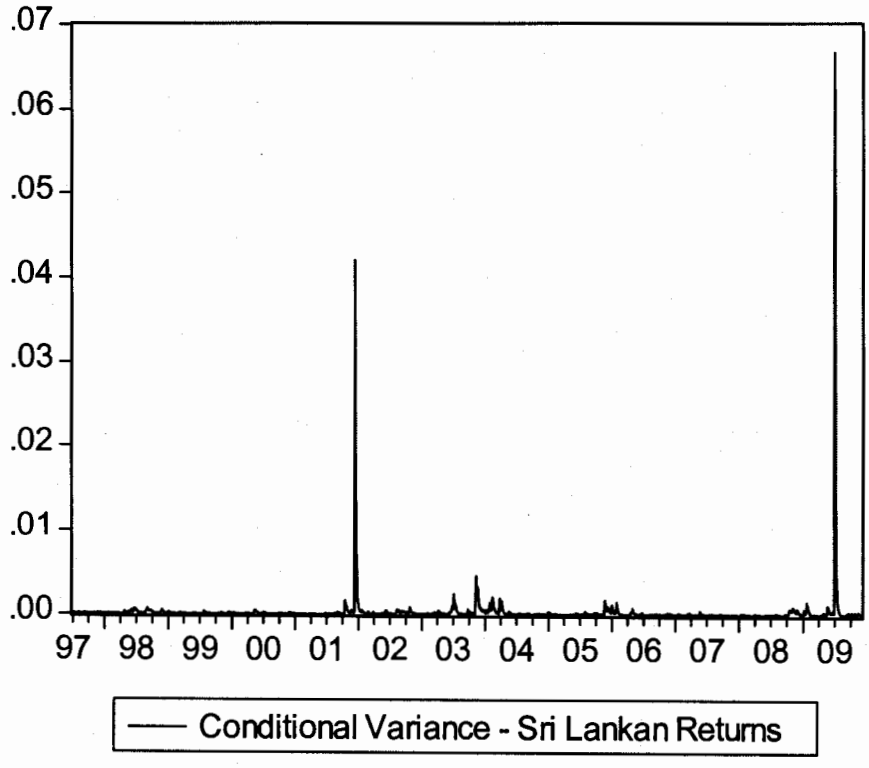


Figure 5.21 **S&P 500, Conditional Volatility**

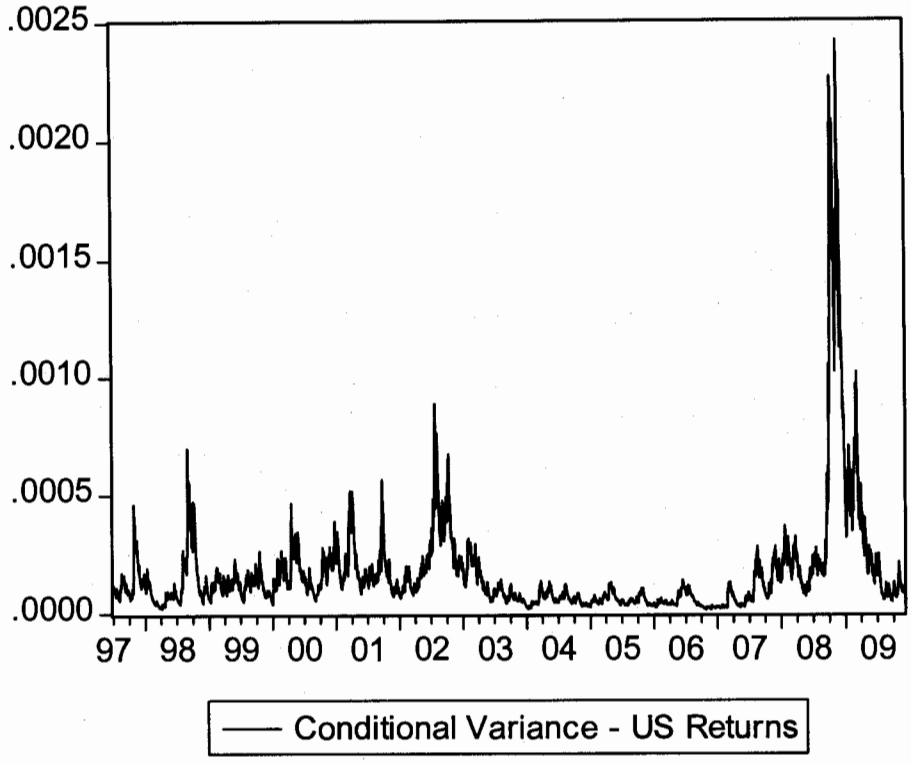


Figure 5.22 **STI, Conditional Volatility**

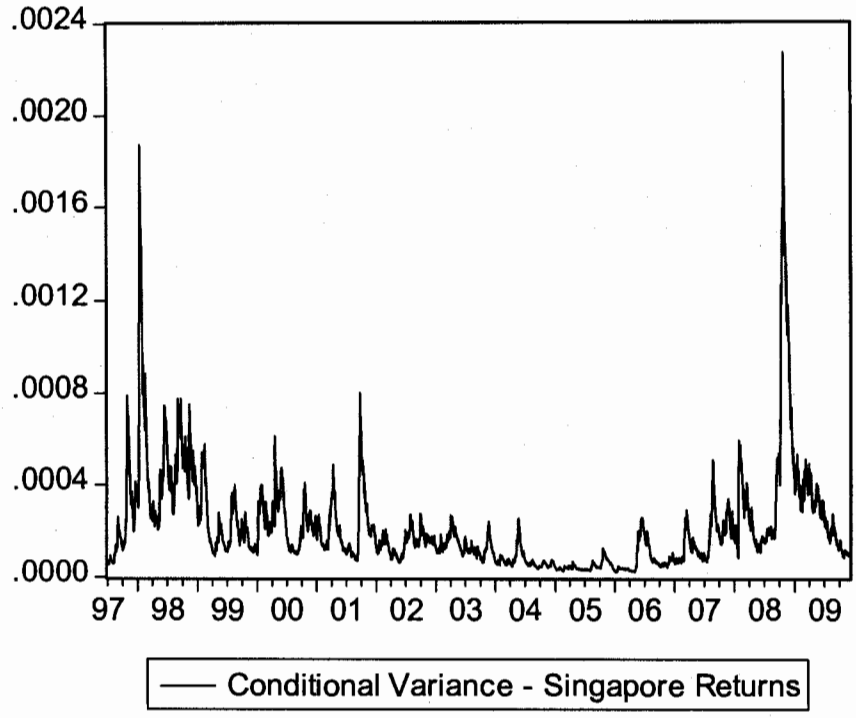


Figure 5.23 **Nikkei 225, Conditional Volatility**

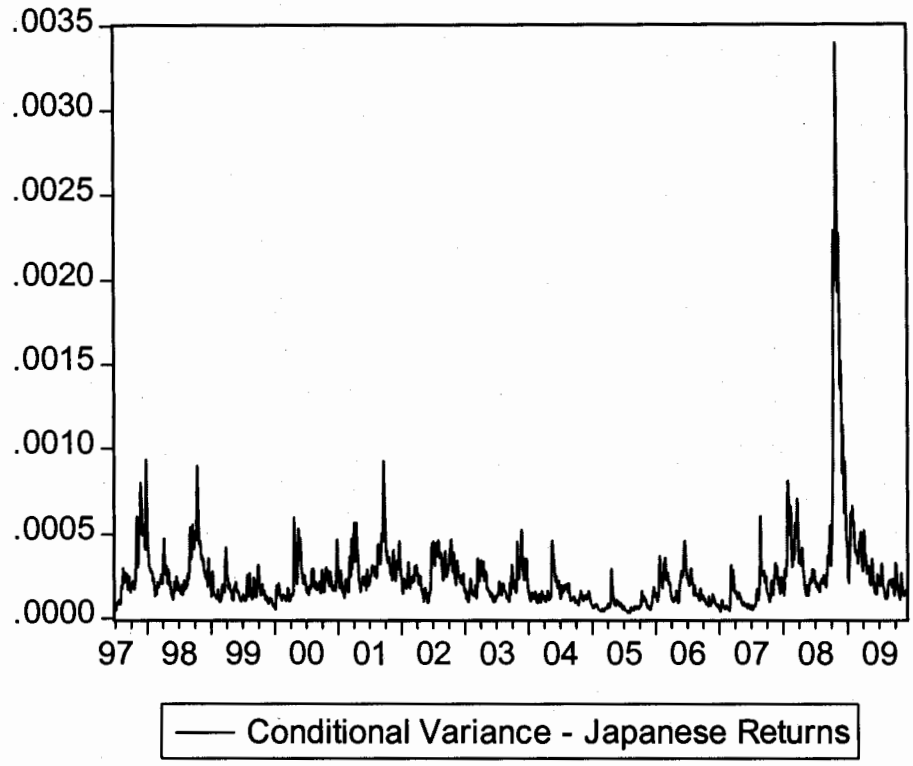
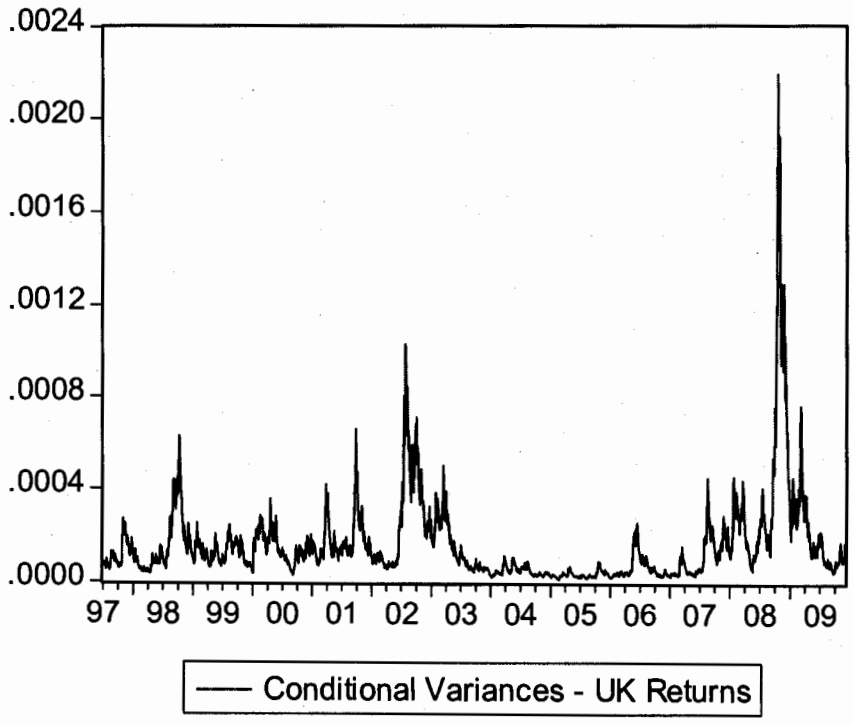


Figure 5.24 **FTSE, Conditional Volatility**



Bivariate EGARCH Estimation

As we are examining volatility transmission in this study so it is important to check the existence of transfer of volatility from one country to another country. To see the persistence of shocks within the market EGARCH model helps. It basically examines the existence of shocks on the basis of its previous regresses and white noise error term. The lag value of conditional volatility of each market has been added as explanatory variable in the variance equation of other markets to estimate pair wise bi variate EGARCH. The bi variate EGARCH model is

$$\log \sigma_{t,m}^2 = \gamma_0 + \theta \log \sigma_{t-i,m}^2 + \gamma \frac{|\varepsilon_{t-1,m}|}{\sqrt{\sigma_{t-1,m}^2}} + \nu \frac{|\varepsilon_{t-i}|}{\sqrt{\sigma_{t-i}^2}} + \delta \sigma_{t-1,n}^2$$

Where m is the primary country and n is the country whose transmission is to be estimated. The coefficient δ will estimate the transmission between both countries. The volatility transmission is expected to happen in those countries which have some similarities. These common strands can be in real economy sector, dependence of international portfolio investors, same channel of lending and borrowing, and herd behavior or some other reasons.[13] If the coefficient of volatility transmission δ has been significant then we will reject null hypothesis of no volatility transmission

[13] Piesse Jennifer and Hearn Bruce (2005)

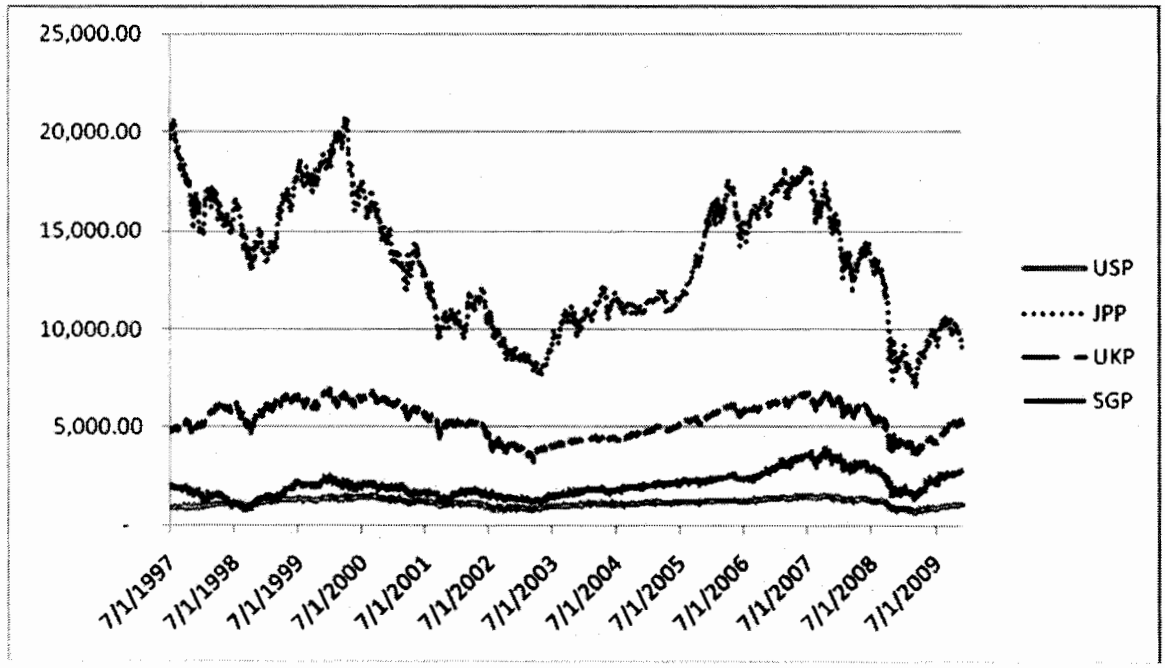
Table 5.11 Bivariate EGARCH coefficient (1997-2009)

Transmission → From	Pakistan	China	India	Sri Lanka	United States	Japan	Singapore	United Kingdom
Pakistan	-	-0.615331 (0.2958)	165.1081 (0.0000)*	0.234412 (0.9229)	174.0798 (0.0000)*	131.1359 (0.0003)*	265.8189 (0.0000)*	142.9915 (0.0011)*
China	0.159537 (0.8445)		412.7541 (0.0000)*	2.004801 (0.8646)	159.8035 (0.0280)**	229.5623 (0.0010)*	206.1466 (0.0276)**	178.2306 (0.0568)***
India	0.057726 (0.0132)**	0.258280 (0.4054)		1.270553 (0.0103)**	56.43401 (0.0022)*	28.49722 (0.0780)***	112.3108 (0.0000)*	39.77318 (0.0434)**
Sri Lanka	0.703219 (0.0826)***	0.988721 (0.0000)*	12.85071 (0.0633)**		15.75047 (0.0982)***	5.364187 (0.6761)	32.77531 (0.0027)*	16.78288 (0.2400)
United States	0.027839 (0.0441)**	0.063216 (0.7198)	2.705008 (0.7240)	0.339640 (0.3909)		4.260571 (0.6197)	29.86536 (0.0008)*	63.49317 (0.0014)*
Japan	0.167971 (0.0087)*	0.002987 (0.9795)	10.34108 (0.0090)*	0.2501109 (0.4470)	26.30058 (0.0015)*		27.12383 (0.0015)*	33.41359 (0.0012)*
Singapore	0.017916 (0.2869)	0.441977 (0.0012)*	-17.66736 (0.0074)*	0.487484 (0.4203)	8.512162 (0.3065)	5.402141 (0.4579)		9.161428 (0.3906)
United Kingdom	0.002989 (0.8232)	0.096674 (0.7469)	3.899886 (0.6031)	0.073478 (0.8876)	9.094892 (0.3415)	3.256090 (0.6662)	18.31185 (0.3906)	

*, ** and *** represents the significance at 1%, 5% and 10% respectively.

The hypothesis that volatility transferred from country m to country n is accepted if value of coefficient δ is significantly different from zero, In case of Pakistan volatility transmission from developed countries (United States, Japan, Singapore and United Kingdom) has been investigated, and transmission from these markets is found significant at α=1%. We can see that these markets are influential. Therefore, transmission is expected from them to Pakistani Markets.

Figure 5.25 Volatility of USP, JPP, UK & SGP



Volatility transmission in the market of China has been examined. The results showed that transmission from Japan is significant at α=1% whereas, from United States and Singapore it is significant at 5% level. The volatility coefficient for Chinese stock market is insignificant from Pakistan and Sri Lanka whereas significant from India.

The volatility transmissions from developed countries (United States, Japan, Singapore and United Kingdom) to Indian stock market are giving mix results. The volatility coefficient of USA and Japan for Indian market is significant at α=1%. Whereas it is significant at α=5% only from United Kingdom. One reason of significant value of USA for Indian stock market can be the increasing role of United States in Indian affairs in last few years. Although volatility transmission from India to China is present but from China to India it is not. This result is showing that there is no evidence of bi variate transmission between these two countries.

For Sri Lankan stock market volatility coefficient of United Kingdom and Japan is insignificant whereas, it is significant at α=10% only from United States. It can be due to less direct connection with other major world markets. The volatility transmission from China is significant at α=1%, from India at α=5% and from Pakistan it is significant only at α=10%. The reason can be regional issues or less integration from United States which is World's largest financial market.

The volatility coefficient for United States is insignificant from China, India and Sri Lanka and from Pakistan it is significant at α=5%. This insignificance from India and Sri Lanka was predictable but significant value from Pakistan is unexpected. Whereas transmission from United Kingdom and Singapore is significant at α=1%. It can be due to increasing integration among world markets in recent years.

The transmission coefficients into the market of Japan can be predictable .For example transmission is significant from United States, United Kingdom and Singapore at α=1%. The reason for this can be the trade relations of Japan with these

countries. Unexpectedly, United Kingdom and Singapore has no significant transmission from United States and Japan. In the same way no significant volatility transmission can be predicted nor can be found from Pakistan, China, India and Sri Lanka to United Kingdom. The markets of Singapore seem to have transmission of volatility from China and India. Where as no significant transmission is evidenced from Pakistan and Sri Lanka. The volatility transmission hypothesis is also rejected from United States, United Kingdom and Japan. It was unexpected whereas, some other unpredictable results are also found e.g. the volatility transmission from Pakistan to Japan (α= 0.0087)*, the volatility transmission from Pakistan to United States (α= 0.0041)**, and the rejection of hypotheses of volatility transmission of all seven countries (United States, Japan, Singapore, Pakistan, China, India and Sri Lanka) to United Kingdom.

Table5.12 Correlation Matrix

	RUSP	RUKP	RSLP	RSGP	RPKP	RJPP	RINP	RCHP
RUSP	1							
RUKP	0.4999	1						
RSLP	-0.0032	0.0449	1.					
RSGP	0.2153	0.3911	0.0691	1				
RPKP	0.0191	0.0267	5.87E-05	0.0651	1			
RJPP	0.1128	0.3071	0.0431	0.5107	0.0319	1		
RINP	0.1989	0.3148	0.0323	0.4738	0.0614	0.3233	1	
RCHP	0.0143	0.0392	0.0076	0.1373	0.0129	0.1221	0.1018	1

Table above displays the result of correlation analysis among equity markets of Pakistan, China, India and Sri Lanka. There is no significant correlation exists among major South Asian equity markets. Indian equity market is more correlated with major world equity markets than Pakistan and China.

5.2 CO INTEGRATION ANALYSIS

In order to check the dynamic relationships among the eight stock markets we tested for long run relationship among the logarithm of the eight stock indices.

Table 5.13 Multivariate Co integration Analysis Trace Statistics (Pakistan, China, India and Sri Lanka)

Hypothesized No. of CE(s)	Eigen value	Statistic	Critical Value
None *	0.11450	54.07264	47.85613
At most 1	0.007021	24.32604	29.79707
At most 2	0.00187	6.125627	15.49471
At most 3	0.000583	1.506962	3.841466

Trace test indicates 1 cointegrating egn(s) value at the 0.05 level.
*denotes rejection of the hypothesis at 0.05 level.
**Mackinnon Haug-Michelis (1999) p-values

Above table displays the results of the Multivariate Co integration Analysis for Pakistan, China, India and Sri Lanka. Model is applied under the assumption of constant and linear trend in the co-integration vector. Lags are chosen to minimize SIC (Schwarz Criterion) and set at 1 in first order differences. Trace test indicates one co-integrating vector at the 0.05 level. Maximum Eigen value test also confirms the presence of one co-integrating vector at $\alpha = 0.05$. Thus Trace Test Statistics lead to a rejection of null hypothesis of no co integrating relationship, but not the null hypothesis of at least one co integrating vector. As they will move together in long run, there can be possibility of short deviation yet when long run relationships are present between those markets. We examined this between the Pakistani equity markets with other Asian markets by following error correction model:

$$\Delta PK_t = \alpha_0 + \gamma Y_{t-1} + \sum_{j=1}^{p} \alpha_{1j} \Delta PK_{t-j} + \sum_{j=1}^{p} \alpha_{2j} \Delta CH_{t-j} + \sum_{j=1}^{p} \alpha_{3j} \Delta IN_{t-j} + \sum_{j=1}^{p} \alpha_{4j} \Delta SL_{t-j} + \varepsilon_t$$

Where $Y_{t-1} = PK_{t-1} - \beta_1 CH_{t-1} - \beta_2 IN_{t-1} - \beta_3 SL_{t-1}$.

Vector Error Correction Model is a restricted VAR for co-integration analysis. It is designed for using non-stationary series that are known to be co-integrated. The VECM restricts the long-run behavior of variables to converge to their co-integrating relationships. Co-integrating term is known as the error correction term because the deviation from long-run equilibrium is steadily corrected through partial short-run modifications. The results from the co-integration equation for Pakistan's case with selected Asian countries are presented in Table 1 (Appendix A); it is found that with all selected countries the coefficients of error correction are found positive and statistically significant. This means that except Sri Lankan case all the selected countries are showing no such signs of convergence and hence suggesting no long run stability in the model.

Table 5.14 Multivariate Co integration Analysis Trace Statistics (Pakistan, USA, UK, Japan and Singapore)

Hypothesized No. of CE(s)	Eigenvalue	Statistic	Critical Value
None *	0.012765	94.76424	88.80380
At most 1	0.009011	53.16648	63.87610
At most 2	0.004146	23.85679	42.91525
At most 3	0.002449	10.40535	25.87211
At most 4	0.000762	2.467100	12.51798

Trace test indicates 1 cointegrating egn(s) value at the 0.05 level.
*denotes rejection of the hypothesis at 0.05 level.
**Mackinnon Haug-Michelis (1999) p-values

When we investigated integration of markets of Pakistan with developed countries United States, United Kingdom, Japan and Singapore then we found 1 co integrating vector at the 0.05 level. Max Eigen value test also confirms the presence of 1 co integrating vectors at $\alpha = 0.05$.

The results from the co-integration equation for Pakistan's case with selected developed block are presented in Table 2 (Appendix A); it is found that with all selected countries the coefficients of error correction are found negative but statistically insignificant. This is inconclusive as far as long run stability in the model is concerned.

5.15 Multivariate Co integration Analysis Trace Statistics (China, USA, UK, Singapore and Japan)

Hypothesized No. of CE(s)	Eigenvalue	Statistic	Critical Value
None *	0.020081	99.60042	88.80380
At most 1	0.007992	47.20256	63.87610
At most 2	0.005658	26.47648	42.91525
At most 3	0.002889	11.82038	25.87211
At most 4	0.001682	4.347550	12.51798

Trace test indicates 1 cointegrating egn(s) value at the 0.05 level.
*denotes rejection of the hypothesis at 0.05 level.
**Mackinnon Haug-Michelis (1999) p-values

When we investigated integration of China with developed countries United States, United Kingdom, Japan and Singapore then we found 1 co integrating vector at the 0.05 level. Max Eigen value test also confirms the presence of 1 co integrating vectors at $\alpha = 0.05$.

The results from the co-integration equation for China's case with selected developed countries are presented in Table 3 (Appendix A); it is found that with all selected countries the coefficients of error correction are found negative and statistically significant except for US whose VEC coefficient is found positive. This means that except USA all the selected countries are showing signs of convergence and hence suggesting no long run stability in the model for China.

5.16 Multivariate Co integration Analysis Trace Statistics of (India, USA, UK, Singapore and Japan)

Hypothesized No. of CE(s)	Eigenvalue	Statistic	Critical Value
None *	0.009479	91.82867	88.80380
At most 1	0.009021	60.98975	63.87610
At most 2	0.005730	31.64597	42.91525
At most 3	0.003191	13.03842	25.87211
At most 4	0.000830	2.689799	12.51798

Trace test indicates 1 cointegrating egn(s) value at the 0.05 level.
*denotes rejection of the hypothesis at 0.05 level.
**Mackinnon Haug-Michelis (1999) p-values

When we examined integration of India with developed countries United States, United Kingdom, Japan and Singapore then we found 1 co integrating vector at the 0.05 level. Max Eigen value test does not confirm the presence of 1 co integrating vector at $\alpha = 0.05$.

The results from the co-integration equation for India's case with selected developed countries are presented in Table 4 (Appendix A), it is found that with all selected countries the coefficients of error correction are found negative and statistically significant except for US whose VEC coefficient is found positive (just like China's case). This means that except USA all the selected countries are showing signs of convergence and hence suggesting no long run stability in the model for India.

Table 1 (Appendix B) displays the results of the Multivariate Co integration Analysis for Pakistan, China, India and Sri Lanka for data from 2005 to 2009. Lags are chosen to minimize SIC and set at 1 in first differences .Trace test indicates zero co integrating vector at the 0.05 level. Max Eigen test also confirms the absence of any

co integrating vectors at $\alpha = 0.05$. This shows that from 2005 to 2009 correlation among these Asian markets decreased. Although different studies showed increasing integration among markets of other regions[14]. The reason of less integration of these four Asian Markets after 2005 can be their political and regional issues or it can be because of International Financial Crises.

When we took sample from 2005-2009and investigate co integration of Pakistani equity markets with major developed countries USA, UK, Japan and Singapore. The results are presented in Table 2 (Appendix B) .We found presence of long run equilibrium among theses markets. This shows portfolio diversification chances are decreasing among these equity markets.

Result for China (2005-2009) presented in Table 3 (Appendix B) with major developed countries USA, UK, Singapore and Japan showed the increasing integration among these markets. According to Trace statistics there is 1 co integrating equation at the 0.05 level. Maximum Eigen values indicate test indicates 2 co integrating eqn(s) at the 0.05 level. That's why; international investors' benefits of portfolio diversification, by reducing risk, in these markets are declining.

A bivariate analysis has also been performed to explore the possibility of pair wise long term relation ship among Stock market indices and results are displayed in table below

[14] Elfakhani Said, Arayssi Mahmoud and Smahta Hanin A.(2008), " Globalization and Investment Opportunities, A Co integration Study of Arab, U.S. and Emerging Stock Markets". The Financial Review 43 (2008) , 591- 611

Table 5.17 Bivariate Co integration Analysis Trace Statistics (Pakistan, China, India, Sri Lanka)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value
PKP & CHP			
None	0.000777	3.822474	15.4947
At most 1	0.000702	1.814051	3.8415
PKP& INP			
None	0.001716	5.887374	15.4947
At most 1	0.000101	0.326651	3.8415
PKP& SLP			
None	0.003285	10.68547	15.4947
At most 1	1.06E-05	0.034164	3.8415
CHP & INP			
None	0.002124	5.854938	15.4947
At most 1	0.000141	0.363274	3.8415
CHP & SLP			
None	0.001091	3.702289	15.4947
At most 1	0.000342	0.883267	3.8415
INP & SLP			
None	0.003062	9.948637	15.4947
At most 1	5.77E-06	0.018674	3.8415

Trace test indicates no cointegrating egn(s) value at the 0.05 level.
*denotes rejection of the hypothesis at 0.05 level.
**Mackinnon Haug-Michelis (1999) p-values

Table 5.18 Bivariate Co integration Analysis Trace Statistics (Pakistan, USA, UK Singapore and Japan)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value 0.05
PKP & USA			
None	0.001530	5.202406	15.4947
At most 1	7.61E-05	0.246390	3.8415
PKP& UK			
None	0.001665	5.692997	15.4947
At most 1	9.21E-05	0.298188	3.8415
PKP& SGP			
None	0.001945	6.512361	15.4947
At most 1	6.51E-05	0.210866	3.8415
PKP &JPP			
None	0.001216	4.346069	15.4947
At most 1	0.000126	0.407032	3.8415

Trace test indicates no cointegrating egn(s) value at the 0.05 level.
*denotes rejection of the hypothesis at 0.05 level.
**Mackinnon Haug-Michelis (1999) p-values

We can see from results displaying in above tables 5.17 and 5.18 that there is no evidence of Bivariate Co integration among four Asian Markets i.e. Pakistan, China, India and Sri Lanka. We did not find pair wise co integration among Pakistani and all four developed Markets USA, UK, Japan and Singapore also. Results show there is no pair wise long run relationship between these markets.

CHAPTER 6

6.1 Conclusions and Policy Recommendations

This study aims to investigate the presence of volatility transmission and long run relationship among regional equity markets of Pakistan, China, India, and Sri Lanka. China's importance is growing exponentially for its neighboring countries as well as for the whole world. It has very close relations with Pakistan since last many decades. Whereas, Pakistan's relationship with India has showed so many ups and downs since independence of both countries (1947). We tried to find the integration of equity markets of Pakistan and China as well as Pakistan and India. These markets represent a significant part of Asian markets. Many studies showed that regionally integrated markets progress more rapidly than the isolated ones.[15] If countries of same region have long run relationship then chances of optimum currency area increased whereas, diversification strategy to reduce risk is not workable there.

To check the long run relationship and volatility transmission from developed stock markets, stock index of four major developed countries USA, Japan, Singapore and UK have also been taken. To examine the volatility transmission two methodologies have been used. First of all Bi variate Exponential GARCH has been used to check presence of transmission within each pair of all eight countries for the period from July 1997 to December 2009. Secondly, Multivariate as well as bivariate co integration analysis has been employed to check co integration among these equity markets. On the bases of these methodologies, mixed results have been obtained.

[15] Piesse Jennifer and Hearn Bruce (2005), "Regional Integration of Equity Markets In Sub Saharan Africa", South African Journal of Economics, Vol 73:1

- Results obtained provide ample evidence of transmission of volatility between countries on unfriendly terms. It implies presence of volatility transmission from India to Pakistan. We also found that transmission of volatility between India and Pakistan is bi directional. A closer examination of data indicates that among these countries volatility spillover is mostly from a larger market to a smaller market. Some evidence of spillovers from the smaller market to larger market is found. These results clearly show that volatility spillover will take place, even between countries on unfriendly terms, as long as trade and commerce links exist. Whereas null hypothesis of no volatility transmission between Pakistan and China can not be rejected. Although both countries have friendly relations and geographically close to each other. Looking at these results we can say that market behavior is showing indifferent attitude from political issues. So volatility transmits towards and from Pakistan is due to economic factors rather than political and others. Volatility transmits to Pakistan, India and Sri Lanka is due to economic fundamentals instead of herd behavior. India is more speedily integrated with other countries.
- Results between the developed (United States, Singapore, Japan, and United Kingdom) and Asian countries show that volatility transmission is present between friendly countries of different regions with economic links. Ample evidence is provided of volatility spillover from the United States, Singapore, and Japan to these Asian markets, but little evidence of the other way. These results may be due to the economic, trade, and investment link between countries, increased integration of financial markets in recent years, and policy coordination between countries. The significance of the size of the market and importance in the world financial market is clearly backed by this result.

- Johanson and Jusilius Trace Statistics in this study indicated that, Asian markets are integrated within a group. We found one co integrating equation it means long run relationship exists among these equity markets. Thus according to multivariate Co integration analysis markets are integrated and there exist a long term association among these markets. However Bivariate analysis indicates that no pair wise co integration exists among equity markets of China and India which are two major emerging markets of the region. It can be due to low trade between these countries. Thus investors of these two countries can get the benefits of portfolio diversification by investing in these countries. We also found that no pair wise long run relationship exist between Asian markets (China ,India, Pakistan, Sri Lanka) and they are not co integrated pair wise with equity markets of USA, UK, Japan and Singapore. Therefore funds managers of US, UK, Singapore and Japan can get the benefits of portfolio diversification by investing in Asian stock markets.
- Results of shorten sample period 2005-2009 of multivariate and bivariate co integration analysis although show that Asian countries are becoming integrated with major developed countries but with low pace than the countries of other regions. Opportunities of portfolio diversification are still existing here, Hence need to regulate financial sector and resolve political and other internal issues to attract capital inflow all over the world. It's the duty of Government to provide political stability, investor friendly environment and security to international investors to gain foreign direct investment via this channel.

6.2 Limitations of the study

Presence of volatility transmission may lead to very serious financial and economic consequences and can result in economic recession. This recession will be imported to other parts of the world. Volatility transmission and long run equilibrium

relationships of equity markets have multi dimensional aspects and, it is not possible to cover all aspects in single study. The constraints such as short time, lack of resources and data availability etc have restricted the scope and analyses of the study. The availability of data for other South Asian Markets is an issue. The author had the intention to extend the results to other South Asian Markets, but majority of these countries are still trying to develop their financial markets. This is the reason of serious problem in data availability.

6.3 Recommendations for Future Research

There are several areas where research can be done to improve available knowledge. First of all in future research volatility transmission can also be checked among national financial markets or within various sectors, instead of taking one market of a country as a proxy. It can also be investigated within specific sectors for example Energy and Telecom sector.

Secondly, it can be useful to check impact of different economic factors like money supply on volatility transmission of different stock exchanges within country.

Finally, by collecting intraday data from other markets series of regional overnight returns can get to test regional lagged spillover.

APPENDICES

APPENDIX A VECM (Short Run Analysis)

Table 1 Causality in the VECM (Short run Analysis) (Pakistan, China, India and Sri Lanka)

Cointegrating Eq:	CointEq1			
LPKP(-1)	1.000000			
LCHP(-1)	0.015388			
	(0.12687)			
	[0.12129]			
LINP(-1)	0.009763			
	(0.16975)			
	[0.05751]			
LSLP(-1)	-1.255874			
	(0.13048)			
	[-9.62522]			
C	0.302907			
Error Correction:	D(LPKP)	D(LCHP)	D(LINP)	D(LSLP)
CointEq1	-0.014861	-0.002312	-0.003508	0.000637
	(0.00287)	(0.00250)	(0.00192)	(0.00171)
	[-5.17538]	[-0.92489]	[-1.82548]	[0.37240]

Table 2 Causality in the VECM (Short run Analysis)
(Pakistan, USA, UK, Japan, Singapore)

Cointegrating Eq:	CointEq1				
LPKP(-1)	1.000000				
LUSP(-1)	-2.342119				
	(0.70667)				
	[-3.31429]				
LUKP(-1)	6.393280				
	(0.86192)				
	[7.41748]				
LSGP(-1)	-0.077490				
	(0.42011)				
	[-0.18445]				
LJPP(-1)	-3.484644				
	(0.47613)				
	[-7.31870]				
@TREND(7/01/97)	-0.001005				
	(0.00012)				
	[-8.28570]				
C	-11.23768				
Error Correction:	D(LPKP)	D(LUSP)	D(LUKP)	D(LSGP)	D(LJPP)
CointEq1	-0.005341	0.000293	-0.001964	-0.000671	0.002747
	(0.00157)	(0.00080)	(0.00072)	(0.00083)	(0.00082)
	[-3.40312]	[0.36591]	[-2.72821]	[-0.80731]	[3.33556]

Table 3 Causality in the VECM (Short run Analysis)
(China, USA, UK, Japan, Singapore)

Cointegrating Eq:	CointEq1				
LCHP(-1)	1.000000				
LUSP(-1)	24.27552				
	(3.55316)				
	[6.83209]				
LUKP(-1)	-4.150354				
	(2.75433)				
	[-1.50685]				
LSGP(-1)	-15.41228				
	(2.46349)				
	[-6.25626]				
LJPP(-1)	-1.918338				
	(1.78192)				
	[-1.07656]				
@TREND(7/01/97)	0.003616				
	(0.00063)				
	[5.77649]				
C	-14.67625				
Error Correction:	D(LCHP)	D(LUSP)	D(LUKP)	D(LSGP)	D(LJPP)
CointEq1	-0.000868	-0.000565	0.000243	0.001220	0.000435
	(0.00042)	(0.00025)	(0.00023)	(0.00023)	(0.00025)
	[-2.06470]	[-2.21461]	[1.06980]	[5.32776]	[1.71884]

Table 4 Causality in the VECM (Short run Analysis)
(India, USA, UK, Japan, Singapore)

Cointegrating Eq:	CointEq1				
LINP(-1)	1.000000				
LUSP(-1)	1.948360				
	(0.36358)				
	[5.35883]				
LUKP(-1)	-1.650996				
	(0.44346)				
	[-3.72301]				
LSGP(-1)	-0.624898				
	(0.21616)				
	[-2.89095]				
LJPP(-1)	-0.867949				
	(0.24506)				
	[-3.54184]				
@TREND(7/01/97)	-0.000575				
	(6.2E-05)				
	[-9.21155]				
C	5.584579				
Error Correction:	D(LINP)	D(LUSP)	D(LUKP)	D(LSGP)	D(LJPP)
CointEq1	-0.006723	-0.001316	0.003133	0.001769	0.005422
	(0.00231)	(0.00181)	(0.00163)	(0.00188)	(0.00186)
	[-2.91276]	[-0.72826]	[1.92499]	[0.94177]	[2.91904]

APPENDIX B Multivariate Co integration Analysis (2005-2009)

Table 1 Multivariate Co integration Analysis Trace Statistics of (Pakistan, China, India, Sri Lanka 2005-2009)

Hypothesized No. of CE(s)	Eigenvalue	Statistic	Critical Value
None	0.011067	24.44314	47.85613
At most 1	0.003786	10.20904	29.79707
At most 2	0.002951	5.357485	15.49471
At most 3	0.001233	1.577602	3.841466

Trace test indicates 1 cointegrating egn(s) value at the 0.05 level.
*denotes rejection of the hypothesis at 0.05 level.
**Mackinnon Haug-Michelis (1999) p-values

Table 2 Multivariate Co integration Analysis Trace Statistics (Pakistan, USA, UK, JPP, SGP)

Hypothesized No. of CE(s)	Eigenvalue	Statistic	Critical Value
None *	0.032064	91.91965	88.80380
At most 1	0.020164	50.23824	63.87610
At most 2	0.011469	24.18452	42.91525
At most 3	0.005247	9.430959	25.87211
At most 4	0.002111	2.703006	12.51798

Trace test indicates 1 cointegrating egn(s) value at the 0.05 level.
*denotes rejection of the hypothesis at 0.05 level.
**MackinnonHaug-Michelis(1999)p-values

Table 3 Multivariate Co integration Analysis Trace Statistics (China, USA UK Singapore and Japan 2005-2009)

Hypothesized No. of CE(s)	Eigenvalue	Statistic	Critical Value
None *	0.033844	103.7659	88.80380
At most 1	0.028654	59.72941	63.87610
At most 2	0.009883	22.54607	42.91525
At most 3	0.006290	9.843400	25.87211
At most 4	0.001386	1.773484	12.51798

Trace test indicates 1 cointegrating egn(s) value at the 0.05 level.
*denotes rejection of the hypothesis at 0.05 level.
**Mackinnon Haug-Michelis (1999) p-values

Table 4 Multivariate Co integration Analysis Trace Statistics (India, USA, UK Singapore and Japan 2005-2009)

Hypothesized No. of CE(s)	Eigenvalue	Statistic	Critical Value
None *	0.029264	76.01895	69.81889
At most 1	0.018997	38.03161	47.85613
At most 2	0.007805	13.50094	29.79707
At most 3	0.002217	3.478564	15.49471
At most 4	0.000501	0.640409	3.841466

Trace test indicates 1 cointegrating egn(s) value at the 0.05 level.
*denotes rejection of the hypothesis at 0.05 level.
**Mackinnon Haug-Michelis (1999) p-values

Table 5 Bivariate Co integration Analysis Trace Statistics 2005-2009

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value	Prob**.
PKP & CHP				
None	0.002548	5.589308	15.49471	0.7434
At most 1	0.001817	2.326200	3.841466	0.1272
PKP& INP				
None	0.003596	4.850746	15.4947	0.8245
At most 1	0.000190	0.243433	3.8415	0.6217
PKP& SLP				
None	0.003102	4.479505	15.4947	0.8613
At most 1	0.000395	0.505859	3.8415	0.4769
CHP & INP				
None	0.005573	8.468495	15.4947	0.4167
At most 1	0.001032	1.320191	3.8415	0.2506
CHP & SLP				
None	0.003600	6.321793	15.4947	0.6575
At most 1	0.001335	1.708737	3.8415	0.1911
INP & SLP				
None	0.004743	8.834200	15.4947	0.3809
At most 1	0.002151	2.753888	3.8415	0.0970

Trace test indicates no cointegrating egn(s) value at the 0.05 level.
*denotes rejection of the hypothesis at 0.05 level.
**Mackinnon Haug-Michelis (1999) p-values

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