# CAUSAL AND DYNAMIC LINKAGE OF STOCK MARKETS

## (An Empirical Study of KSE with Emerging and Developed Equity Markets)






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# ABSTRACT

The main purpose and scope of this empirical study is to explore the causal and dynamic linkages of KSE-100 with emerging stock markets of India, China, Hong Kong, Malaysia, Indonesia, Thailand, Turkey, and Brazil as well as with the developed stock markets of Japan, USA, UK and France for the period January 1998 to December 2008. 132 monthly stock indices observation are taken. Descriptive analysis, correlation analysis, unit root test, co-integration test, vector error correction model, granger causality test, variance decomposition test and impulse response test is used to identify the existence of short run and long run relationships. Empirical results conclude that KSE-100 is a volatile market and have suitable level of returns. Moreover JCI and BCI have long run relationships with KSE and SCI have short run relationships to KSE. The equity markets of BSE, SCI, SET, KLSE, JCI, ISE, BCI and Nikkei-225 granger causes to KSE-100 and KSE-100 granger causes to HSI, SET, KLSE, JCI. Further study explores that the major change in KSE-100 is due to its own innovations and other markets have no significant impact on the KSE. The findings conclude that there is a further need of future study to explore the factors of economic integration among these stock markets. The overall study creates awareness to economic and financial decision makers, international & regional investors, investment agencies and banks about the opportunities of portfolio diversification benefits, funds management and trends of the stock market.



**Keywords:** Indices, Linkages, Portfolio Diversification, Co-integration, Vector error correction model, Emerging & Developed stock markets, Economic integration, KSE-100

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## DECLARATION

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KASHIF HAMID
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*KASHIF HAMID*

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| | |
|---|---|
| ASEAN | The Association of Southeast Asian Nations |
| OECD | Organization for Economic Co-operation and Development |
| MENA | Middle East North America |
| EU | European Union |
| SAARC | South Asian association of Regional cooperation |
| GDP | Gross Domestic Product |
| GNP | Gross National Product |
| KSE, KSE-100 | Karachi Stock Exchange |
| BSE, BSE-SENSEX | Bombay Stock Exchange |
| SCI | Shanghai Composite Index |
| HSI | Hang Seng Index |
| SET | Stock Exchange Thailand |
| ISE | Istanbul Stock Exchange – National 100 |
| JCI | Jakarta Composite Index |
| BCI | BOVESPA Composite Index |
| KLSE | Kuala Lumpur Stock Exchange |
| S & P-500 | Standard and Poor 500 Index |
| FTSE-100 | Financial Times Stock Exchange 100 Index |
| NIKKEI-225 | Nihon keizai shimbun ( Stock Market of Japan) |
| CAC-40 | Cotation Assitee en Continue- 40 Index |
| VECM | Vector Error Correction Model |
| ARDL | Auto Regressive Decomposition Lag Test |
| MSCI | Morgan Stanley Composite Index |
| UK | United Kingdom |
| USA, US | United States of America |
| UAE | United Arab Emirates |
| AIC | Akaike Information Criterion |
| VAR | Vector Auto Regression |
| IDR | Indonesian Rupiah |
| PKR | Pakistani Rupee |
| BRL | Brazilian Real |
| ADF | Augmented Dickey Fuller |
| PP | Phillip Perron |

# CHAPTER 1

# INTRODUCTION

# 1. INTRODUCTION

## 1.1 CAPITAL MARKETS OVERVIEW

Generally capital market is known as the market for long term financial instruments where the potential buyers and sellers meet together for efficient trading of securities. Financial securities include both the debt and equity securities. Capital market is generally considered as a backbone of the economy and facilitates to the investor for short term and long term investment portfolios in existing securities. Capital markets provides a channel in an efficient way to market based economies and financial systems regarding to the regular stream of long term financial and economic resources from the saving end to the borrowing end of capital. For consistent economic growth and prosperity efficient capital markets are quite necessary. Well structured and developed capital markets play a dynamic and vital role for the promotion of investments into the financial assets and also facilitate to the efficient allocation of savings towards the most productive sectors of the economy.

## 1.2 LINKAGE MECHNISM OF THE STOCK MARKETS

In an economy capital markets push the savings in an effective way towards the investment portfolios and thus assist to develop an investment culture. Due to this reason the trends of investments are rapidly changing in the emerging markets of the world therefore economies are developing and growing smoothly. It may lead towards associated integration among these emerging economies. Business and Economies are

going towards more globalization during this century which has tremendously increased the volume of investments into the financial instruments. Due to rise in globalization the global equity markets are going towards integration for example ASEAN, NAFTA, EU, MENA, and Scandinavian countries. This element is a positive signal for the world economic growth and minimizes the risk of contagion effects of financial crisis, particularly if this one originates from the bigger equity markets sides.

The 2007 USA sub-prime mortgage financial crisis affected the equity markets around the globe and due to billion dollars loss the risk aversion attitude has increased harshly which has negatively impacted on the international financial markets. The stock market of Pakistan has exposed significant resistance to the recent worldwide turmoil and has been declared as one of the sharply growing equity markets in the emerging economies. The investment culture in year 2007 and 2008 has sharply increased the indices to its climax which cause to increase the confidence of internal and external investors.

In this era investors are in dire need of the most updated and purposeful information about the various economic variables and related forces which can impact on the movement of the stock returns. Such information will facilitate to the investor that how he will respond and behave to the dynamic market transactions. In this era of globalization each economy is reshaping its financial structures regarding to the forthcoming international trade scenario. The term globalization has squeezed the whole world into a global village where the market interactions have created a critical issue of

efficient control and monitoring of funds management. Its efficient management is only possible if we have sufficient information about the integration of the markets. The flow of funds around the globe is affected by the market measures and also due to the introduction of new financial products. The macroeconomic policies are affected by the existence of interactive elements of the international financial markets and portfolio diversification. The International portfolio diversification opportunities are becoming the most attractive element for the international and institutional investors in the emerging and developed stock markets. The world is moving towards constructing economic blocks i.e., ASEAN, OECD, MENA, EU, SAARC which are in continuous struggle to equip with trade liberalization and sound financial integration.

Emerging equity markets are generally known as the equity markets of the developing countries whose industrial and financial infrastructures are in a grooming stage. These economies are moving towards development of the corporate and investment culture so these can improve their GDP and GNP at par to the developed countries. According to this scenario these markets are generally considered risky markets but have a large potential towards higher returns. So the linkages of the stock market study gets more attention that how domestic and international investors can take the benefits of portfolio diversification from one market investment to another market investment for search of higher returns and risk minimization.

Due to increase in close relationships like trade liberalization, financial interactions, technology developments in between the developed markets, the financial

concentration and integration is momentously increasing. These elements have diverted the attention of investors in emerging stock markets for search of potential returns.

All these elements have focused the attention of investors and academicians towards the issue of dynamic linkages among equity markets around the globe.

## 1.3 BRIEF OVERVIEW OF KARACHI STOCK EXCHANGE

The benchmark equity market of Pakistan KSE-100 index has risen from 1609.16 points on January 1, 1998 to 15122.47 points on April 30, 2008 – An aggregate rise of 13513.31 points or an increase of 939.77 percent to its peak in the year 2008 but from April 2008 to December 2008 index decreased to 5865.01 points in these 8 months, a fall of over 9257.46 points or 61% decrease. Following were the main reasons in the year 2007-2008 which caused to the uprising parameters in the equity market of Pakistan. These elements include progress in the basic country's economic parameters, constancy in the exchange rates, decrease in the interest rates by financial institution, collection of due debts, rearrangement of foreign loans and advance payment of the costly foreign debts, less costly valuation of the shares, great scale of mergers and acquisitions transactions, betterment in the relationship with the bordering countries, booming GDR assistance and an increase in publicity of Pakistani equity market by large number of global brokerage houses and investment banks, Government of Pakistan (2008). This element also had a deep effect on the activities of the equity market. In the last eight months the trend of indices sharply dropped. The main reasons for this sharp fall were the shift of outside investor's capital, political instability, financial instability, energy crises,

war against terrorism, cross border pressures, increase in imports and decrease in exports. Before this sharp fall when the market was at boom the largest push and backup to the stock market were due to the concentration revealed by foreign and institutional investors with an enormous liquidity. Equity market of Pakistan best explains the economic growth and absorbs the potential information about the rise and falls of major economic and social factors. An optimistic equity market can be endorsed to the consistent and stability of the macroeconomic policies and financial strategies of the government and equity market reforms. Tough internal and external conditions negatively affected foreign portfolio investment into the domestic stock market. Pakistan shows that external portfolio investment shows a net drop of US$45 million during the initial nine months of the FY 2007-08. The outflow remained continued till the end of year 2008. According to Government of Pakistan (2008) the major stock indexes including S&P 500 (US), FTSE 100 (UK) and Nikkei 224 (Japan) also showed decrease of 6.6 %, 8% and 10 % respectively in the financial year 2008. In emerging equities the KSE-100 is the largest and the most liquid market in the Pakistan which seems that it is positively behaving. In year 2007 the Karachi stock exchange was declared the sixth best performer among the emerging equity markets of the world. At the end of December 31, 2008, 652 companies were listed on the KSE.

World Bank (1997) states that the numerous world financial markets are speedily converting into a single global market and investors are moving towards developing countries in the search for higher returns and to find the new opportunities for risk diversification.

The primary purpose and scope of this research is to examine the causal and dynamic linkages among KSE (Pakistan) with emerging stock markets of India, China, Hong Kong, Malaysia, Indonesia, Thailand, Turkey, and Brazil as well as with the developed stock markets of Japan, USA, UK and France for the period January 1998 to December 2008.

## 1.4 SIGNIFICANCE OF THE STUDY

Its an era of knowledge management and an investor is becoming rational about the present scenario of globalization impact on the behavior of stock market patterns. Globalization impact may increase the volume of investments into the financial instruments. And the scope of portfolio diversification within the region is becoming more attractive and significant. With the help of this study an investor can get updated information about the linkage mechanism of the stock market movements and how the short run and long run positions can be taken within this scenario. This empirical study will lead towards another element that how co-movement of equity markets may have an important effect on macroeconomic decisions of the countries. Moreover the linkage study is also necessary for designing the financial strategy by those investors who have interest in multinational companies stocks in the emerging and developed equity markets. The importance of institutional investors is increasing because they have desire and ability to invest across the boarders due to the greater influx of capital flow. It may increase the investment in mutual funds in the emerging markets. Emerging Markets might be integrated due to the co-movement of the expected cash flows in a similar

manner and it may be said that there will be cumulative economic shock on all the markets in same manner. It will also assist to know the spillover effects across the economies. It is also significant to study that portfolio diversification will decrease if equity markets have closer inter-linkage. The portfolio diversification stream of benefits will increase if there is no linkage among the stock markets. Presently there is very little amount of work done in Pakistan with reference to linkages among emerging and developed equity markets. Further this study will be significant because it will provide an opportunity to understand that what are those economic variables and related forces which can cause to integrate or disintegrate the movement of the stock returns. Therefore such information will facilitate and lead to the regional as well as international investors that how they will respond to the causal and dynamic equity market transactions. All these elements have focused the attention of investors, financial analysts, economists and academicians towards the issue of long run and short term relationships among capital markets around the globe.

## 1.5 OBJECTIVES OF THE RESEARCH

Main objectives of this research are as follows.

i. To identify the long term relationship between KSE and emerging markets.
ii. To identify the long term relationship between KSE and developed markets.
iii. To explore the short term dynamics of the prices of KSE and emerging markets.
iv. To explore the short term dynamics of the prices of KSE and developed markets.

v. To provide awareness and information to the international and regional investors about the existing and future trends of the stock market.

vi. To explore the possibility of portfolio diversification among KSE and emerging equity markets.

vii. To explore the possibility of portfolio diversification among KSE and developed markets.

viii. To facilitate the decision makers in estimating the spillover effects of changes in other markets.

ix. To provide opportunities to further study about how macroeconomic and other forces may impact on the interdependence of the stock markets.

## 1.6 PLAN OF THE STUDY

Chapter – 2 presents a epigrammatic overview of linkages study for emerging and developed equity markets.

Chapter – 3 provides various models to measure the linkage and relationship issues. It provides information about data taken for this study, statistical methodologies used to explore the data behavior and trends.

Chapter – 4 contains the empirical results of the study and comprehensive data analysis.

Finally chapter – 5 concludes the study in an elaborative manner along with the implications of the study.

# CHAPTER 2

# LITERATURE REVIEW

# 2. LITERATURE REVIEW

The past studies justify that why this issue is important in its contents regarding to the regional and international scenario. A number of markets are testified regarding to their capacity of portfolio diversification and related stream of benefits and how the spillover effects are managed. Some studies include the time period into different sessions regarding to an event or crises element. The purpose is only to view whether these markets are affected by these shocks or not if yes then how much it decompose to other markets behavior and how much these markets are integrated on this act. The macroeconomic factors need further justification regarding to the integration issue. Moreover the behavior of investor is generalized that how he response to such situations where he is in a position to get decisions as a risk averse portfolio manager. The term long- run and short-run indicates that either these markets are interdependent on long term basis or the relationship is temporary or short term in nature. In first instance of my review study I have focused the inter-linkage mechanism of the developed markets relationships and then emerging equity markets interdependencies and co-movements.

## 2.1 CO-INTEGRATION AMONG DEVEOLOPED MARKETS

Eun and Shim (1989) studied the relationships of nine stock markets of Australia, Hong Kong, Japan, UK, Switzerland, France, Germany, Canada, US, by using the VAR model for the period of December 31, 1979 to December 20, 1985. Results reveal that significant level of interdependencies exists between the national stock markets. Moreover they concluded that the U.S market is the most influential market in terms of

variances around the world. Mathur and Subrahmanyam (1990) investigated the linkages among the Nordic (Norway, Sweden, Finland, Denmark) and United States equity markets through the Granger causality approach and VAR method. They took the observations from 1974 to 1985 on monthly basis. They concluded that the USA markets have impact on the Denmark but no affect on Norway, Sweden and Finland. The equity market of Sweden does Granger cause to Norway and Finland. And the stock markets of the Norway, Denmark and Finland do not Granger cause to any other market. Moreover they found that there is lower level of integration among the Nordic equity markets. Kasa (1992) found that there is a single common trend which drives the stock markets of USA, Japan, England, Germany and Canada by using co-integration test for the period 1974 to 1990. Further he concluded that there exists a long term relationship between these stock markets. It leads to an instinctive idea of that either stock markets share long-run linkages over the scale of time or it has a short run relationship phenomena. Such interest has motivated a number of studies with new dimension in present era. Ammer and Mei (1996) explored the new model to measure the financial and real economic inter-linkage among the USA and UK. The observations were taken from 1957 to 1989. In their study they concluded that there exists a closer relationship after the BW currency settlement. Thereafter they studied 15 markets correlations commencing from 1974 to 1-1-1990 and determined that dividend growth expecting in future is more correlated in between the countries. Janakiramanan and Lamba (1998) investigated the linkage mechanism among the Pacific-Basin region stock markets from 1988 to 1996. They concluded that the United State market has greater effect on the Australian stock

markets than other stock markets of the region. Due to financial and regional closeness a number of elements affect each other market significantly. Roca (1999) examines the interrelatedness among stock markets of the Japan, Korea, U.K, and U.S, Taiwan, Singapore, Australia and Hong Kong by applying co-integration test. He concluded that there exists no co-integration between Australia and rest of the markets of the study. Further he concluded that U.S and UK markets significantly influence the Australian Stock market. Cha and Oh (2000) examined the relationship between the developed markets of US, Japan and the emerging markets of Hong Kong, Korea, Singapore and Taiwan for the period January 4, 1980, to September 18, 1998. The stock prices were taken on weekly basis. They found that there is an increasing trend of linkage between the largest developed equity markets and the emerging equity markets. They concluded that the strength in links between developed markets and the Asian emerging markets initiated to rise after the stock market crash in October 1987 till to the end of year 1997. The results explores that the sensitivity of shocks to an emerging market from the developed markets is concerned with the degree of openness. Johnson and Soenen (2003) studied the equity markets of Argentina, Chile, Brazil, Mexico, and Canada for the period 1988 to 1999 and further examined Columbia, Peru and Venezuela for the period 1993 to 1999. They focused their study towards the integration of these markets with the United States and also investigated the factors that causes to integration by applying Co-integration Tests, Covariance and Geweke measures. They found significant relationship in between the US and other eight markets. A greater amount of trade in between U.S and other countries have significant impact on the equity market

integrations. A raise in exchange rates variations and greater ratios of equity market capitalization has lower impact on co-movements of the stock markets in between US and other countries. Yang, Kolari and Sutanto (2004) studied the 13 emerging equity markets from Asia (India, Korea, Malaysia, Taiwan and Thailand), Latin America (Argentina, Brazil, Chile, Columbia, Venezuela and Mexico), Europe (Greece), and Africa (Zimbabwe) and one from USA. The study consists of monthly observations for 17 years and 26 years respectively. For Malaysia, Taiwan, Columbia and Venezuela observation are taken from 1st January 1985 to 31st December 2001 and for remaining equity markets, observations are taken from Jan 1, 1976 to Dec 31, 2001. They applied multivariate and bi-variate co-integration tests. In their empirical study they concluded that no long run relationship exists between thirteen emerging and US markets throughout the year 1997 but after 1997 crises, the scene has changed the linkage mechanism and put up a query that crises effects significantly to the market co-movements. Hazem (2005) investigated the level of integration among four emerging equity markets of MENA and between the developed markets of (US, UK and Germany) for the period 1994 to 2004. He applied autoregressive distributed lag (ARDL) approach to co-integration. He found that there exists integration among equity markets in the MENA region and prevails no integration in between the MENA markets and the developed markets. However he concluded that there exists opportunities for international investors to obtain long-run gains through portfolio diversification in the MENA region but there are limited long run opportunities for the regional investors.

Arouri, Jawadi & Nguyen (2008) investigated the stock return linkages between the main Latin American markets (Argentina, Brazil, Chile, Colombia, Mexico and Venezuela) and the world market (MSCI world stock market index) from the period 1985 to 2005 on monthly returns basis. They used co-integration, VECM and investigated the short run and long-run market co-movements and integration. However the results revealed that there exits increasing trend on short run basis and long term linkages between the Latin American markets and the MSCI world market index.

## 2.2 CO-INTEGRATION AMONG EMERGING MARKETS

Chung and Liu (1994) investigated that the United States stock markets and 5 Asian countries have four familiar stochastic trends. Studies found in which multivariate co-integration framework is applied and there exists two co-integrated relationships. United States and Taiwan markets have no co-integrated elements. Impulse response test indicates that there exists a short-term shock adjustment. Sheng and Tu (2000) explored interrelatedness among 11 Asia-Pacific countries and US stock market for the period July 1, 1996 to June 30, 1998 by applying multivariate co-integration, error correction model and variance decomposition test. Daily stock prices were taken for this purpose. They segregated the study before and during the period of the Asian financial crisis, and examined evidences in support of the existence of co-integration relationships among the national stock indices during, but not before the period of financial crises. Further they found that the inter-linkage between the South East Asian countries is more than the North East Asian Countries. Naeem (2002) studied the relationship and inter-linkages in between the four South Asian stock markets including Pakistan, India, Sri Lanka and

India and the USA and UK equity markets. He analyzed the observations from Jan 1, 1994 to Dec 31, 1999 by applying multivariate and bi-variate co-integration methods. He concluded that there exists no co-integration in between the South Asian stock markets after May 1998 nuclear tests and evidences exists that prior to this period co-integration exists. Further evidences prove that there is no co-integration in between the South Asian emerging markets and USA, UK markets throughout the whole period under study. Moreover he remarked that there exists portfolio diversification opportunities for investors regarding to these markets. Ng (2002) found no evidence regarding to co-integration among the ASEAN Stock markets (Indonesia, Malaysia, Philippines, Singapore and Thailand) during the period 1988-1997. Further he found that there exists no long run relationship among the ASEAN stock market except in short time periods. Correlation indicates that the integration is increasing and time varying analysis says that some markets are going closer to integrate with Singapore. Narayan, Smyth and Nandha (2004) investigated the linkage between Pakistan, India, Bangladesh and Sri Lanka by applying Granger causality approach, Auto Regressive distributive lag and impulse response method for the period 1995-2001. They concluded that the there exists a long run relationship in the stock prices of these countries if the Pakistan is based as dependent variable. The stock prices of India, Sri Lanka and Bangladesh Granger causes to the stock prices of Pakistan. In short run there exist unidirectional relationship and the Bangladesh equity market is the more exogenous market among all these. Lamba (2005) concluded that there exists a long run relationship among South Asian emerging stock markets and the developed equity markets for the period of July 1997 to December 2003 by applying

multivariate co-integration test. Empirical results indicate that developed equity markets of US, UK and Japan has impact on Indian stock market. Further he founded that the stock markets of Pakistan and Sri Lanka are relatively independent and are not influenced by the stock markets of developed countries during the whole period. Moreover he noted that the three South Asian equity markets are integrating with each other but relatively in a slow manner. Shachmurove (2005) investigated the dynamic linkages by using the daily returns of the stock market in the Middle East Countries of Egypt, Israel, Jordan, Lebanon, Morocco, Oman, Turkey and the United States for the period 22-10-1996 to 30-09-1999. They concluded that there is very small relationship and even though markets are proficient but still dynamic integration can be investigated and exploited to get the stream of benefits through the diversified global investors. Suchismita and Paramita (2006) studied the linkage of the India with two developed equity markets of the US, Japan and seven emerging markets of Hong Kong, Malaysia, South Korea, Singapore, Taiwan, Thailand including India for the period January 1999 to June 2004 on daily data basis by applying co-integration and Granger Causality Tests. They concluded that the US equity markets have no participation in the linkage of the Asian Stock markets. However, the results pointed out that the nature of interlinkage with the emerging Asian markets do not yet guarantee any instant apprehension regarding possible infectivity in the situation of any financial crisis in the constituency. Further they explained that the level of linkage prevails between different markets leads towards that there have a great deal of scope for harvesting potential benefits of portfolio diversification by investing in Indian equity markets on short run basis because of the co-movement of Asian markets is

not in a great amount but leave gaps for switching between established markets of US, Asian markets and India. Hoque (2007) founds no element that particularly examines the integration of capital market of Bangladesh with the developed markets. He analyzed stock price co-movements of Bangladesh, USA, Japan and India by applying the Johansen and Juselius multivariate co-integration model and further examined through vector error correction model from the period January 1990 to December 2000 on daily data basis. The results of his study explain that stock prices in those countries share a common stochastic tendency. Further the results reveal that the shocks to the US equity market have influence on the Bangladesh market. However, the evidence of Bangladesh market to Indian market is little weak and there is no impact of Japanese market on Bangladesh stock market. Abbas and Surachai (2008) studied the linkage between Thai equity market and its 11 major trading associates including Australia, Hong Kong, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan, the UK and USA by using co-integration and error correction approach for the period December 1987 to December 2005 on monthly data basis. He founded that the long run benefits can be potentially attained through the international portfolio diversification but have to reduce the associated risk across the borders. However, on short run basis three unidirectional Granger Causalities of stock returns of Hong Kong, Philippines and UK in relation to the stock market of Thailand exists and in the same way the unidirectional Granger Causality of the stock returns of Thailand exits to Indonesia and USA equity markets. Further he examined the bidirectional Granger Causality of the stock returns of Thailand exits to the Malaysia, Singapore and Taiwan.

Hasan ,Saleem & Abdullah (2008) investigated the dynamic linkage of Pakistan equity market with the nine developed equity markets of USA, UK, France, Germany, Japan, Canada , Italy and Australia for the period 2000 to 2006 by using a Johansen and Juselius multivariate co-integration analysis on weekly prices basis. The results reveal that Pakistani equity market is not co-integrated with the equity markets of the USA, UK, Germany, Canada, Italy and Australia. However, they founded that there exists co-integration with France and Japan. Moreover the results reveal that the UK and USA stock markets have little impact on Pakistan equity market. Hasan and Durrani (2008) studied the long run relationship among the emerging stock markets of Pakistan, Bangladesh, India and Sri Lanka for the period commencing from 1st July 1997 to 30th June 2008 based on monthly observations. They applied correlation, multivariate co-integration, bi-variate co-integration, Granger causality test, variance decomposition test and the impulse response analysis technique. Results shows that the stock market of Pakistan have no bi-variate co-integration with any one of these markets but multivariate co-integration test reveals that there exists long run relationships with the group of these emerging equity markets. Pakistani stock market does not Granger cause to these markets. Moreover they concluded that the KSE is an exogenous performer because the largest part of its sensations is explained by its own exclusive shocks and investors can get the stream of benefits from portfolio diversification. Alkulaib, Najand & Mashayekh (2009) investigated the MENA region stock market. They used the markets from Bahrain, Egypt, Jordon, Kuwait, Lebanon, Oman, Morocco, Qatar, Saudi Arabia, Tunisia, Turkey and UAE. The data were taken for the period of January 3, 1999 to December 31,

2004 and were examined through descriptive statistics, correlation matrix, state space model, Granger Causality test. They did not explore any causality element or spillover effect from one country to other country in the North African area. They concluded that there exists linkages between equity markets in this particular region and further explored that there exist bi-directional causality between the Turkey market and Lebanon equity markets, On the other hand the Jordan's market is not impressed by any mean. GCC region indicates the results that there exists greater contact and linkage in between the GCC region other than in the NA, and Levant regions. The review literature indicates that there is no recent work is available regarding to the Pakistan and a number of emerging markets, so this study also fills this gap by examining the long run relationships and short term relationships among these markets. This study also provides updated information about the linkages between emerging and developed markets.

# CHAPTER 3

# DATA AND METHODOLOGY

# 3. DATA AND METHODOLOGY

## 3.1 DATA

This empirical study includes 132 monthly closing stock values of the 13 stock market indices related to emerging and developed equity markets. Observations are taken for the period January 1998 to December 2008 relating to the 9 emerging stock markets i.e,

i. Karachi Stock Exchange, KSE-100 index (Pakistan)

ii. Bombay Stock Exchange, BSE SENSEX (India)

iii. Shanghai Composite Index, SCI (China)

iv. Hang Seng Index, HSI (Hong Kong)

v. Stock Exchange Thailand, SET Index (Thailand)

vi. Kuala Lumpur Stock Exchange, KLSE (Malaysia)

vii. Jakarta Composite Index, JCI (Indonesia)

viii. ISE-Istanbul National -100 Index (Turkey)

ix. BOVESPA Composite index, BCI (Brazil)

Four stock markets are taken from the developed world.

i. Standard and Poor 500 Index, S&P 500 Index (US)

ii. Financial Times Stock Exchange 100 index, FTSE-100 index (England)

iii. Nikkei-225 Index (Japan)

iv. Cotation Assistee en Continue CAC-40 Index (France)

The data for these stock markets indices is taken from the various web sources. These markets are selected because there remained a significant economic growth within this time frame, moreover there are number of success stories are attached to these particular equity markets and global market players have shown the interest in this time period. As for as concerned to the developed markets these markets are established markets and hence are considered for providers of the major proportionate of market attractiveness to the global and institutional investors.

The continuous compounded rate of return is calculated by using the following model.

**Return = $Rt = ln(SP_t / SP_{t-1})$**

$R_t$ = Return for Given Period't'

$SP_t$ = Price at month end

$SP_{t-1}$ = Price at the end of last month

$ln$ = Natural Log

## 3.2 METHODOLOGY

There are many methods to measure the linkage of the stock markets. This study emphasizes to test the inter-linkage of the markets through following methods.

i. Descriptive Statistics

ii. Correlation

iii. Unit Root Test

iv. Johansen and Juselius Co-integration Test

v. Vector Error Correction Method

vi. Granger Causality Test.

vii. Variance Decomposition Test and Impulse Response Test

### 3.2.1 DESCRIPTIVE STATISTICS

Descriptive Statistics for the stock returns includes the Mean, Median, Maximum, Minimum, Standard Deviation (level of Risk), Skewness, Kurtosis, Variance, Jarque - Bera values. It tells us about the behavior of time series.

### 3.2.2 CORRELATION

Correlation Matrix includes the correlation coefficients among all the stock markets in a table format which indicates the level of association among these stock market returns. It measures the degree of relationship among two series that how one series is related to the other series. It may have no correlation, positive correlation or negative correlation. This technique is considered weak because it does not show the cause and effect relationship.

### 3.2.3 UNIT ROOT TEST

Unit root tests are used to check the stationarity of the time series. Following are the tests used to check this element.

The Augmented Dickey Fuller Test (1981) "ADF" and Phillips-Perron Test (1988) "PP" used to testify the stationarity of the series. The following econometric parameters are used to testify the stationarity of the indices series.

#### 3.2.3.1 Augmented Dickey Fuller Test (ADF)

This test is applied to investigate the level of integration so that appropriate econometric model for long term relationship can be selected.

An AR (1) Model

$V_t = \pi V_{t-1} + e_t$

$V_t$ = Variable under study for the given time period't'

$\pi$ = Coefficient

$e_t$ = Error term

If the regression model is redesigned, the following equation is established as under.

$\Delta V_t = (\pi-1)V_{t-1} + e_t = \delta V_{t-1} + e_t$

$\Delta V_t$ = First difference operator for the underlying variable

$\pi$ = Coefficient

$e_t$ = Error term

The above model may be estimated and used for testifying the existence of unit root that should be $\delta$ = Zero. ADF considers that $e_t$ are statistically independent and follows an unvarying variance. Such severe type of condition and assumption leads towards the Phillip-Parren Test (1988).

### 3.2.3.2 Phillip-Parren Test

ADF test assumes that data is independently identically distributed which is rather strict parameter so another test may also be used to testify the stationarity of the time series with less restrictive parameters. PP test is explained as under.

$$V_t = b_0 + b_1 V_{t-1} + b_t [t-T/2] + e_t$$

Test statistics indicates that the coefficients considering $H_0$, the series will created by $V_t = V_{t-1} + e_t$, then $E(e_t)$ = Zero. So a series is confirmed to integrated of order one.

### 3.2.4 CO-INTEGRATION TEST

The co-integration analysis requires that the time series should be incorporated in same order format. For this purpose level of stationarity is confirmed by using unit root tests. The Johansen (1988:1991) and Engle-Granger (1987) co-integration methods tests the existence of long run relationship between the variables and Engle-Granger (1987) is also used to measure the error corrections in co-integration analysis. Johansen and Juselius (1990) Multivariate Co-integration method is explained as under.

#### 3.2.4.1 Johansen and Juselius Multivariate Co-integration method

The multivariate co-integration model is explained as under.

$$\Delta V_t = a + \sum_{t=1}^{m-1} \lambda_t \Delta V_{t-1} + \Psi_t V_{t-1} + e_t$$

$a$ = Constant

$V_t$ = Variable column vectors to be tested.

$\lambda$ and $\Psi$ = Coefficients.

$\Delta$ = Change or Difference operator.

$m$ = Denotes the lag length

$e_t$ = Error term or white noise term

The MEV test is taken as under.

#### Maximum Eigen Value Test

Johansen and Juselius (1990) recommend two possible likelihood ratio tests for the determination of co-integrated vectors numbers. One of these is the Maximal Eigen

value Method, used for the purpose of evaluating the $H_0$ and tests the possibility of existence of $k$ co-integrating vectors alongside the $H_1$ of $k+1$ co-integrated vectors.

$\eta_{maximum} = T\ ln\ (1-\eta k+1)$

$\eta\ k+1 \ldots\ldots \eta k = (n-k)$ = Lowest Canonical Correlations,

T= Total number of observations under study,

## Trace Statistics

The second method which is used to know the co-integration in between the variables for k number of vectors is trace statistics. It tests $H_0$ of k co-integrated vectors against the $H_1$ of k or further co-integrated factors.

$\eta_{trace} = -T \sum ln\ (1-\eta_j)$

Akaike Information Criterion (AIC) is used to select the lag length for Vector Autoregressive process.

### 3.2.4.2 Bi-Variate Co-Integration Test

The prior multivariate co-integration test measures the long run relationship in between the various financial time series. In the same way to test the Bi-variate co-integration among the two financial series the below model is used in an autoregressive manner in between two financial time series. It also measures the long run relationship in between the two the time series.

Bi-variate Auto-regression Equation

$$V_t = a_0 + \sum_{i=1}^{m} a_i V_{t-i} + \sum_{i=1}^{m} \delta_i W_{t-i} + e_t$$

$$W_t = b_0 + \sum_{i=1}^{m} b_i V_{t-i} + \sum_{i=1}^{m} \Pi_i W_{t-i} + \varepsilon_t$$

$V_t$ and $W_t$ = Stationary Series for which bi-variate co-integration is to be tested

$a_0$ = Constants

$b_0$ = Constants

$a_i$ ,$b_i$ , $\delta_i$ , $\Pi_i$ = Coefficients

m = Positive integer

i = Number of values

$e_t$ = Error term

The above test is applicable only to stationary series or in other case it may be converted into 1(1) by taking the first order differencing.

## Trace Statistics

The method used to know the bi-variate co-integration in between the variables for k number of vectors is trace statistics. It tests $H_0$ of k co-integrated vectors against the $H_1$ of k or further co-integrated factors.

$$\eta_{trace} = -T \sum ln (1-\eta_j)$$

For Bi-variate Co-integration AIC is used to select the lag length for Vector Autoregressive process.

## 3.2.5 VECTOR ERROR CORRECTION METHOD

If there exists long run relationship between the financial time series according to J and J approach then below equations are amended by including the Error Correction Term (ECT) to know the short term relationship. ECT is used to know the short term inter-linkage elements among the stock price series according to their symmetric values.

$$\Delta V_t = a_0 + \sum_{i=1}^{m} a_i \Delta V_{t-i} + \sum_{i=1}^{m} \delta_i \Delta W_{t-i} + \gamma ECT_{i-1} + e_t$$

$$\Delta W_t = b_0 + \sum_{i=1}^{m} b_i V_{t-i} + \sum_{i=1}^{m} \Pi W_{t-i} + \Phi ECT_{i-1} + \varepsilon_t$$

$\Delta V_t$ and $\Delta W_t$ = Stationary Series with difference operator

$a_0$ = Constants

$b_0$ = Constants

$a_i, b_i, \delta_i, \Pi_i$ = Coefficients

m = Positive integer

i = Number of values

$e_t$ , $\varepsilon_t$ = Error terms

$ECT_{i-1}$ = Error correction term

$\gamma$ and $\Phi$ = Error Correction Term coefficients

## 3.2.6 GRAGER CAUSALITY TEST

Granger causality test is used to see the lead and lag relationship between two series. The above bi-variate auto-regression equation before including the ECT is used to know the causality in between two stationary time series of $V_t$ and $W_t$ based on the historical values. Granger (1969:1988) used to analyze the relationships and causality elements

among the series. Its little complex technique. The $H_o$ says that one series does not granger cause to other series and $H_1$ explains that one series does granger cause to other series. A time series $V_t$ Granger causes to another time series of $W_t$ can be bitterly predicted by treating past data of ($V_t$ , $W_t$) instead of using only the lag value of $V_t$. In other words $W_t$ fails to Granger cause $V_t$ if all n>0 the conditional probability distribution of ($V_{t+n}$ for given t, t- 1 ), $V_t$ is the same as the conditional probability distribution of $V_{t+n}$ given for both ($V_t$,$V_{t-1}$ and $W_t$ , $W_{t-1}$), that is $W_t$ does not granger cause if the above condition of n>o does not fulfils and vice versa for all time series with each other.

$$C_{prob}(V_{t+n} \mid \Phi_t \mid = C_{prob}(V_{t+n} \mid \Psi_t)$$

$C_{prob}$ = Conditional Probability

$\Phi_t$ = The information set at time t on Past values of $V_{t+m}$

$\Psi_t$ = The information set containing values of Both $V_t$ and $W_t$ for't' time period

Granger theorem provides that if two variables are co-integrated then there should be Granger causality in at least one direction, which is result of the relationships described by the ECM. Lead lag relationship is captured by Granger causality test within the sample period.

### 3.2.7 VARIANCE DECOMPOSITION ANALYSIS AND IMPULSE RESPONSE ANALYSIS

VDA is applied to know the lead lag relationship for out-of-sample causality tests. It segregates the variance of the estimated error of a certain variable into proportionate attributable to the shocks in each variable in the structure. In simple words variance decomposition analysis actually provides a breakdown of the changes in the value of the

variable in a given period due to arise from changes in the same variable in addition to other variables in previous periods. The impulse response analysis leads to investigate the impact of random shock on the markets and how impulse responses of returns in various markets in relation to a shock carries out in their own pattern and how other market innovations behave to impulse response situations. The variance decomposition is a better technique to measure and visualize the cumulative effects of shocks.

## 3.3 HYPOTHESIS OF THE STUDY

Following hypothesis of the study will be testified by applying the above explained methodologies.

**HYPOTHESIS: 1**

$H_0$ Emerging equity markets have long term relationship with KSE

$H_1$. Emerging equity markets have no long term relationship with KSE

**HYPOTHESIS: 2**

$H_0$ Developed equity markets have long term relationship with KSE

$H_1$. Developed equity markets have no long term relationship with KSE

**HYPOTHESIS: 3**

$H_0$ Emerging equity markets have short term relationship with KSE

$H_1$. Emerging equity markets have no short term relationship with KSE

**HYPOTHESIS: 4**

$H_0$ Developed equity markets have short term relationship with KSE

$H_1$. Developed equity markets have no short term relationship with KSE

# CHAPTER 4

# RESULTS AND DISCUSSION

# 4. RESULTS AND DISCUSSION

Descriptive statistics is applied on the 13 stock markets for the period 1998 to 2008. According to the statistical analysis Table 1 indicates the descriptive statistics of return series regarding to the emerging and developed equity markets. Results reveal that the average return of KSE-100 is 0.99% at a given level of standard deviation 10.66% and Istanbul Stock Exchange has 1.55% return at 14.70% level of risk. In the same way the BCI is providing 1.03% return at 10.03% risk surface. BSE is producing 0.84% average monthly return at 7.91% risk level. The return level of JCI is 0.78% at 9.14% risk level. HSI, SCI have 0.34% and 0.30% returns respectively along with 7.63% and 8.46% risk level. KLSE has 0.33% return at 7.85% risk and all other markets have lower level of returns. According to this scenario ISE is that market which is producing high level of returns at high level of risk. BCI is providing on an average 1.03% returns which is on second position and the risk level is also lesser than the KSE-100. Then at level third the KSE-100 is providing good return at certain level of risk. BSE and JCI are generating the returns after the turns of ISE, BCI and KSE-100. The volatility of KSE-100 returns ranges from 24% to -44.9% and returns volatility of Istanbul Stock Exchange ranges from 58.7% to -49%. The level of volatility of BCI, BSE and JCI returns ranges from 21.55% to -50, % 17.61% to -27% and 25% to -37.7% respectively. Exception to KLSE and ISE, all other markets have little negatively skewed returns. In developed markets only CAC-40 has positive returns of 0.01% and all other developed equity markets have negative stream of average returns. The equity market of Thailand, United

States, England and Japan have negative average monthly returns and the risk level is also lower except SET which have 9.40% standard deviation.

## Table 1: Descriptive Statistics of Emerging and Developed Equity Market

| Equity Markets | Country | Mean | Median | Maximum | Minimum | S.D. | Skewness | Kurtosis | Variance | Jarque-Bera | Probability | Obs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KSE-100 | Pakistan | 0.0099 | 0.0127 | 0.2411 | -0.4488 | 0.1066 | -1.1055 | 6.4260 | 0.0114 | 90.7499 | <0.0001 | 131 |
| BSE | India | 0.0084 | 0.0201 | 0.1761 | -0.2730 | 0.0791 | -0.6783 | 3.4163 | 0.0063 | 10.9911 | 0.0041 | 131 |
| SCI | China | 0.0030 | 0.0030 | 0.2781 | -0.2828 | 0.0846 | -0.1814 | 4.6650 | 0.0072 | 15.8497 | 0.0004 | 131 |
| HSI | Hong Kong | 0.0034 | 0.0104 | 0.2532 | -0.2545 | 0.0763 | -0.0015 | 4.2217 | 0.0058 | 8.1468 | 0.0170 | 131 |
| SET | Thailand | -0.0007 | 0.0074 | 0.2664 | -0.3592 | 0.0940 | -0.4366 | 4.8461 | 0.0088 | 22.7642 | <0.0001 | 131 |
| KLSE | Malaysia | 0.0033 | 0.0060 | 0.2944 | -0.2846 | 0.0785 | 0.3072 | 5.8715 | 0.0062 | 47.0672 | <0.0001 | 131 |
| JCI | Indonesia | 0.0078 | 0.0214 | 0.2502 | -0.3772 | 0.0914 | -0.9185 | 5.9536 | 0.0084 | 66.0354 | <0.0001 | 131 |
| ISE | Turkey | 0.0155 | 0.0230 | 0.5866 | -0.4949 | 0.1470 | 0.1560 | 5.5413 | 0.0216 | 35.7823 | <0.0001 | 131 |
| BCI | Brazil | 0.0103 | 0.0176 | 0.2155 | -0.5034 | 0.1003 | -1.2803 | 7.5143 | 0.0101 | 147.0218 | <0.0001 | 131 |
| S&P-500 | US | -0.0006 | 0.0071 | 0.0923 | -0.1843 | 0.0468 | -0.9222 | 4.6986 | 0.0022 | 34.3166 | <0.0001 | 131 |
| FTSE-100 | England | -0.0016 | 0.0038 | 0.0830 | -0.1395 | 0.0425 | -0.9387 | 3.9716 | 0.0018 | 24.3922 | <0.0001 | 131 |
| NIKKEI-225 | Japan | -0.0048 | 0.0028 | 0.1005 | -0.2722 | 0.0590 | -0.9571 | 5.1961 | 0.0035 | 46.3220 | <0.0001 | 131 |
| CAC-40 | France | 0.0001 | 0.0119 | 0.1259 | -0.1923 | 0.0585 | -0.6987 | 3.9468 | 0.0034 | 15.5512 | 0.0004 | 131 |

Table 2 indicates the empirical results of correlations in between the stock markets returns of Pakistan, India, China, Hong-Kong, Thailand, Malaysia, Indonesia, Turkey, Brazil, United States, United Kingdom, Japan, and France. Correlation test is used to see the overview of the relationship.

## Table 2: Correlation Matrix of Emerging and Developed Markets

| Equity Markets | KSE-100 | BSE | SCI | HSI | SET | KLSE | JCI | ISE | BCI | S&P-500 | FTSE-100 | NIKKEI-225 | CAC-40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KSE-100 | 1.00 | | | | | | | | | | | | |
| BSE | 0.26* | 1.00 | | | | | | | | | | | |
| SCI | 0.04 | 0.36* | 1.00 | | | | | | | | | | |
| HSI | 0.11 | 0.48* | 0.35* | 1.00 | | | | | | | | | |
| SET | 0.17 | 0.43* | 0.19 | 0.60* | 1.00 | | | | | | | | |
| KLSE | 0.18 | 0.36* | 0.26* | 0.53* | 0.58* | 1.00 | | | | | | | |
| JCI | 0.06 | 0.44* | 0.23* | 0.45* | 0.56* | 0.50* | 1.00 | | | | | | |
| ISE | 0.18 | 0.32* | 0.16 | 0.41* | 0.33* | 0.22 | 0.28* | 1.00 | | | | | |
| BCI | 0.26* | 0.49* | 0.30* | 0.62* | 0.54* | 0.41* | 0.52* | 0.51* | 1.00 | | | | |
| S&P-500 | 0.05 | 0.47* | 0.28* | 0.68* | 0.55* | 0.48* | 0.49* | 0.51* | 0.69* | 1.00 | | | |
| FTSE-100 | 0.05 | 0.44* | 0.18 | 0.68* | 0.49* | 0.36* | 0.47* | 0.53* | 0.65* | 0.84* | 1.00 | | |
| NIKKEI-225 | 0.12 | 0.55* | 0.33* | 0.56* | 0.48* | 0.30* | 0.53* | 0.42* | 0.60* | 0.60* | 0.59* | 1.00 | |
| CAC-40 | 0.04 | 0.42* | 0.22 | 0.57* | 0.31* | 0.31* | 0.43* | 0.53* | 0.61* | 0.79* | 0.84* | 0.56* | 1.00 |

*Significant at 0.05 level

The results indicate that there exist no significant correlations between KSE-100 and other markets. There exist 0.26 correlation in between the KSE-100 and BSE. Further the statistics indicate that there exists 0.26 correlation in between KSE-100 and BCI. Figure1 and Figure 2 present the snap of both markets behavior with KSE-100 for this period. Graphical presentation of other markets returns behavior to KSE-100 is reported in the appendix A. Table 2.1 clearly indicates the correlations in between Pakistan and the remaining emerging equity markets.

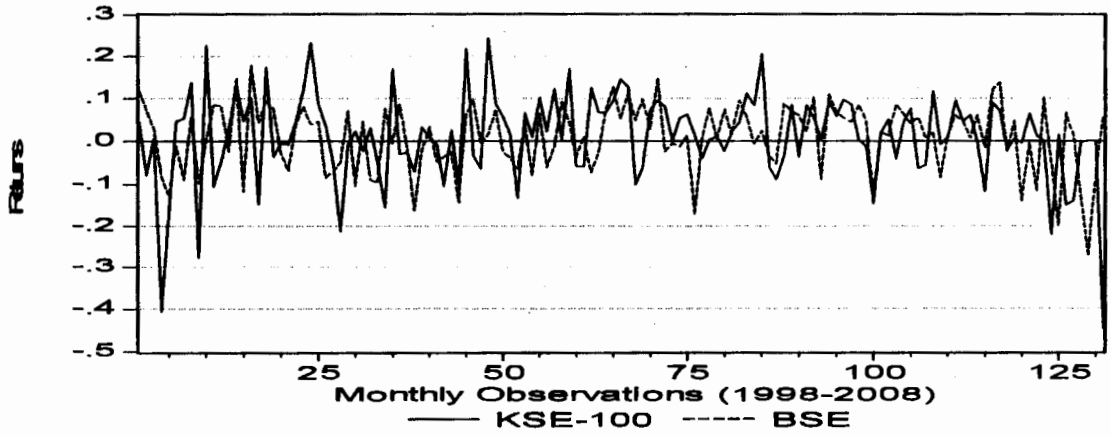


**Figure 1: Returns Movement of KSE-100 with BSE**

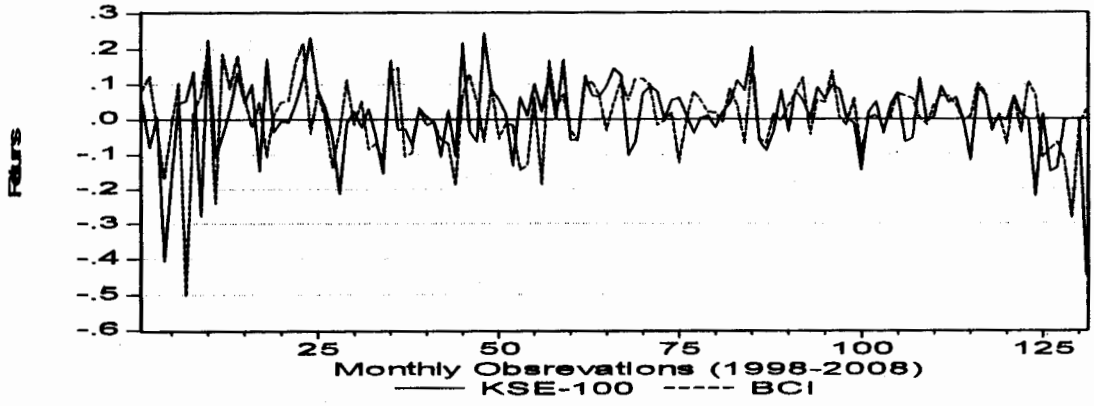


**Figure 2: Returns Movement of KSE-100 with BCI**

**Table 2.1: Correlation Matrix of KSE-100 with Emerging Markets**

| Equity Markets | KSE-100 | BSE | SCI | HSI | SET | KLSE | JCI | ISE | BCI |
|---|---|---|---|---|---|---|---|---|---|
| KSE-100 | 1.00 | | | | | | | | |
| BSE | 0.26* | 1.00 | | | | | | | |
| SCI | 0.04 | 0.36* | 1.00 | | | | | | |
| HIS | 0.11 | 0.48* | 0.35* | 1.00 | | | | | |
| SET | 0.17 | 0.43* | 0.19 | 0.60* | 1.00 | | | | |
| KLSE | 0.18 | 0.36* | 0.26* | 0.53* | 0.58* | 1.00 | | | |
| JCI | 0.06 | 0.44* | 0.23* | 0.45* | 0.56* | 0.50* | 1.00 | | |
| ISE | 0.18 | 0.32* | 0.16 | 0.41* | 0.33* | 0.22 | 0.28* | 1.00 | |
| BCI | 0.26* | 0.49* | 0.30* | 0.62* | 0.54* | 0.41* | 0.52* | 0.51* | 1.00 |

*Significant at 0.05 level

Table 2.1 presents the results in a more collaborative way that how the emerging markets correlates among them-selves and explains the position of Pakistan regarding to the association with these markets. Correlation measure indicates that the level of integration exists or not among these markets. KSE-100 has 0.18, 0.18, 0.17 degree of correlation with the ISE, KLSE and SET respectively which seems apparently not too much significant. Correlation results reveal that India has higher association levels with other emerging markets than Pakistan. It has 0.49, 0.48, 0.44 and 0.43 with Brazil, Hong-Kong, Indonesia, and Thailand respectively which seems quite significant. It seems that Indian economy has increased cash flow patrons with these economies. Hong Kong has 0.60, 0.62 and 0.53 correlations with the Thailand, Brazil and Malaysia respectively which seems quite significant and shows the higher degree of relationship among these markets. The market of Thailand has significant degree of relationship with Hong Kong, Malaysia, Indonesia and Brazil. Brazilian market has significant correlation of 0.52 with Indonesian equity market. High correlations level indicates that these markets have integration and it may be due to high influx of capital flow among these economies. Table 2.2 indicates the correlations in between Pakistan, United States, England, Japan and France.

**Table 2.2: Correlation Matrix of KSE-100 with Developed Markets**

| Equity Markets | KSE-100 | S&P-500 | FTSE-100 | NIKKEI-225 | CAC-40 |
|---|---|---|---|---|---|
| KSE-100 | 1.00 | | | | |
| S&P-500 | 0.05 | 1.00 | | | |
| FTSE-100 | 0.05 | 0.84* | 1.00 | | |
| NIKKEI-225 | 0.12 | 0.60* | 0.59* | 1.00 | |
| CAC-40 | 0.04 | 0.79* | 0.84* | 0.56* | 1.00 |

*Significant at 0.05 level

Results explore that Pakistan has poor degree of correlation with United States, England, Japan and France, but it is very clear that United States has strong correlation of 0.84 and 0.79 with the equity market of England and France respectively. US have 0.59 correlation with the Japan. England has also strong correlation of 0.84 with the France which is highly significant, it is because of that both countries belong to European Union economic block and have high level of economic and business interactions. Japanese market has 0.56 correlation with French market which is also significant. The lower level of correlation in between the KSE-100 and the developed markets provides attraction to the foreign and institutional investors to get the stream of portfolio diversification benefits by investing in Pakistan. In the same practices the increased correlations among these developed markets are reducing the portfolio diversification opportunities. Figure 3 presents the movement of the KSE-100 with the developed markets.

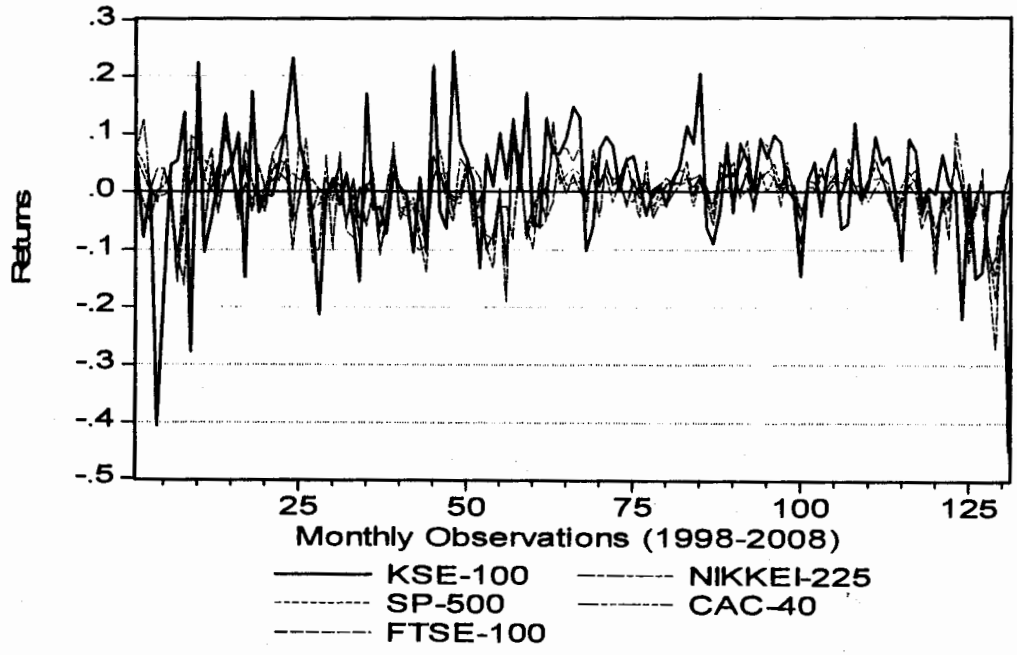


**Figure 3: Returns Movement of KSE-100 with Developed Stock Markets**

Graphical representation indicates that equity market of Pakistan has his own movement pattern separate from the developed market returns patterns. As correlation analysis is a weaker approach because it does not study the cause and effect relationship. So the study further focuses on other methodologies to view the long term and short term causal and dynamic nature of relationship.

**Table 3: Unit Root Test**

| Stock Markets | Augmented Dicky-Fulller Test at Level | Augmented Dicky-Fulller Test at 1st Difference | Phillip - Perron Test at Level | Phillip-Perron Test at 1st Difference |
|---|---|---|---|---|
| KSE-100 | -1.31223 | -3.08269 | -1.07712 | -9.06159 |
| BSE | -1.2952 | -3.18235 | -1.08985 | -10.5195 |
| SCI | -2.54922 | -2.81845 | -1.80221 | -11.4771 |
| HSI | -1.85977 | -4.66697 | -1.80127 | -9.86858 |
| SET | -1.79966 | -5.06831 | -1.50654 | -10.7137 |
| KLSE | -1.8219 | -4.77613 | -1.74731 | -9.70842 |
| JCI | -1.27006 | -3.36238 | -1.04141 | -8.46961 |
| ISE | -1.30087 | -4.1366 | -1.32913 | -12.5332 |
| BCI | -1.32323 | -4.34049 | -1.08113 | -9.08951 |
| S & P- 500 | -1.58193 | -3.78711 | -1.74302 | -10.2449 |
| FTSE-100 | -1.42167 | -4.38234 | -1.34741 | -11.0615 |
| NIKKEI-225 | -1.59139 | -3.9933 | -1.46029 | -10.3516 |
| CAC-40 | -1.59503 | -4.01877 | -1.72176 | -9.91856 |

**Table 3.1 Critical Values**

| Probabilities | 1% | 5% | 10% |
|---|---|---|---|
| ADF at level | -3.4826 | -2.8842 | -2.5787 |
| ADF at First difference | -3.4831 | -2.8844 | -2.5788 |
| PP at level | -3.4811 | -2.8835 | -2.5783 |
| PP at First difference | -3.4815 | -2.8837 | -2.5784 |

Table 3 indicates the unit root analysis of the series. Augmented Dickey Fuller (1981) and Phillip-Perron (1988) test is applied to testify the stationarity of the financial data series. Test has been applied on level and at first difference based on constant and trend in the model. Suitable lag length is used to view the stationarity of the series. By applying the ADF test on the monthly data series at level it remained non- stationary but at differencing 1 the series became stationary at 5% probability level and only SCI become stationary at 10% probability. By applying the PP test at level it remained non-stationary but at first difference all series become stationary at 5% level of probability. All indices series become integrated of order 1(1). For next step the study takes into consideration the Johansen and Juselius multivariate and bi-variate co-integration tests. It is assumed that the co-integration model has constant and linear trend regarding to their co-integrating vectors. Lags for this purpose are selected from 1 to 4 to see the stronger co-integrating relationships and to minimize the Akaike Information Criterion. Table 4 and 4.1 indicates the multivariate co-integration test-trace statistics and maximum eigenvalue statistics respectively. Trace statistics indicates that there are eleven co-integrating vectors at 0.05 critical value. And for further confirmation the study applied the Maximum eigenvalue test. It means that these markets are integrated among each other on long run basis.

## Table 4: Multivariate Co-Integration Test-Trace Statistics

| Equity Markets | Hypothesis | Eigenvalue | Trace Statistics | Critical Value at 5% | Remarks |
|---|---|---|---|---|---|
| KSE-100 | None* | 0.565372 | 679.8332 | 334.9837 | Trace Statistics provides results that there exists eleven co-integrating equations at 0.05 critical value level |
| BSE | At most 1* | 0.560204 | 574.0085 | 334.9837 | |
| SCI | At most 2* | 0.519965 | 469.685 | 285.1425 | |
| HSI | At most 3* | 0.453445 | 376.4803 | 239.2354 | |
| SET | At most 4* | 0.399292 | 299.7571 | 197.3709 | |
| KLSE | At most 5* | 0.351318 | 235.032 | 159.5297 | |
| JCI | At most 6* | 0.318643 | 180.0648 | 125.6154 | |
| ISE | At most 7* | 0.279437 | 131.3389 | 95.75366 | |
| BCI | At most 8* | 0.224866 | 89.71821 | 69.81889 | |
| S&P-500 | At most 9* | 0.159694 | 57.36887 | 47.85613 | |
| FTSE-100 | At most 10* | 0.149755 | 35.27231 | 29.79707 | |
| NIKKEI-225 | At most 11 | 0.100829 | 14.669 | 15.49471 | |
| CAC-40 | At most 12 | 0.00918 | 1.171209 | 3.841466 | |

## Table 4.1: Multivariate Co-integration Test Maximum Eigenvalue Statistics

| Equity Markets | Hypothesis | Eigenvalue | Maximum Eigenvalue Statistics | Critical Value at 5% | Remarks |
|---|---|---|---|---|---|
| KSE-100 | None* | 0.565372 | 105.8246 | 76.57843 | Maximum eigenvalue Statistics provides results that there exists 8 co-integrating equations at 0.05critical value level |
| BSE | At most 1* | 0.560204 | 104.3235 | 76.57843 | |
| SCI | At most 2* | 0.519965 | 93.20471 | 70.53513 | |
| HSI | At most 3* | 0.453445 | 76.72321 | 64.50472 | |
| SET | At most 4* | 0.399292 | 64.72513 | 58.43354 | |
| KLSE | At most 5* | 0.351318 | 54.96714 | 52.36261 | |
| JCI | At most 6* | 0.318643 | 48.72594 | 46.23142 | |
| ISE | At most 7* | 0.279437 | 41.62069 | 40.07757 | |
| BCI | At most 8 | 0.224866 | 32.34934 | 33.87687 | |
| S&P-500 | At most 9 | 0.159694 | 22.09656 | 27.58434 | |
| FTSE-100 | At most 10 | 0.149755 | 20.6033 | 21.13162 | |
| NIKKEI-225 | At most 11 | 0.100829 | 13.4978 | 14.2646 | |
| CAC-40 | At most 12 | 0.00918 | 1.171209 | 3.841466 | |

Table 4.1 authenticates the eight co-integrating vectors at 0.05 critical value levels. Moreover it confirms that there exist eight co-integrating vectors among these markets. So it means that there exists long run relationship among these markets. According to hypothesis 1 the results of table 4 and 4.1 accept the $H_0$ and reject the $H_1$. Moreover the study also confirms the hypothesis 2 that developed markets have long run relationships with the KSE and rejects the alternate hypothesis $H_1$. So the above results reveal that emerging and developed market has long run relationships with the KSE. Figure 4 shows the trend of Karachi Stock Exchange and other emerging markets. Figure 5 shows the trend of KSE and developed markets. Figure 4 indicates that the flow of all markets indices movement is going in a rhythm and the trend is in a smooth manner. Figure 5 shows that developed markets are going in same patrons but KSE-100 has its own patron. Trend of KSE-100 with other emerging and developed markets is presented in appendix B.

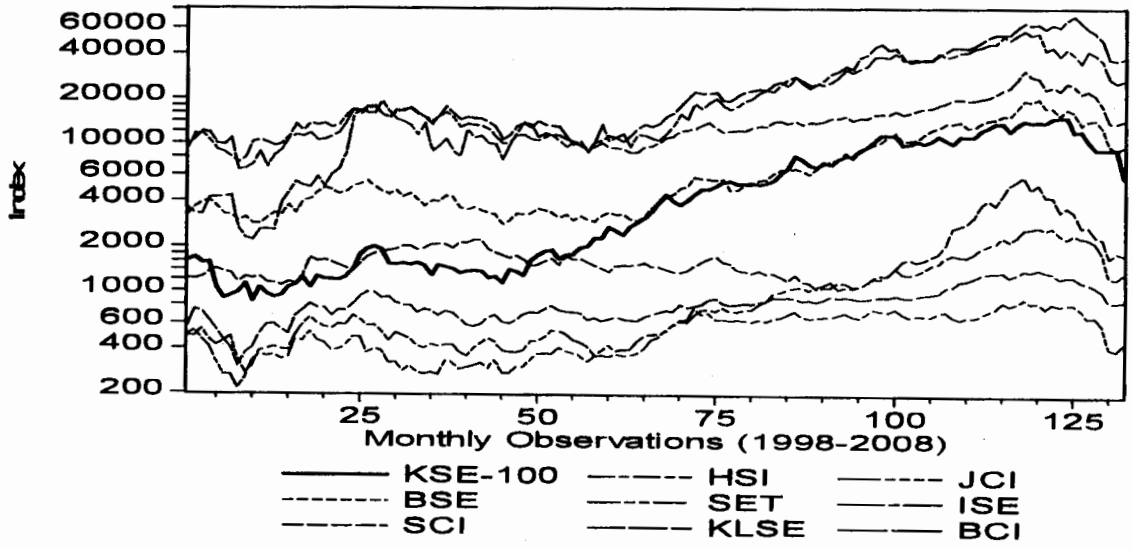


**Figure 4: Trend of KSE-100 with Emerging Markets**

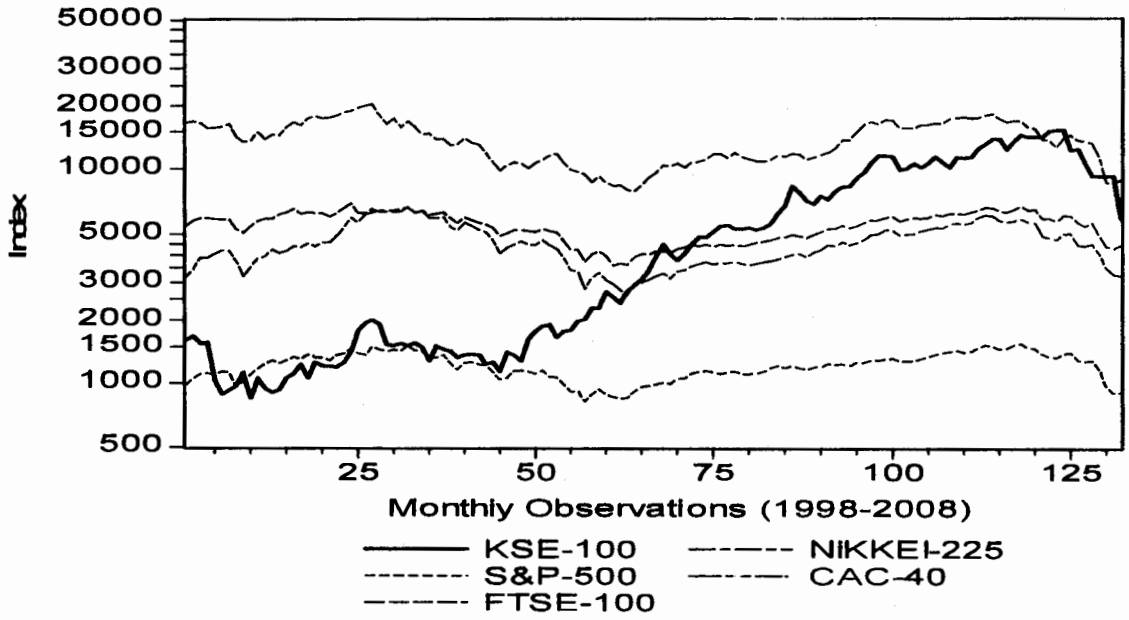


**Figure 5: Trend of KSE-100 with Developed Markets**

Bi-variate test is applied to know the pair-wise co-integration among the KSE-100 and other equity markets. It indicates the presence of long run relationship among the couples. Table 5 indicates the Trace Statistics under Bi-variate co-integration test. Bi-variate statistics indicates at lag 1 to 4 that there exist two co-integrating vectors at 0.05 levels with the JCI and only one co-integrating vector exists with the BCI at 0.05 critical value. The results reveal that KSE-100 has no longer relationships to other markets except JCI and BCI and therefore attracts the opportunity of portfolio diversification benefits to the investors of India, China, Hong Kong, Turkey, Malaysia, USA, UK, Japan, France and other interested parties. Figure 6 and 7 indicates clearly the trend of SE-100 with JCI and BCI in same behavior on long run basis with KSE-100.

## Table 5: Bi-variate Co-integration Test-

## Trace Statistics

| | Hypothesis | Eigenvalue | Trace Statistics | Critical Values at 0.05 level | Remarks |
|---|---|---|---|---|---|
| KSE-100—BSE | None | 0.089351 | 15.3685 | 15.49471 | No existence of |
| | At most 1 | 0.027041 | 3.481552 | 3.841466 | Co-integration |
| KSE-100—SCI | None | 0.090421 | 13.59471 | 15.49471 | No existence of |
| | At most 1 | 0.012197 | 1.558543 | 3.841466 | Co-integration |
| KSE-100—HSI | None | 0.058896 | 9.249952 | 15.49471 | No existence of |
| | At most 1 | 0.012059 | 1.540858 | 3.841466 | Co-integration |
| KSE-100—SET | None | 0.090143 | 14.68735 | 15.49471 | No existence of |
| | At most 1 | 0.020958 | 2.68989 | 3.841466 | Co-integration |
| KSE-100—KLSE | None | 0.067796 | 10.72862 | 15.49471 | No existence of |
| | At most 1 | 0.014172 | 1.812731 | 3.841466 | Co-integration |
| KSE-100—JCI | None * | 0.09062 | 16.46303 | 15.49471 | Existence of 2 |
| | At most 1 * | 0.034045 | 4.39902 | 3.841466 | Co-integrations |
| KSE-100—ISE | None | 0.093082 | 14.19428 | 15.49471 | No existence of |
| | At most 1 | 0.013964 | 1.785943 | 3.841466 | Co-integration |
| KSE-100—BCI | None * | 0.111654 | 17.77988 | 15.49471 | Existence of 1 |
| | At most 1 | 0.021374 | 2.743914 | 3.841466 | Co-integration |
| KSE-100- S&P500 | None | 0.023205 | 3.719448 | 15.49471 | No existence of |
| | At most 1 | 0.005792 | 0.737697 | 3.841466 | Co-integration |
| KSE -100—FTSE-100 | None | 0.02159 | 3.575532 | 15.49471 | No existence of |
| | At most 1 | 0.006308 | 0.803592 | 3.841466 | Co-integration |
| KSE-100—NIKKEI-225 | None | 0.021546 | 4.342553 | 15.49471 | No existence of |
| | At most 1 | 0.012336 | 1.576361 | 3.841466 | Co-integration |
| KSE-100—CAC-40 | None | 0.022505 | 3.916949 | 15.49471 | No existence of |
| | At most 1 | 0.008047 | 1.026153 | 3.841466 | Co-integration |

According to the hypothesis 1 here the results confirms $H_0$ only for JCI and BCI for long run relationship to KSE and rejects $H_0$ for other emerging markets regarding long run relationship to KSE. Moreover for Hypothesis 2 the results reject the $H_0$ and accept the $H_1$. It means that developed markets have no long run relationship individually with the KSE.

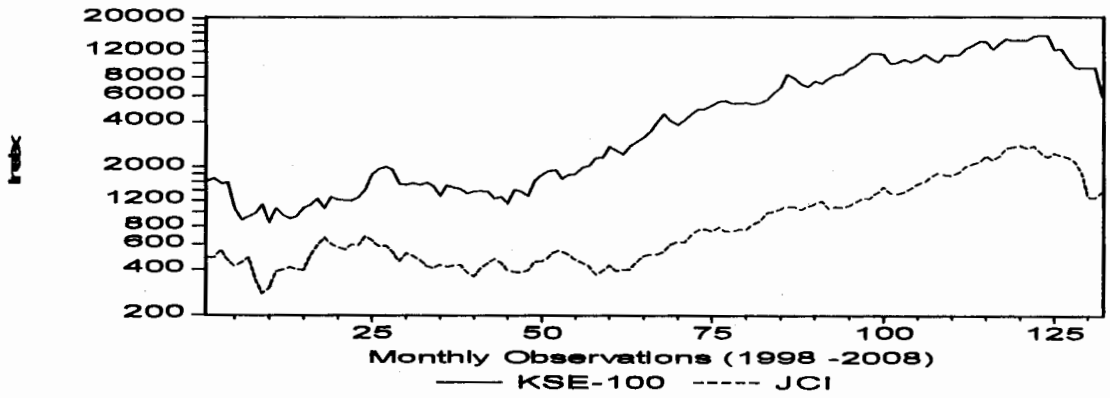


**Figure 6: Trend of KSE-100 with JCI**

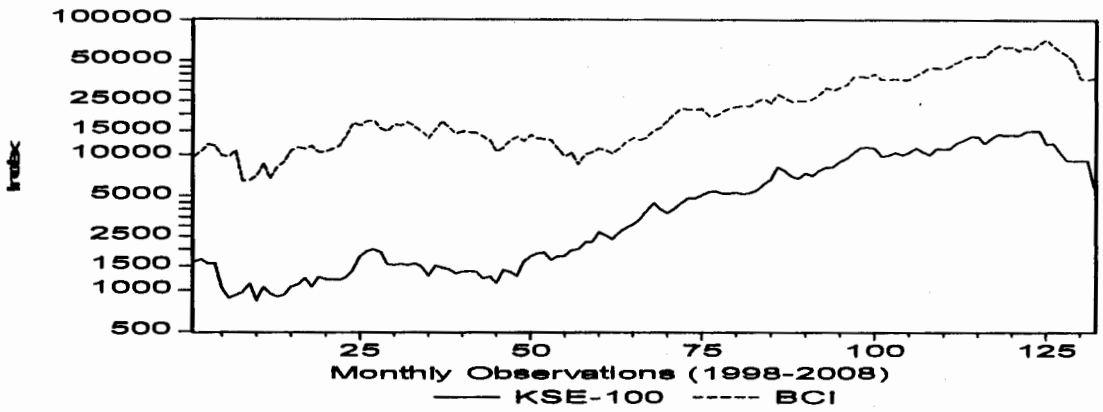


**Figure 7: Trend of KSE-100 with BCI**

As for as concerned to the long run relationships. the study also focus on short term relationship in between the equity markets. So error correction term is absorbed in the Vector Autoregressive Model. Table 6 provides VECM to explain short run co-integrating vectors. The error correction model is consistently significant for KSE-100, BSE, SCI, JCI, ISE, BCI, FTSE-100 and NIKKEI-225 at 1% level and further significant for HSI, S&P-500, CAC-40 at 5% level regarding to this period. VECM provides that 23% of total variation is adjusted within one time period. According to short run analysis

the KSE-100 indicates that it does not depends upon the lagged value of its own indices at 0.05 level.

## Table 6: Vector Error Correction Model Cont...

| Error Correction: | D(KSE-100) | D(BSE) | D(SCI) | D(HSI) | D(SET) | D(KLSE) | D(JCI) | D(ISE) | D(BCI) | D(S&P-500) | D(FTSE-100) | D(NIKKEI-225) | D(CAC-40) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CointEq1 | -0.235399 | 0.456469 | 0.109192 | 0.390803 | 0.012361 | -4.97E-05 | 0.06993 | 1.191908 | 1.631527 | 0.020657 | 0.096536 | 0.624152 | 0.092077 |
| | (0.08916) | (0.09428) | (0.03695) | (0.17581) | (0.00663) | (0.00824) | (0.01218) | (0.40431) | (0.34003) | (0.00886) | (0.03619) | (0.11833) | (0.04184) |
| | [-2.64032] | [ 4.84183] | [ 2.95527] | [ 2.22289] | [ 1.86450] | [-0.00603] | [ 5.74209] | [ 2.94799] | [ 4.79816] | [ 2.33079] | [ 2.66723] | [ 5.27484] | [ 2.20063] |
| D(KSE-100(-1)) | 0.244289 | 0.0115 | -0.026886 | 0.082035 | 0.007421 | 0.013699 | -0.016233 | 0.528151 | -0.305605 | 0.002499 | 0.018212 | -0.191139 | 0.050716 |
| | [ 2.04156] | [ 0.09088] | [-0.54218] | [ 0.34767] | [ 0.83397] | [ 1.23922] | [-0.99314] | [ 0.97330] | [-0.66965] | [ 0.21009] | [ 0.37491] | [-1.20358] | [ 0.90312] |
| D(KSE-100(-2)) | 0.005979 | -0.219757 | -0.058075 | -0.185888 | 0.005943 | 0.0035 | -0.012663 | -1.125154 | 0.299958 | -0.002586 | 0.025879 | -0.214534 | -0.009023 |
| | [ 0.05335] | [-1.85438] | [-1.25042] | [-0.84114] | [ 0.71309] | [ 0.33806] | [-0.82721] | [-2.21387] | [ 0.70177] | [-0.23216] | [ 0.56881] | [-1.44236] | [-0.17156] |
| D(BSE(-1)) | 0.04993 | -0.342508 | -0.068706 | -0.198322 | -0.004303 | -0.01233 | -0.0197 | -1.904221 | -0.460378 | -0.014093 | -0.078103 | -0.312411 | -0.101641 |
| | [ 0.37421] | [-2.42758] | [-1.24254] | [-0.75377] | [-0.43373] | [-0.99983] | [-1.08086] | [-3.14707] | [-0.90469] | [-1.06252] | [-1.44193] | [-1.76421] | [-1.62319] |
| D(BSE(-2)) | 0.084821 | -0.494258 | -0.122291 | -0.724409 | -0.022319 | -0.01178 | -0.039874 | -1.064039 | -1.343645 | -0.017701 | -0.0573 | -0.196266 | -0.075095 |
| | [ 0.69724] | [-3.84220] | [-2.42567] | [-3.01976] | [-2.46719] | [-1.04831] | [-2.39953] | [-1.92872] | [-2.89596] | [-1.46377] | [-1.16026] | [-1.21561] | [-1.31533] |
| D(SCI(-1)) | 0.278899 | -0.660753 | 0.011509 | -0.261521 | -0.056108 | -0.01796 | -0.056446 | -1.980544 | -1.39456 | 0.006578 | -0.003019 | -0.21993 | 0.031205 |
| | [ 0.99374] | [-2.22646] | [ 0.09895] | [-0.47255] | [-2.68848] | [-0.69252] | [-1.47237] | [-1.55612] | [-1.30285] | [ 0.23577] | [-0.02650] | [-0.59044] | [ 0.23691] |
| D(SCI(-2)) | 0.955585 | 1.178357 | 0.455327 | 2.400263 | 0.049592 | 0.056288 | 0.155925 | 2.220451 | 2.828609 | 0.007211 | 0.119297 | 0.063801 | 0.036636 |
| | [ 3.31911] | [ 3.87059] | [ 3.81622] | [ 4.22787] | [ 2.31643] | [ 2.11622] | [ 3.96481] | [ 1.70069] | [ 2.57605] | [ 0.25195] | [ 1.32071] | [ 0.16697] | [ 0.27115] |
| D(HSI(-1)) | -0.186144 | 0.305737 | 0.007482 | 0.353857 | 0.013328 | 0.015892 | 0.020094 | 1.068012 | 0.641383 | 0.017783 | 0.059769 | 0.121353 | 0.053246 |
| | [-2.38841] | [ 3.70985] | [ 0.23166] | [ 2.30249] | [ 2.29981] | [ 2.20710] | [ 1.88751] | [ 3.02182] | [ 2.15777] | [ 2.29531] | [ 1.88909] | [ 1.17322] | [ 1.45576] |
| D(HSI(-2)) | -0.10476 | 0.124556 | 0.036091 | -0.121535 | -0.000126 | 0.0086 | -0.005274 | 0.394324 | -0.127045 | 0.001119 | -0.007587 | -0.07359 | 0.013736 |
| | [-1.26995] | [ 1.42791] | [ 1.05571] | [-0.74714] | [-0.02058] | [ 1.12839] | [-0.46807] | [ 1.05409] | [-0.40381] | [ 0.13648] | [-0.22657] | [-0.67217] | [ 0.35480] |
| D(SET(-1)) | 0.917211 | -0.510126 | 1.466865 | 3.020958 | -0.17977 | -0.00181 | -0.314217 | -2.730715 | 1.634302 | -0.250745 | -1.73785 | -3.476181 | -1.337535 |
| | [ 0.51680] | [-0.27182] | [ 1.99433] | [ 0.86319] | [-1.36214] | [-0.01103] | [-1.29608] | [-0.33928] | [ 0.24144] | [-1.42124] | [-2.41201] | [-1.47577] | [-1.60583] |
| D(SET(-2)) | 1.649266 | 3.366596 | 1.015825 | 8.767355 | 0.165013 | 0.357728 | 0.058803 | -5.650079 | 2.540985 | 0.185844 | 0.199486 | 2.329852 | 0.144399 |

## Table 6: Vector Error Correction Model

**Cont...**

| Error Correction: | D(KSE-100) | D(BSE) | D(SCI) | D(HSI) | D(SET) | D(KLSE) | D(JCI) | D(ISE) | D(BCI) | D(S&P-500) | D(FTSE-100) | D(NIKKEI-225) | D(CAC-40) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [ 0.92832] | [ 1.79202] | [ 1.37969] | [ 2.50256] | [ 1.24905] | [ 2.17948] | [ 0.24230] | [-0.70128] | [ 0.37500] | [ 1.05230] | [ 0.27659] | [ 0.98810] | [ 0.17319] |
| D(KLSE(-1)) | 0.649705 | -3.312402 | -0.817803 | -5.128447 | -0.071634 | 0.135868 | -0.097864 | -17.21492 | -11.32325 | -0.275275 | -0.81932 | -0.194949 | -0.992117 |
| | [ 0.48130] | [-2.32054] | [-1.46186] | [-1.92661] | [-0.71363] | [ 1.08946] | [-0.53073] | [-2.81213] | [-2.19937] | [-2.05141] | [-1.49510] | [-0.10881] | [-1.56605] |
| D(KLSE(-2)) | 1.799745 | -2.61407 | -0.219113 | -4.829705 | 0.025428 | -0.13377 | -0.232153 | 1.755261 | -3.831038 | 0.022972 | 0.235842 | -1.652302 | 0.222654 |
| | [ 1.44519] | [-1.98507] | [-0.42456] | [-1.96672] | [ 0.27459] | [-1.16273] | [-1.36471] | [ 0.31080] | [-0.80660] | [ 0.18556] | [ 0.46650] | [-0.99970] | [ 0.38097] |
| D(JCI(-1)) | -1.305709 | 3.599289 | 0.825686 | 2.717044 | 0.109563 | -0.03687 | 0.459842 | 10.77201 | 5.561089 | 0.191516 | 0.572565 | 2.14788 | 0.568181 |
| | [-1.34422] | [ **3.50420**] | [ 2.05115] | [ 1.41851] | [ 1.51686] | [-0.41086] | [ **3.46567**] | [ 2.44542] | [ 1.50111] | [ 1.98343] | [ 1.45200] | [ 1.66611] | [ 1.24640] |
| D(JCI(-2)) | 0.107263 | 3.817426 | 0.374857 | 2.8949 | 0.054799 | 0.03069 | 0.153027 | 6.441487 | 9.962005 | 0.13299 | 0.361096 | 2.401773 | 0.432985 |
| | [ 0.12498] | [ **4.20624**] | [ 1.05390] | [ 1.71049] | [ 0.85863] | [ 0.38705] | [ 1.30526] | [ 1.65499] | [ **3.04335**] | [ 1.55876] | [ 1.03637] | [ 2.10851] | [ 1.07496] |
| D(ISE(-1)) | -0.019077 | 0.084202 | 0.018397 | -0.052956 | -0.000213 | 0.000492 | 0.006535 | 0.072509 | 0.070836 | 0.000785 | 0.012125 | 0.082006 | 0.01596 |
| | [-0.60879] | [ 2.54115] | [ 1.41666] | [-0.85700] | [-0.09156] | [ 0.16984] | [ 1.52673] | [ 0.51025] | [ 0.59271] | [ 0.25208] | [ 0.95315] | [ 1.97186] | [ 1.08529] |
| D(ISE(-2)) | 0.018826 | 0.12493 | 0.027287 | 0.127842 | 0.004956 | -0.00025 | 0.015017 | 0.465439 | 0.461938 | 0.004874 | 0.01974 | 0.142793 | 0.027234 |
| | [ 0.60601] | [ **3.80306**] | [ 2.11952] | [ 2.08691] | [ 2.14560] | [-0.08579] | [ **3.53889**] | [ **3.30380**] | [ **3.89880**] | [ 1.57830] | [ 1.56529] | [ **3.46333**] | [ 1.86797] |
| D(BCI(-1)) | 0.024418 | -0.079911 | -0.026198 | -0.018223 | 0.001791 | -0.00247 | -4.34E-05 | -0.037184 | 0.138973 | -0.001372 | -0.005066 | -0.017261 | -0.009274 |
| | [ 0.64233] | [-1.98792] | [-1.66294] | [-0.24310] | [ 0.63366] | [-0.70177] | [-0.00836] | [-0.21569] | [ 0.95853] | [-0.36319] | [-0.32825] | [-0.34213] | [-0.51982] |
| D(BCI(-2)) | 0.030612 | -0.09169 | -0.022011 | -0.022871 | -0.00666 | -0.00318 | -0.002816 | -0.211073 | -0.276802 | -0.004439 | -0.019626 | -0.031348 | -0.02249 |
| | [ 0.79088] | [-2.24019] | [-1.37218] | [-0.29964] | [-2.31393] | [-0.89023] | [-0.53256] | [-1.20250] | [-1.87506] | [-1.15373] | [-1.24898] | [-0.61023] | [-1.23809] |
| D(S&P-500(-1)) | 0.481199 | 1.188569 | -0.10197 | 1.565837 | 0.159575 | -0.07433 | 0.193194 | 9.870645 | 6.056403 | 0.079452 | 1.835164 | 1.393991 | 1.860431 |
| | [ 0.24255] | [ 0.56656] | [-0.12402] | [ 0.40025] | [ 1.08167] | [-0.40554] | [ 0.71289] | [ 1.09711] | [ 0.80042] | [ 0.40287] | [ 2.27859] | [ 0.52942] | [ 1.99817] |
| D(S&P-500(-2)) | 0.868583 | -0.536635 | -1.244863 | -3.629125 | -0.089486 | -0.0119 | 0.315627 | -1.926267 | 7.017421 | -0.07479 | 0.96821 | 0.042966 | 0.638846 |
| | [ 0.44461] | [-0.25977] | [-1.53760] | [-0.94205] | [-0.61599] | [-0.06594] | [ 1.18275] | [-0.21743] | [ 0.94183] | [-0.38512] | [ 1.22082] | [ 0.01657] | [ 0.69680] |
| D(FTSE-100(-1)) | 0.925136 | -1.426536 | -0.522948 | -2.559737 | 0.004785 | -0.00577 | -0.116897 | -6.402851 | -4.621264 | -0.071408 | -0.545288 | -1.427047 | -0.432992 |
| | [ 1.50830] | [-2.19944] | [-2.05730] | [-2.11635] | [ 0.10490] | [-0.10188] | [-1.39520] | [-2.30190] | [-1.97547] | [-1.17116] | [-2.18991] | [-1.75302] | [-1.50420] |
| D(FTSE-100(-2)) | 0.257681 | -0.919744 | -0.22247 | -0.760748 | 0.012239 | 0.057589 | -0.07313 | -1.394993 | -3.553844 | -0.034764 | 0.003187 | -0.924971 | -0.071175 |

# Table 6: Vector Error Correction Model

| Error Correction: | D(KSE-100) | D(BSE) | D(SCI) | D(HSI) | D(SET) | D(KLSE) | D(JCI) | D(ISE) | D(BCI) | D(S&P-500) | D(FTSE-100) | D(NIKKEI-225) | D(CAC-40) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [ 0.46569] | [-1.57190] | [-0.97015] | [-0.69721] | [ 0.29745] | [ 1.12653] | [-0.96752] | [-0.55592] | [-1.68398] | [-0.63202] | [ 0.01419] | [-1.25952] | [-0.27408] |
| D(NIKKEI-225(-1)) | 0.036383 | 0.035551 | -0.020058 | 0.188283 | -0.00206 | 0.008458 | 0.011028 | 0.719483 | -0.104513 | 0.001015 | 0.037957 | 0.107162 | 0.062392 |
| | [ 0.42647] | [ 0.39408] | [-0.56732] | [ 1.11921] | [-0.32471] | [ 1.07311] | [ 0.94629] | [ 1.85971] | [-0.32121] | [ 0.11964] | [ 1.09598] | [ 0.94645] | [ 1.55834] |
| D(NIKKEI-225(-2)) | -0.004548 | -0.147499 | 0.023587 | -0.085629 | 0.009355 | -0.00034 | -0.018017 | 0.543152 | -0.150845 | 0.008084 | -0.001771 | 0.038897 | 0.022737 |
| | [-0.05268] | [-1.61570] | [ 0.65925] | [-0.50299] | [ 1.45722] | [-0.04250] | [-1.52782] | [ 1.38733] | [-0.45813] | [ 0.94197] | [-0.05054] | [ 0.33947] | [ 0.56117] |
| D(CAC-40(-1)) | -0.115395 | 0.561287 | 0.377308 | 0.976737 | -0.04046 | 0.016536 | 0.010553 | 1.537802 | 1.508648 | 0.049574 | 0.041654 | 0.848585 | -0.032771 |
| | [-0.26584] | [ 1.22281] | [ 2.09740] | [ 1.14108] | [-1.25345] | [ 0.41234] | [ 0.17798] | [ 0.78120] | [ 0.91127] | [ 1.14887] | [ 0.23638] | [ 1.47296] | [-0.16086] |
| D(CAC-40(-2)) | -0.756439 | 0.525606 | 0.292593 | 0.63177 | -0.029687 | -0.04545 | -0.021932 | -0.929057 | 0.654617 | -0.01648 | -0.324822 | -0.005107 | -0.115442 |
| | [-1.79721] | [ 1.18096] | [ 1.67744] | [ 0.76119] | [-0.94854] | [-1.16887] | [-0.38146] | [-0.48674] | [ 0.40779] | [-0.39388] | [-1.90103] | [-0.00914] | [-0.58443] |
| C | 24.28487 | 18.98028 | 4.992398 | 20.23206 | 0.254885 | 3.147572 | 1.690373 | 187.6785 | 46.4459 | -2.498873 | -17.52947 | -79.24429 | -6.763801 |
| | (49.41700) | (52.25520) | (20.47950) | (97.44670) | (3.67469) | (4.56544) | (6.75030) | (224.10200) | (188.47300) | (4.91236) | (20.06130) | (65.58570) | (23.19170) |
| | [ 0.49143] | [ 0.36322] | [ 0.24378] | [ 0.20762] | [ 0.06936] | [ 0.68944] | [ 0.25041] | [ 0.83747] | [ 0.24643] | [-0.50869] | [-0.87380] | [-1.20826] | [-0.29165] |

## Table 6.1 Error Correction Model Statistics

| $R^2$ | Adj. $R^2$ | Sum sq. resids | S.E. equation | F-statistic | Log likelihood | Akaike AIC | Schwarz SC | Mean dependent | S.D. dependent |
|---|---|---|---|---|---|---|---|---|---|
| 0.446339 | 0.29833 | 27364675 | 520.5164 | 3.015627 | -974.132 | 15.53694 | 16.15767 | 33.42597 | 621.3954 |
| 0.55386 | 0.43459 | 3.10E+07 | 550.411 | 4.64389 | -981.336 | 15.6486 | 16.2694 | 44.609 | 731.992 |
| 0.35723 | 0.1854 | 4699769 | 215.714 | 2.079 | -860.5 | 13.7752 | 14.3959 | 4.47899 | 239.005 |
| 0.42327 | 0.26909 | 1.06E+08 | 1026.42 | 2.74537 | -1061.73 | 16.895 | 17.5157 | 22.2388 | 1200.59 |
| 0.38418 | 0.21956 | 151313 | 38.706 | 2.33368 | -638.88 | 10.3393 | 10.96 | -0.0709 | 43.8134 |
| 0.33039 | 0.15138 | 233562 | 48.0884 | 1.8457 | -666.88 | 10.7734 | 11.3941 | 1.21884 | 52.2017 |
| 0.561344 | 0.444079 | 510603.3 | 71.10188 | 4.786984 | -717.331 | 11.55552 | 12.17626 | 6.31 | 95.36183 |
| 0.401065 | 0.240953 | 5.63E+08 | 2360.492 | 2.504909 | -1169.16 | 18.56054 | 19.18128 | 182.9848 | 2709.37 |
| 0.472756 | 0.331809 | 3.98E+08 | 1985.208 | 3.35415 | -1146.82 | 18.21425 | 18.83499 | 198.4729 | 2428.598 |
| 0.278559 | 0.085699 | 270407 | 51.74261 | 1.444358 | -676.331 | 10.91986 | 11.54059 | -1.53876 | 54.11326 |
| 0.306053 | 0.120542 | 4509771 | 211.3083 | 1.649785 | -857.839 | 13.73393 | 14.35466 | -11.6124 | 225.3248 |
| 0.394773 | 0.23298 | 48200932 | 690.8234 | 2.439984 | -1010.65 | 16.10306 | 16.7238 | -59.4375 | 788.7941 |
| 0.22512 | 0.01798 | 6027002 | 244.281 | 1.08679 | -876.544 | 14.0239 | 14.6447 | -5.09558 | 246.507 |

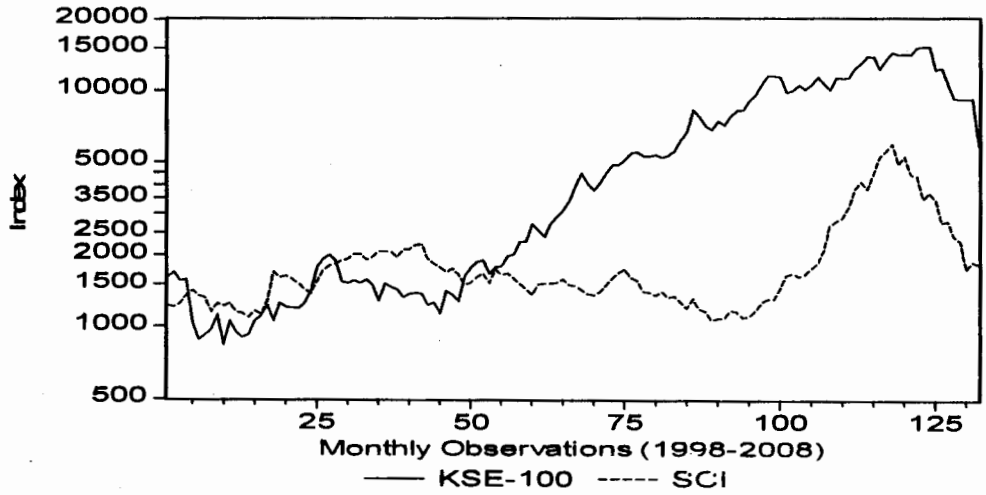


**Figure 8: Trend of KSE-100 with SCI**

Co-integration analysis reveals that KSE-100 has no long run relationship with the SCI but in short run analysis at lag 2 SCI significantly affects the KSE-100. Figure 8 shows the trend of KSE-100 with the SCI. This particular trend express that both markets have short term relationship. In the same way BSE is significantly affected by itself, SCI, JCI, ISE at lag 2 and also affected by HSI, JCI at lag 1. SCI is affected by itself only at lag 2. HSI is influenced by SCI, BSE at lag 2 and by SET at lag 1 significantly. SET is also affected by SCI at lag 1. JCI is influenced by itself, ISE and SCI at lag 2 on short term basis. ISE is affected on short term basis by itself at lag 2 and by KLSE, BSE and HSI at lag 1. BCI is influenced by BSE, JCI and ISE at lag 2. NIKKEI-225 is influenced by ISE at lag 2. The markets of KLSE, S&P-500, FTSE-100 and CAC-40 are not influenced by these markets. According to hypothesis 3, the null hypothesis is accepted only for SCI to KSE which means that SCI have short term relationship with KSE and nullifies the $H_0$ for other emerging markets. As for as concerned to hypothesis 4, the results totally rejects the $H_0$ and accept the $H_1$ that developing markets have no short term

relationship to the KSE. According to Table 6.1 $R^2$ value of KSE-100 is 44% and if $R^2$ is adjusted then it explains that 29% of the total variation is adjustable in 1 time period. Further these values are self-explanatory for other equity markets variation adjustments. Co-integration test does not explain the lead lag relationship and further it do not provide any pre- requisite for this. There may be other characteristics that can reason for causality in between the financial data series. To know the causal affects the study further explores and identifies the relationships through Granger Causality Model (1988). Table 7 indicates the Pair wise Granger Causality Tests of Karachi Stock Exchange-100 at lag 3 to explain the granger causality in between the returns of the data series. Decision criterion defines that if $H_0 < 0.05$ then reject the null hypothesis. By this test it is viewed that either there exits unidirectional or bidirectional granger causality among the KSE and Emerging & Developed markets or not at lag 3. The equity markets of BSE, SCI, SET, KLSE, JCI, ISE, BCI and Nikkei-225 granger causes to KSE-100 and KSE-100 granger causes to HSI, SET, KLSE, JCI. By this test it is very clear that KSE-100 has unidirectional relationship with the BSE, SCI, HSI, ISE, BCI, and Nikkei-225 and bidirectional causality with JCI, SET and KLSE. According to representation theorem it is approved that if two financial data series have bi-variate co-integration there should be granger causality at least in single direction.

## Table 7: Pair wise Granger Causality Test of KSE-100

| Null Hypothesis: | Observations | F-Statistic | Probability |
|---|---|---|---|
| | | | |
| BSE does not Granger Cause KSE-100 | 128 | 4.25386 | 0.00678 |
| KSE-100 does not Granger Cause BSE | | 1.21776 | 0.30628 |
| | | | |
| SCI does not Granger Cause KSE-100 | 128 | 6.22577 | 0.00057 |
| KSE-100 does not Granger Cause SCI | | 2.21605 | 0.08972 |
| | | | |
| HSI does not Granger Cause KSE-100 | 128 | 2.34378 | 0.07641 |
| KSE-100 does not Granger Cause HSI | | 2.97884 | 0.03421 |
| | | | |
| SET does not Granger Cause KSE-100 | 128 | 4.76546 | 0.00356 |
| KSE-100 does not Granger Cause SET | | 3.25843 | 0.02399 |
| | | | |
| KLSE does not Granger Cause KSE-100 | 128 | 4.65195 | 0.0041 |
| KSE-100 does not Granger Cause KLSE | | 6.97855 | 0.00023 |
| | | | |
| JCI does not Granger Cause KSE-100 | 128 | 2.83615 | 0.041 |
| KSE-100 does not Granger Cause JCI | | 3.6833 | 0.01399 |
| | | | |
| ISE does not Granger Cause KSE-100 | 128 | 3.47975 | 0.01811 |
| KSE-100 does not Granger Cause ISE | | 0.97794 | 0.40559 |
| | | | |
| BCI does not Granger Cause KSE-100 | 128 | 4.24612 | 0.00685 |
| KSE-100 does not Granger Cause BCI | | 2.21092 | 0.0903 |
| | | | |
| S&P-500 does not Granger Cause KSE-100 | 128 | 2.46146 | 0.06587 |
| KSE-100 does not Granger Cause S&P-500 | | 1.47573 | 0.22456 |
| | | | |
| FTSE-100 does not Granger Cause KSE-100 | 128 | 1.30331 | 0.27654 |
| KSE-100 does not Granger Cause FTSE-100 | | 0.95817 | 0.41492 |
| | | | |
| NIKKEI-225 does not Granger Cause KSE-100 | 128 | 3.2783 | 0.02339 |
| KSE-100 does not Granger Cause NIKKEI-225 | | 2.3909 | 0.072 |
| | | | |
| CAC-40 does not Granger Cause KSE-100 | 128 | 1.33797 | 0.26527 |
| KSE-100 does not Granger Cause CAC-40 | | 1.05811 | 0.36961 |

So KSE-100 has unidirectional causality with the co-integrated series of BCI and has bidirectional causality with the JCI. The results of pair wise granger causality between the other markets are placed in the appendix C. To view the dynamic responses in between the stock markets, impulse response test and variance decomposition test is

applied. Table 8 indicates the variance decomposition of KSE-100. Impulse response follows the consequences of single time shocks to the single time innovations on the present and futures values of the series. Figure 9 represents the impulse response of one market on other market. The equity market of Pakistan seems an exogenous market because majority of its shocks are described by its own innovations. However BSE, HSI, KLSE, ISE, JCI, BCI, FTSE-100 and CAC-40 have some impact on the equity market of Pakistan. BSE, HSI, BCI, CAC-40 have positive impact and KLSE, ISE, JCI, FTSE-100 have negative impact on KSE-100 on short term basis.

Impulse response behaviors for other markets are presented in Appendix D. The variance decomposition test is applied to view the shocks as described by other markets. It provides further insight into the matter that how these shocks affect the linkage mechanism. It provides the forecast error variance for other variables. The residuals curves of each market are reported in Appendix E.

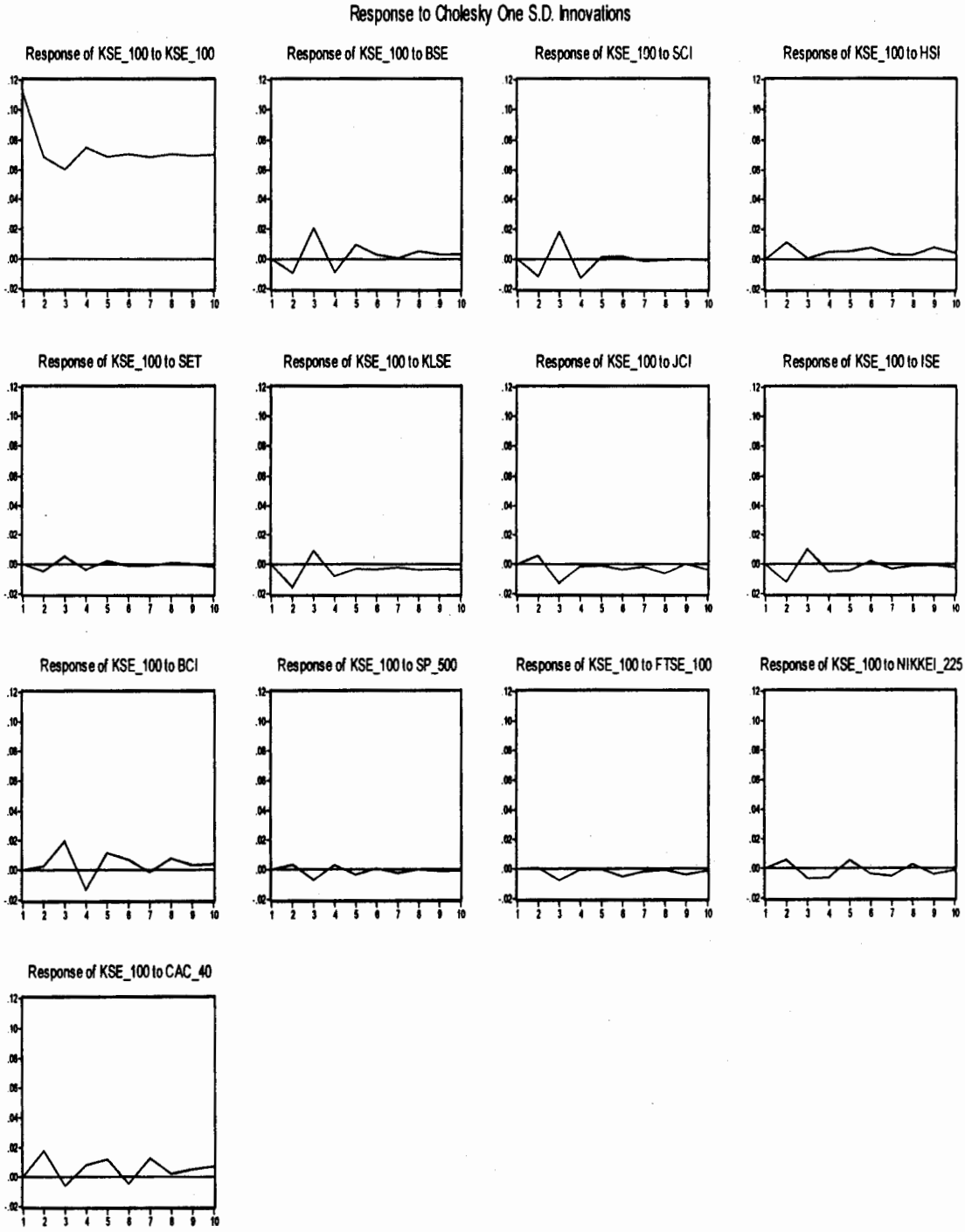


**Figure 9: Impulse Responses**

By the results of variance decomposition test it seems that the equity market of Pakistan is an exogenous market because the majority of its shocks are described by its personal innovations.

**Table 8: Variance Decomposition Analysis of KSE-100**

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0 | 0.13 | 0.15 | 0.17 | 0.19 | 0.20 | 0.21 | 0.22 | 0.24 | 0.25 |
| KSE-100 | 100 | 93.65 | 87.88 | 88.21 | 88.62 | 89.56 | 90.18 | 90.86 | 91.40 | 91.90 |
| BSE | 0 | 0.48 | 2.15 | 1.96 | 1.92 | 1.69 | 1.51 | 1.41 | 1.30 | 1.20 |
| SCI | 0 | 0.74 | 1.94 | 2.06 | 1.76 | 1.54 | 1.37 | 1.23 | 1.12 | 1.03 |
| HSI | 0 | 0.68 | 0.53 | 0.50 | 0.50 | 0.58 | 0.54 | 0.50 | 0.57 | 0.55 |
| SET | 0 | 0.13 | 0.23 | 0.23 | 0.21 | 0.18 | 0.17 | 0.15 | 0.14 | 0.13 |
| KLSE | 0 | 1.33 | 1.36 | 1.30 | 1.13 | 1.01 | 0.91 | 0.85 | 0.79 | 0.75 |
| JCI | 0 | 0.17 | 0.86 | 0.69 | 0.59 | 0.55 | 0.49 | 0.52 | 0.48 | 0.46 |
| ISE | 0 | 0.81 | 1.05 | 0.92 | 0.83 | 0.74 | 0.68 | 0.61 | 0.56 | 0.52 |
| BCI | 0 | 0.03 | 1.64 | 1.90 | 1.99 | 1.86 | 1.66 | 1.61 | 1.48 | 1.38 |
| S&P-500 | 0 | 0.06 | 0.26 | 0.23 | 0.23 | 0.20 | 0.20 | 0.18 | 0.17 | 0.15 |
| FTSE-100 | 0 | 0.00 | 0.26 | 0.20 | 0.18 | 0.22 | 0.21 | 0.19 | 0.20 | 0.19 |
| NIKKEI-225 | 0 | 0.19 | 0.34 | 0.41 | 0.44 | 0.42 | 0.43 | 0.40 | 0.40 | 0.37 |
| CAC-40 | 0 | 1.72 | 1.50 | 1.40 | 1.60 | 1.46 | 1.65 | 1.49 | 1.41 | 1.37 |

The results reveal that major change in KSE-100 is due to its own shocks and it is not affected by the other markets. Only KLSE and CAC-40 have effect on KSE-100 with 1.33 and 1.72 respectively. Other markets results are reported in Appendix F.

According to present study it is found that the there exists co-integration in between KSE-100 and JCI, BCI. To further explore major economic factors that may cause this integration. Table 9 represents the trade statistic of Pakistan with Indonesia and Brazil on % share in total trade basis. Table 9 shows that the exports to Brazil were 0.2 % in 1998-1999 and imports were 0.3%. The proportionate of exports and imports got

down in year 1999-2000 to 0.07% and 0.2 % respectively. Exports increased in year 2000-2001 at 0.08% but imports also increased to 1.2%. In financial year 2001-2002, 2002-2003, 2003-2004 exports portion further decreased and the level of imports decreased in year 2002-2003 to 0.1% but from year 2005 exports increased sharply up to the level of 0.35% in year 2007-2008 and imports level remained up to the level of 0.9%.

**Table 9: Trade Statistics of Pakistan with Brazil and Indonesia**

| FY | Share in Total Exports to Brazil (%) | Share in Total Imports from Brazil (%) | Share in Total Exports to Indonesia (%) | Share in Total Imports from Indonesia (%) |
|---|---|---|---|---|
| 1998-1999 | 0.2 | 0.3 | 1.61 | 2.26 |
| 1999-2000 | 0.07 | 0.2 | 0.62 | 1.70 |
| 2000-2001 | 0.08 | 1.2 | 1.48 | 1.51 |
| 2001-2002 | 0.05 | 0.2 | 0.84 | 2.35 |
| 2002-2003 | 0.04 | 0.1 | 0.66 | 2.11 |
| 2003-2004 | 0.04 | 0.2 | 0.36 | 2.29 |
| 2004-2005 | 0.06 | 0.7 | 0.49 | 2.79 |
| 2005-2006 | 0.12 | 1.2 | 0.35 | 2.65 |
| 2006-2007 | 0.23 | 0.5 | 0.43 | 2.77 |
| 2007-2008 | 0.35 | 0.9 | 0.32 | 0.29 |

*Source: Federal Bureau of Statistics Pakistan and Trade Development Authority of Pakistan*

In the same way exports to Indonesia were sharply declined from 1.61% in year 1998-1999 to onward. It remained 0.32% in year 2007-2008. The level of imports got rise in year 2005, 2006 and 2007 but sharply declined to 0.29% in year 2007-2008. Figure 9 and 10 clearly indicates the trends in a more collaborative way. These results indicate that the investors of Pakistan and Brazil are getting little interest to develop their trade market of their goods and service among themselves. As for as concerned to Pakistan and Indonesia the trade trend among themselves is declining with the passage of time.

Apparently it may be inferred that trade statistics do not reflect any integrating relationship to the equity market presently.

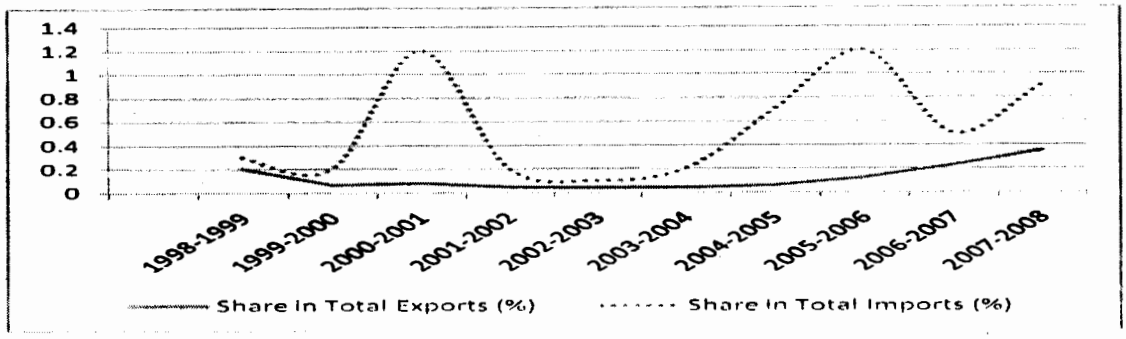


**Figure10: Share of Pakistan Trade with Brazil**

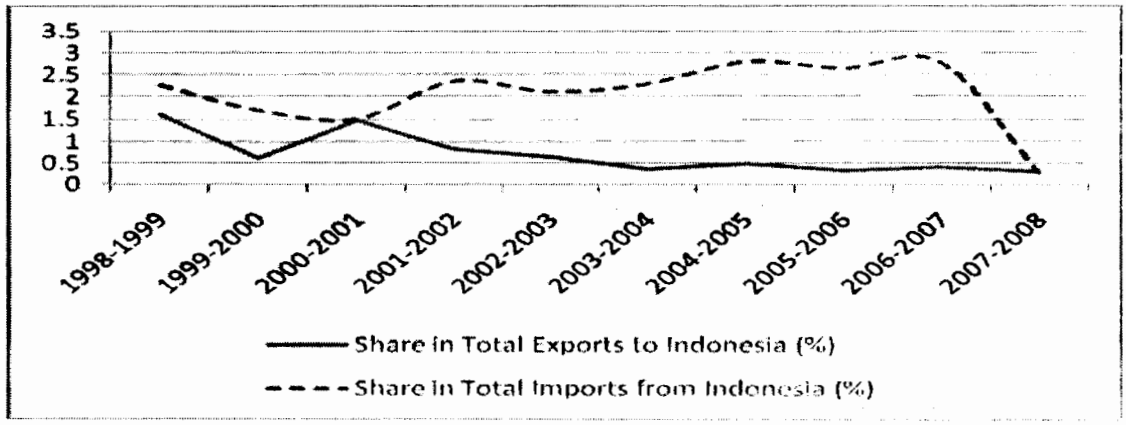


**Figure 11: Share of Pakistan Trade with Indonesia**

Exchange rate analysis presents very interesting results regarding to their interaction with the equity market of KSE-100. For this purpose 132 observations were taken regarding to IDR/PKR and BRL/PKR. Descriptive statistics indicates that both exchange rates remain highly volatile with Pak Rupee. This increased volatility may be one of the major reasons for co-integration among these equity markets.

## Table 10: Descriptive Statistics of IDR/PKR and BRL/PKR

| | IDR/PKR | BRL/PKR |
|---|---|---|
| Mean | 160.7436 | 0.03885 |
| Median | 155.2725 | 0.036265 |
| Maximum | 323.052 | 0.06493 |
| Minimum | 121.171 | 0.02144 |
| Std. Dev. | 24.37922 | 0.010704 |
| Skewness | 3.313304 | 0.569388 |
| Kurtosis | 19.50104 | 2.670194 |
| Observations | 132 | 132 |

Bi-variate co-integration is testified which clearly indicates that there exists one co-integrating vectors among KSE-100 and IDR. One co-integrating vector exists among KSE-100 and BRL. This particular test clearly identifies that exchange rates are one of the most important variable which may cause to integrate the equity market transactions.

## Table 11: Bi-variate Co-integration Test-Trace Statistics

| | Hypothesis | Eigenvalue | Trace Statistics | Critical Values at 0.05 level | Remarks |
|---|---|---|---|---|---|
| KSE-100—IDR | None* | 0.164914 | 24.5375 | 15.49471 | Co-integrated |
| | At most 1 | 24.5375 | 1.64946 | 3.841466 | |
| KSE-100—BRL | None | 0.05155 | 12.02939 | 15.49471 | Co-integrated |
| | At most 1* | 0.040930 | 5.307421 | 3.841466 | |

Due to co-integration among exchange rate in between Pakistan, Brazil and Indonesia it may be inferred that these variables may have significant impact on the integration of equity markets. Further study may explore that that there may be other economic variables like interest rate differentials, GDP, inflation rate, stock market capitalization

ratio, foreign direct investment, portfolio investment, money supply etc., that can cause economic integration among the equity markets. So it is recommended that a detailed study should be intended to identify the factors that may lead to the integration among two equity markets.

# CHAPTER 5

# CONCLUSION

# 5. CONCLUSION

KSE-100 statistics indicates that it is generating the average returns of 0.99% on monthly basis at 10.66% risk level in comparison to the emerging and developed equity markets. KSE-100 returns are followed by ISE and BCI at 1.55% and 1.03% respectively but still the equity market of Pakistan is at marvelous position for investment attractiveness. This particular scenario points towards that the economy of Pakistan has initiated positive growth during 1998-2008 therefore foreign and institutional investors can divert their attention towards this nourishing and developing economy. The correlation matrix provides insignificant evidences for Karachi Stock Exchange in relation to the emerging markets and developed markets scenario. It has only 0.26 correlation co-efficient with BSE and BCI but still this evidence is insignificant to explain the proper degree of association. These elements indicate that KSE is luring the opportunities for portfolio diversification stream of benefits. Correlation statistics discloses that India has higher association levels with Brazil, Hong-Kong, Indonesia, and Thailand. Hong- Kong has significant correlations with Thailand, Brazil and Malaysia. The market of Thailand has significant degree of relationship with Hong Kong, Malaysia, Indonesia and Brazil. Brazilian market has significant correlation with Indonesian equity market as well. Further results reveal that Pakistan has poor correlations with United States, England, Japan and France. On the other hand the statistics is evident that United States has strong correlation with the equity market of England and France. US have significant correlation with Japan. England has also strong correlation with France which is highly significant. Japanese market has also significant relationship with French

market. It means that there may have influx of cash flows among these economies and reason seems to be the relaxation on the barriers regarding to capital induction. It may be inferred from high degree of correlations among emerging markets as well as and in between developed countries that its due to an increase in economic and financial integration among these countries over the years. Correlation analysis is considered weaker approach because it does not provide evidences for the cause and effect relationship. For further investigation into the matter study focused on co-integration, vector error correction model, granger causality, impulse response and variance decompositions tests to view the long term and short term causal and dynamic nature of relationship. ADF and PP test is applied to get the evidence that the financial data series are stationary. The results reveal that all indices series became integrated of order 1(1). Further the study takes into consideration the multivariate and bi-variate co-integration tests. Trace statistics indicates that there are eleven co-integrating equations at 0.05 critical value. Moreover the study applied the maximum eigen value test which also authenticates the eight co-integrating vectors at 0.05 critical value level. These results accept $H_0$ for hypothesis 1 that emerging markets have long run relationships with KSE and also accept $H_0$ for hypothesis 2 that developing markets have long run relationships with KSE. Bi-variate test is applied to know the pair-wise co-integration among KSE-100 and other equity markets. It indicates the presence of long run relationship in a pair wise manner. Bi-variate statistics shows that there exists two co-integrating vectors at 0.05 levels with the JCI and only one co-integrating vector exists with the BCI at 0.05 critical value. The result provides evidences that KSE-100 has no longer relationships to

other markets except JCI and BCI. The bi-variate co-integration only accepts the $H_0$ for hypothesis 1 regarding to JCI and BCI which have long run relationship to KSE and rejects for all other emerging markets. The study for hypothesis 2 rejects the $H_0$ and accepts the $H_1$. So the investors of non co-integrated countries can get the stream of benefits by investing in the equity market of Pakistan. Further study focuses on short run dynamics in between the equity markets. Therefore error correction term is absorbed in the Vector Autoregressive Model. According to VECM, KSE-100 does not depend upon the lagged values of its own indices. Co-integration does not provide evidence that the KSE-100 has long run relationship with the SCI but in short run analysis at lag 2 SCI is significantly influenced by the KSE-100. For hypothesis 3, the $H_0$ is accepted only for SCI to KSE which means that SCI have short term relationship with KSE and rejects the $H_0$ for other emerging markets. As concerned to hypothesis 4, the results totally reject the $H_0$ and accept the $H_1$ that developing markets have no short term relationship with KSE. As co-integration test lacks to explain the lead lag relationship. There may be other features that can reason for causality in between the financial data series. So to investigate the causal affects the study further explores and identifies the relationships through granger causality test. The results indicate that KSE-100 has unidirectional relationship with the BSE, SCI, HSI, ISE, BCI, and NIKKEI-225. It has bidirectional causality with SET, JCI and KLSE. To view the dynamic responses in between the stock markets impulse response test and variance decomposition test is applied. The equity market of Pakistan seems an exogenous market because majority of its shocks are described by its own innovations. However BSE, SCI, HSI, KLSE, SET, ISE, BCI, S&P-

500, NIKKEI-225 and CAC-40 have some impact on the equity market of Pakistan. Results of variance decomposition test reveals that KSE-100 is an exogenous market because the majority of its shocks are described by its personal innovations. Long run relationship is identified in between KSE-100 and BCI, JCI respectively. Trade statistics and exchange rate analysis is performed for these countries to identify the factors for integration. The results reveals that the investors of Pakistan and Brazil are getting little interest to develop their trade market of their goods and service among themselves over time and the investors of Pakistan and Indonesia are losing trade trend among themselves with the passage of time. By this scenario it may be inferred that trade statistics do not reflect any integrating relationship to the equity market of Pakistan. Exchange rate analysis indicates co-integration among Pakistan and Brazil, Indonesia respectively so it may be inferred that this element may have significant impact on the integration of equity markets. Additional study may reveal that there may be other economic variables that can cause economic and financial integration like interest rate differentials, GDP, inflation rate, stock market capitalization ratio, foreign direct investment, portfolio investment, money supply etc. It is recommended that a detailed study should be required to explore and identify those factors among two equity markets that may lead towards economic integration. The overall study is an attempt to provide information and awareness to international and regional investors about the existing and future trends of the stock market. Moreover the study assist to reply that how they can get benefits of portfolio diversification by investing in various markets which have no long run relationships and how can they get escape way from spillover effects. The study

generates the information which is also beneficial to macro-economic decision makers regarding to their economic policy making and funds management. Banks and investment agencies may use this information for their portfolio making decisions. Market players and speculators may use this information for their short term investment decisions as well.

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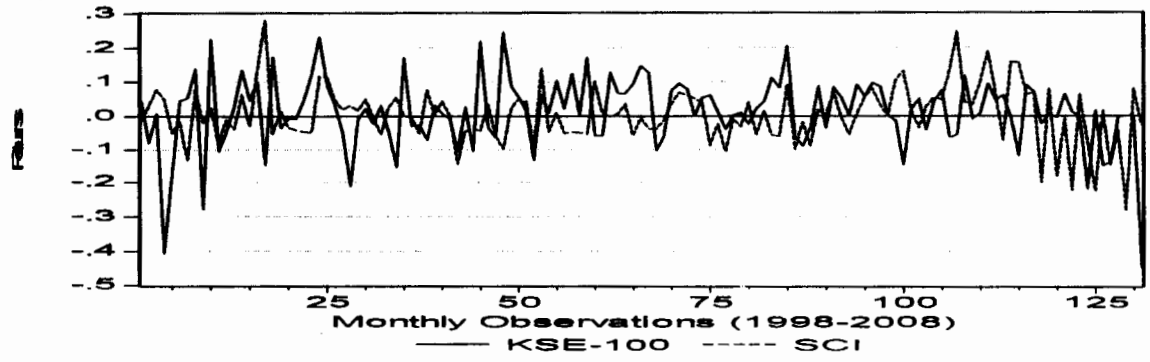
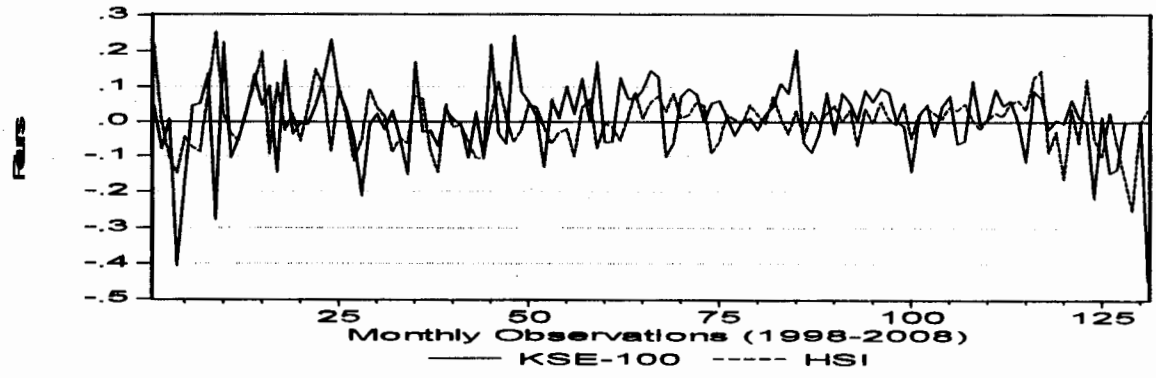
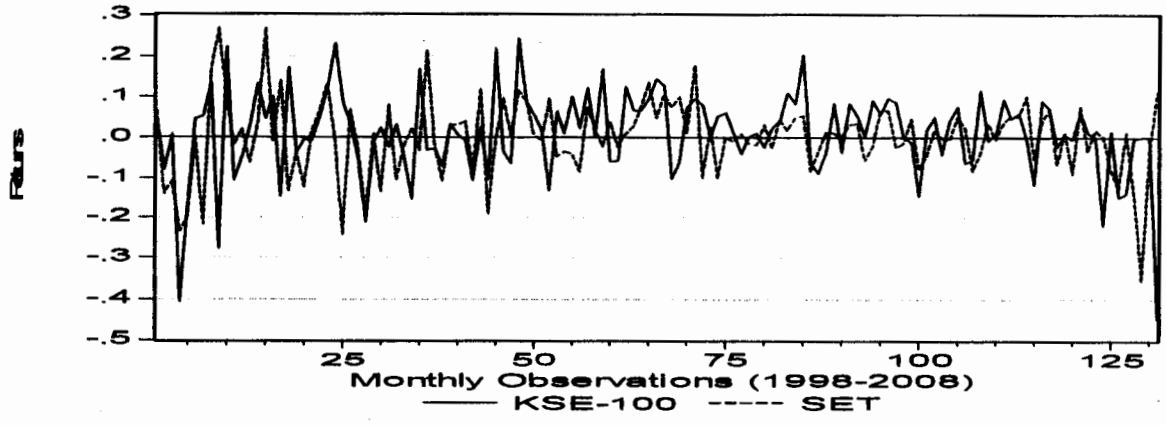
## APPENDICES:

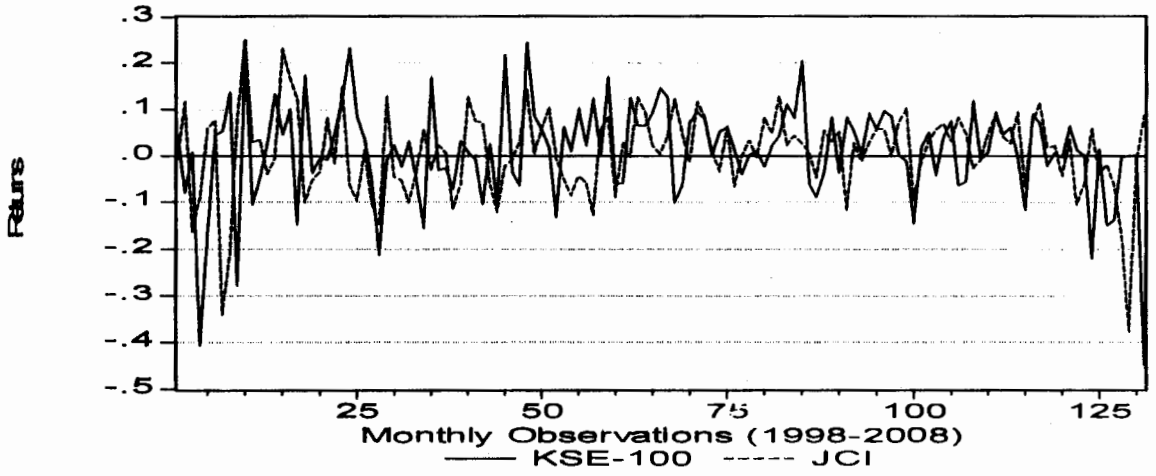
### APPENDIX A:

### Returns Movement of KSE-100 with Emerging and Developed Markets

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.1
.0
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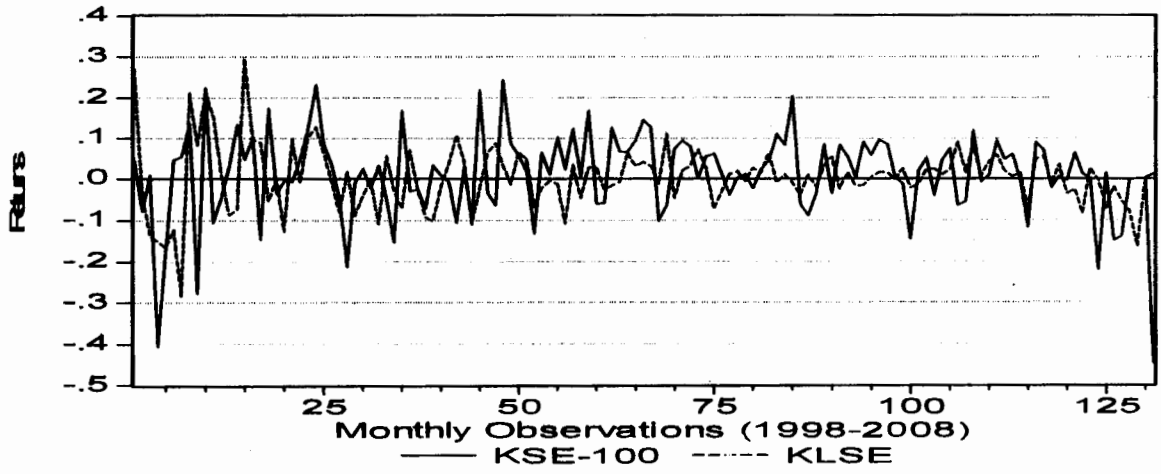
-.4
-.5
Returns
25
50
75
100
125
Monthly Observations (1998-2008)
KSE-100
JCI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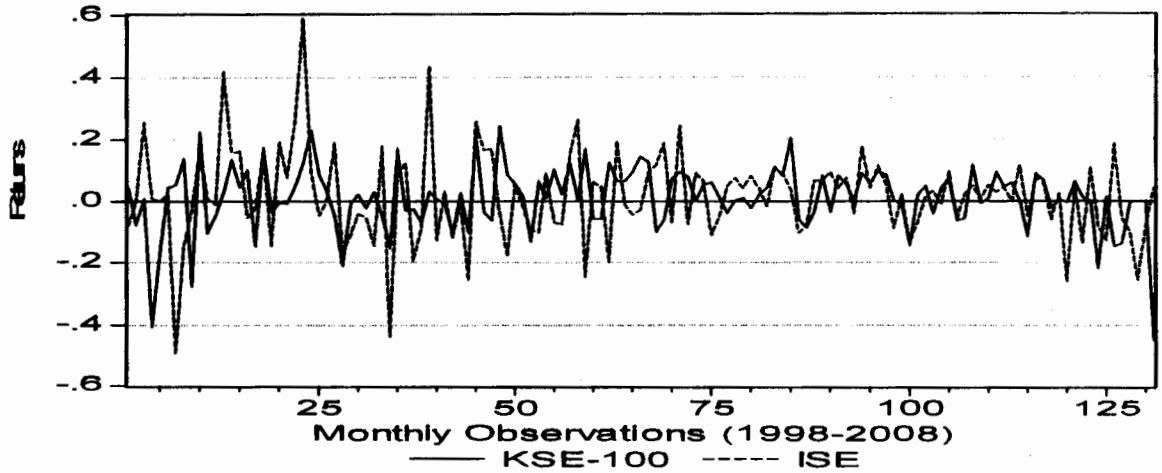
-.4
-.5
Returns
25
50
75
100
125
Monthly Observations (1998-2008)
KSE-100
KLSE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-.6
Returns
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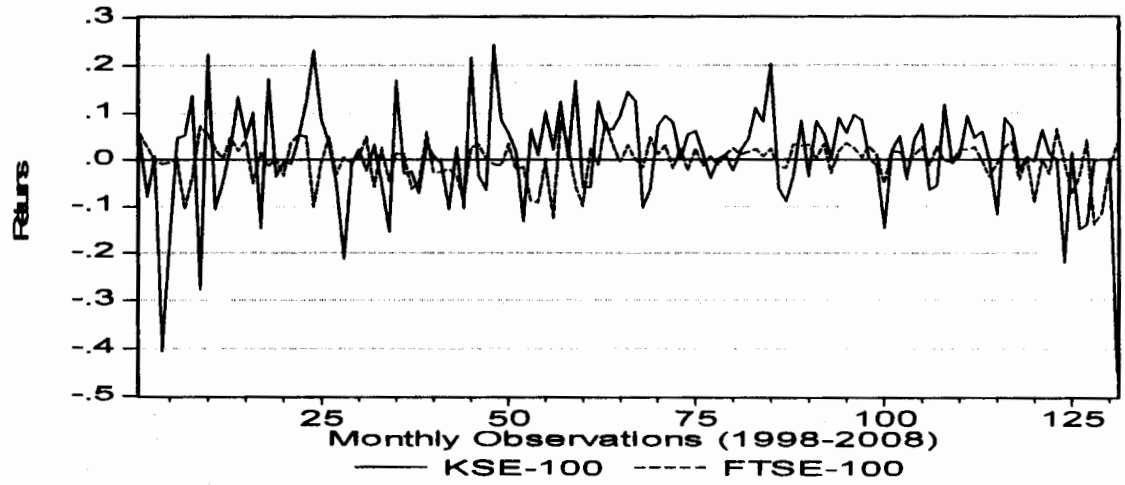
50
75
100
125
Monthly Observations (1998-2008)
KSE-100
ISE


Returns
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-.3
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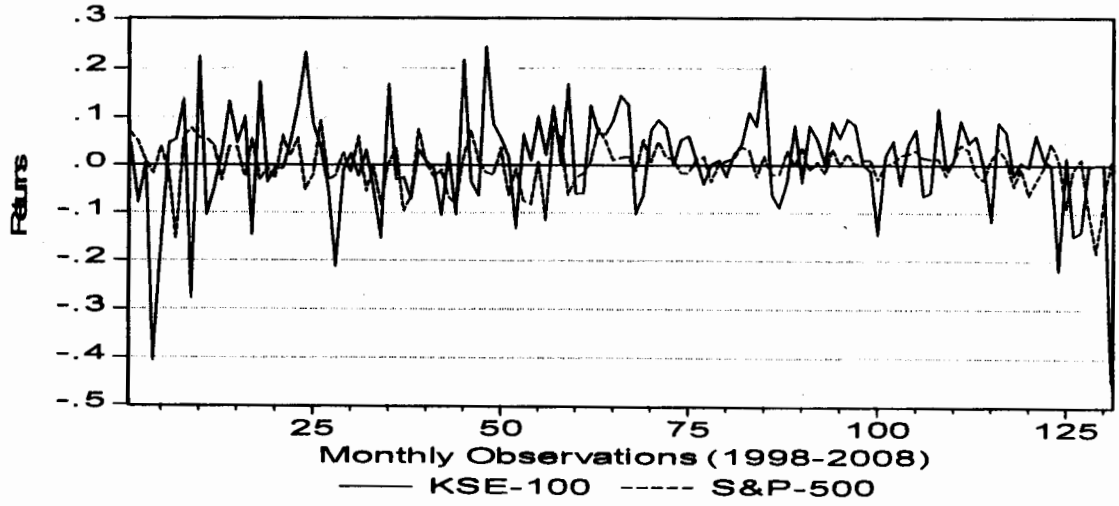
-.5
25
50
75
100
125
Monthly Observations (1998-2008)
KSE-100
FTSE-100


Returns
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-.4
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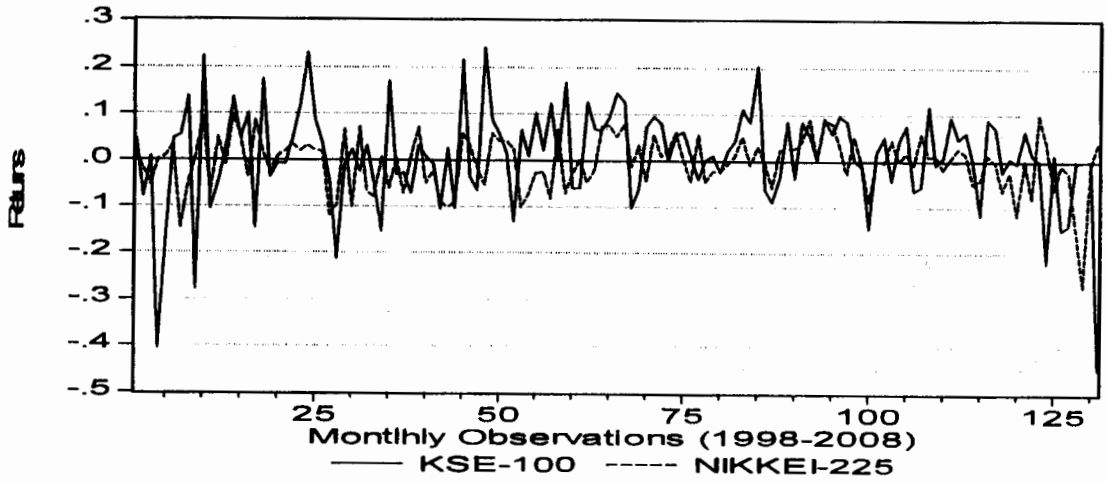
50
75
100
125
Monthly Observations (1998-2008)
KSE-100
S&P-500


Returns
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-.3
-.4
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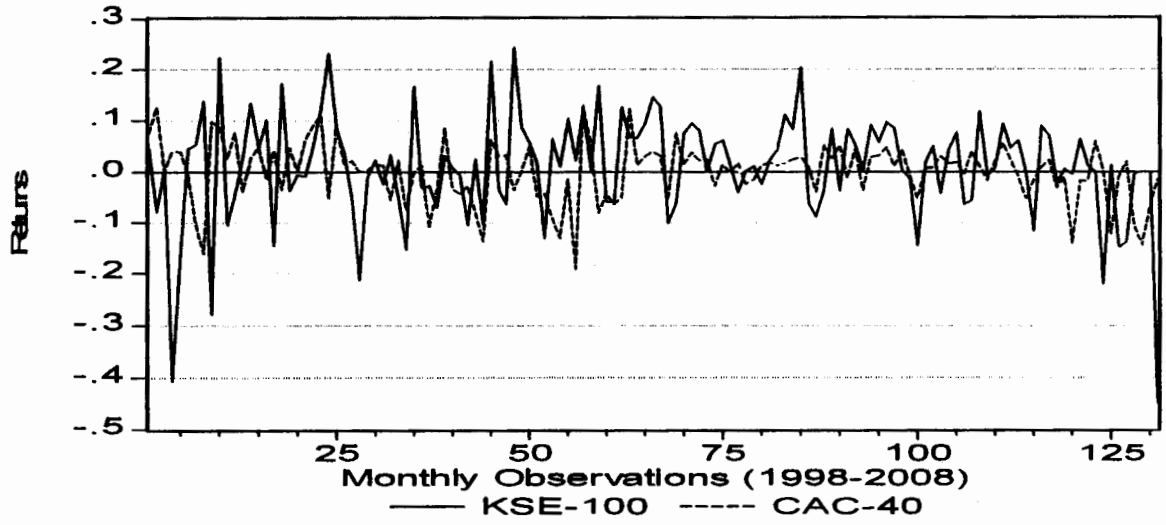
25
50
75
100
125
Monthly Observations (1998-2008)
KSE-100
NIKKEI-225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-.1
-.2
-.3
-.4
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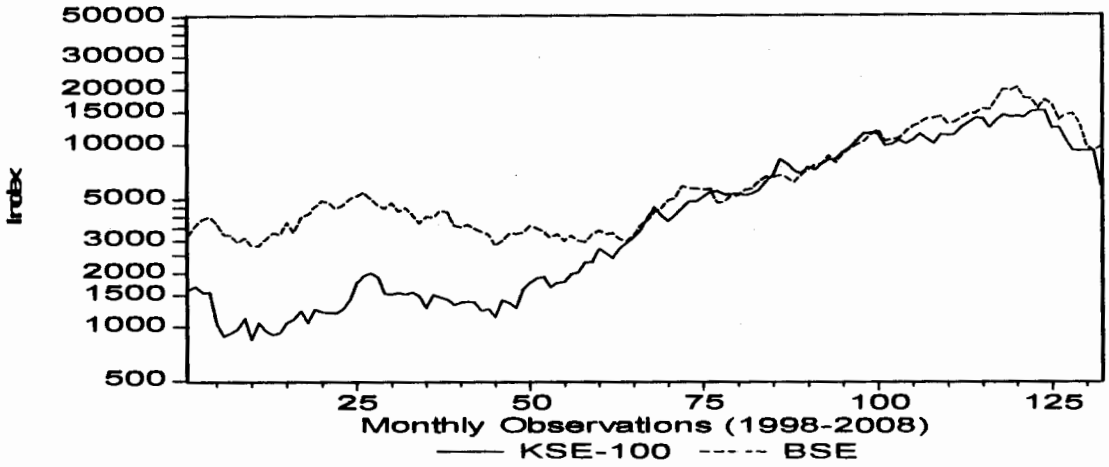
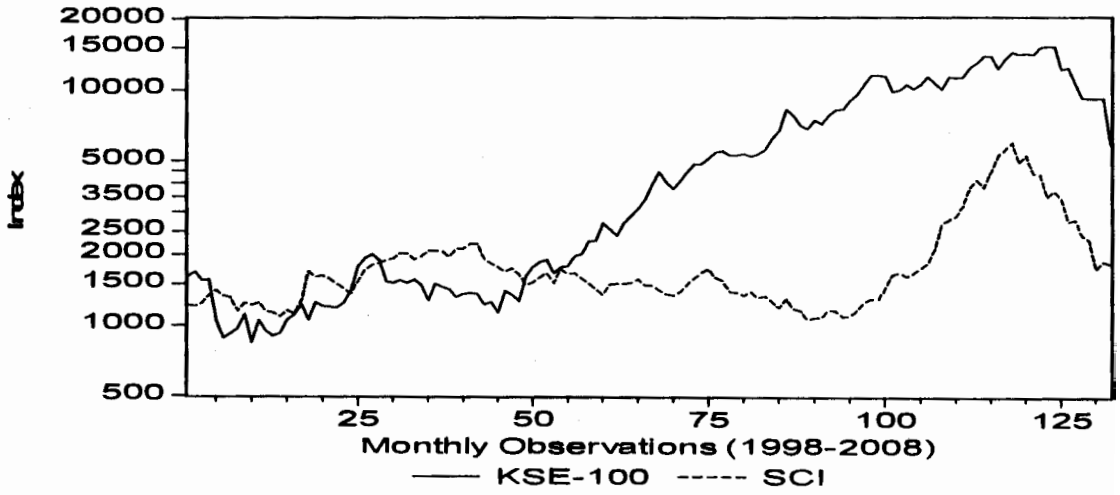
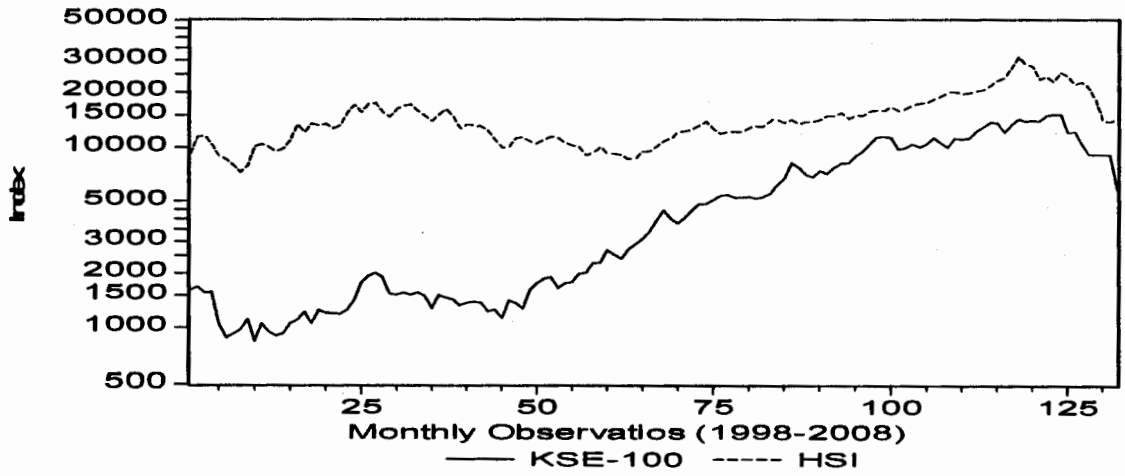
Returns
25
50
75
100
125
Monthly Observations (1998-2008)
KSE-100
CAC-40

# APPENDIX: B

## Trends of KSE-100 with Emerging And Developed Markets

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30000
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15000
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Index
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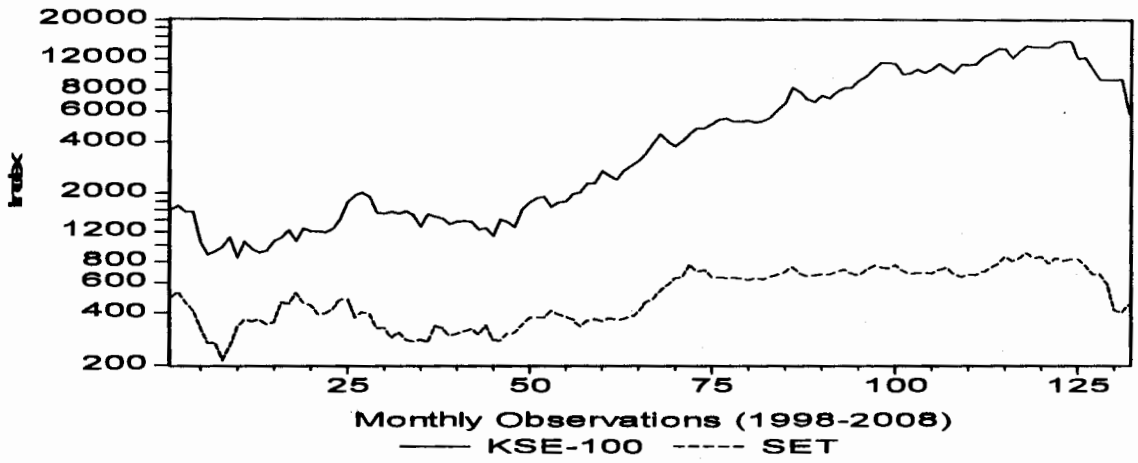
100
125
Monthly Observatios (1998-2008)
KSE-100
HSI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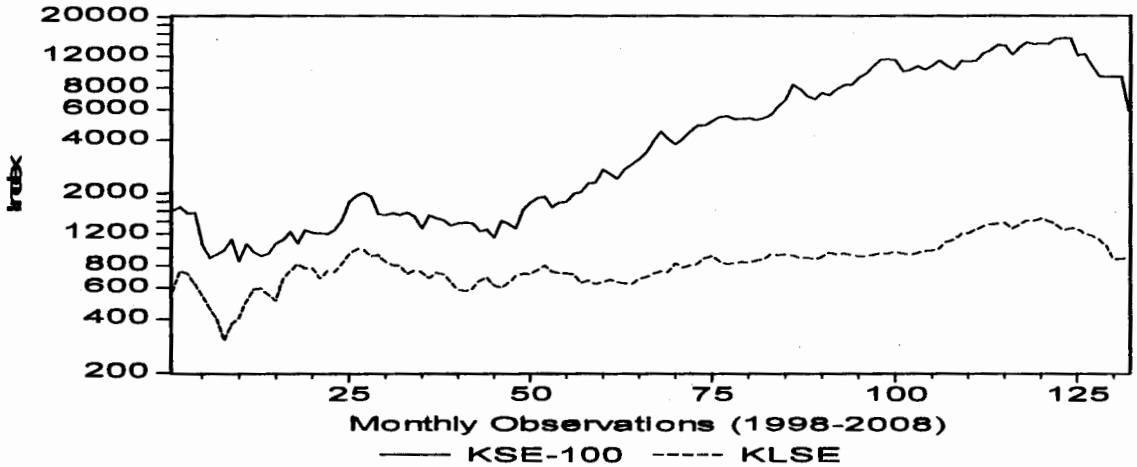
400
200
Index
25
50
75
100
125
Monthly Observations (1998-2008)
KSE-100
SET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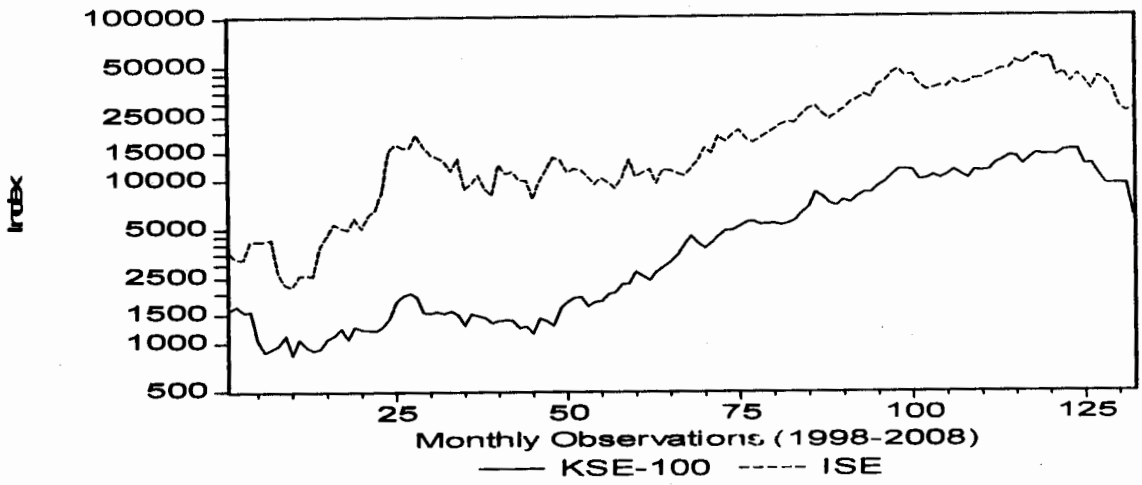
25
50
75
100
125
Monthly Observations (1998-2008)
KSE-100
KLSE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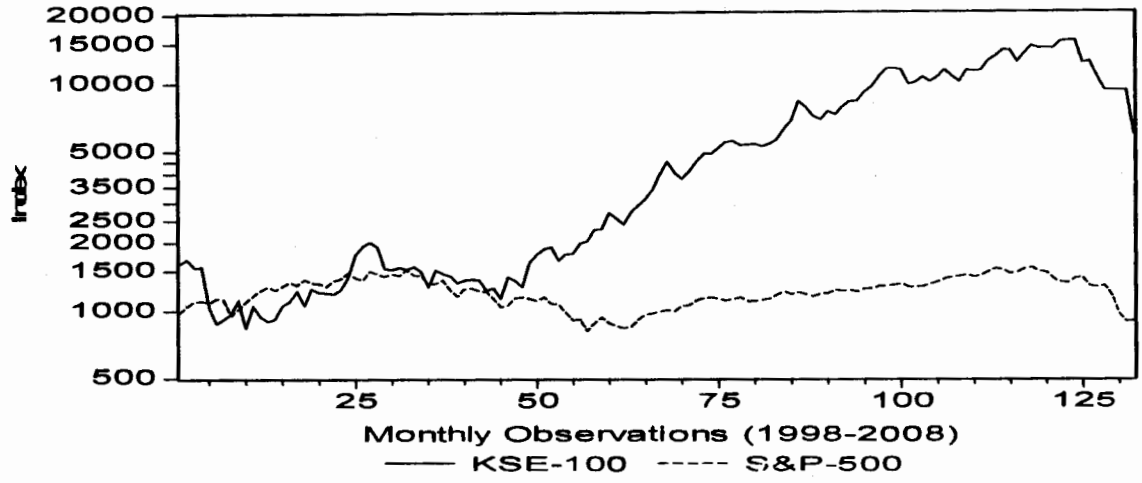
125
Monthly Observations (1998-2008)
KSE-100
ISE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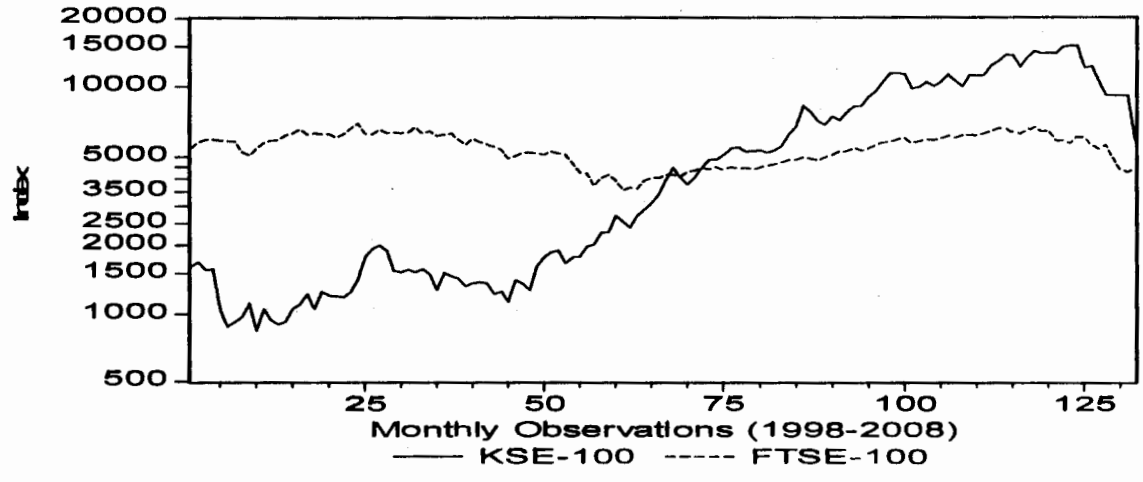
125
Monthly Observations (1998-2008)
KSE-100
S&P-500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Index
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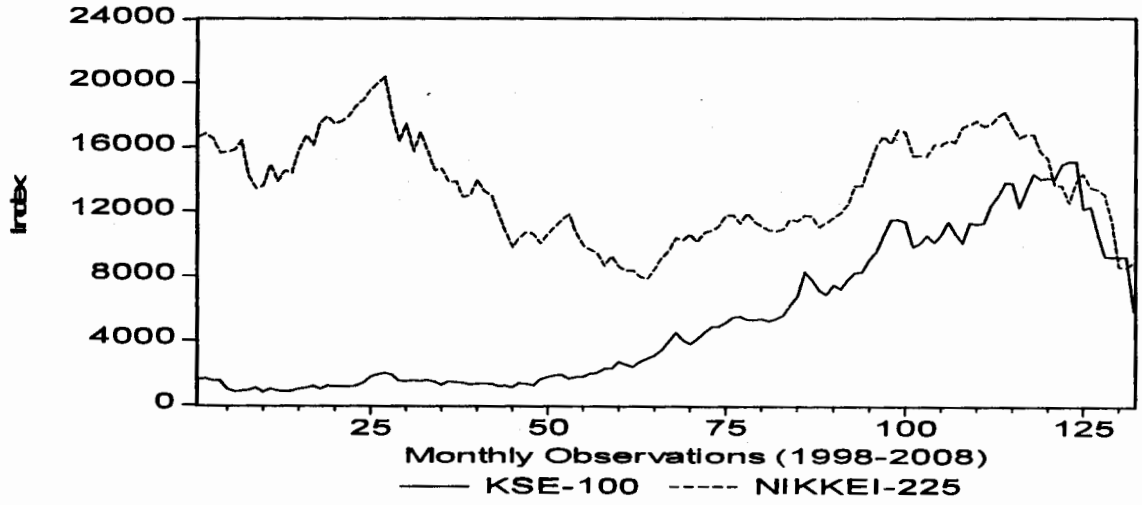
100
125
Monthly Observations (1998-2008)
KSE-100
FTSE-100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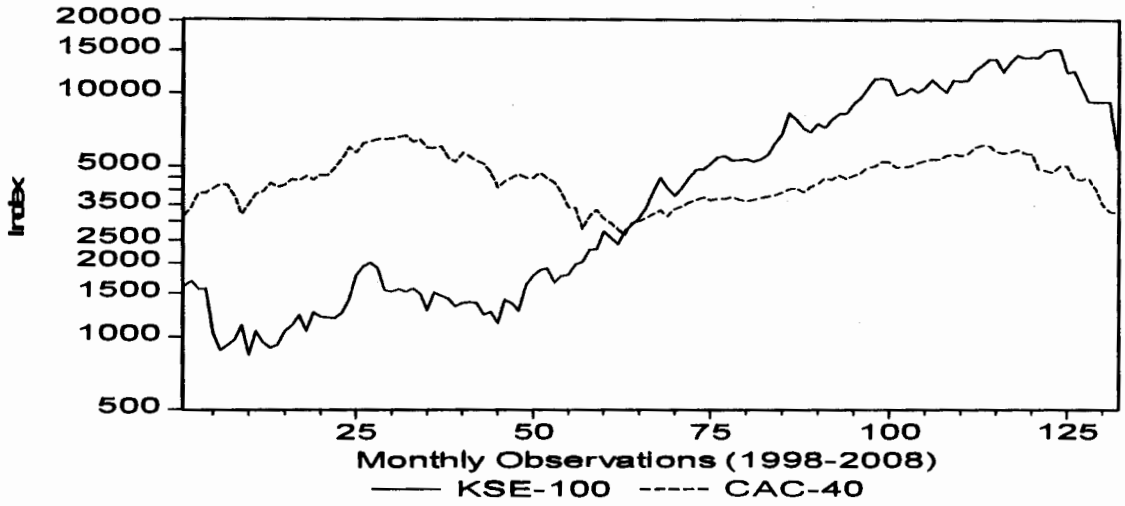
125
Monthly Observations (1998-2008)
KSE-100 ----- NIKKEI-225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Index
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75
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125
Monthly Observations (1998-2008)
KSE-100 ----- CAC-40

# APENDIX C

## Granger Causality Test of Developed and Emerging Markets

| | | | |
|---|---|---|---|
| SCI does not Granger Cause BSE | 128 | 0.50104 | 0.68227 |
| BSE does not Granger Cause SCI | | 0.51716 | 0.67125 |
| | | | |
| HSI does not Granger Cause BSE | 128 | 5.28847 | 0.00184 |
| BSE does not Granger Cause HSI | | 0.73194 | 0.53489 |
| | | | |
| SET does not Granger Cause BSE | 128 | 3.75173 | 0.01282 |
| BSE does not Granger Cause SET | | 1.02146 | 0.3857 |
| | | | |
| KLSE does not Granger Cause BSE | 128 | 2.02619 | 0.11381 |
| BSE does not Granger Cause KLSE | | 0.80976 | 0.49083 |
| | | | |
| JCI does not Granger Cause BSE | 128 | 2.96939 | 0.03463 |
| BSE does not Granger Cause JCI | | 1.63643 | 0.18451 |
| | | | |
| ISE does not Granger Cause BSE | 128 | 2.19898 | 0.09167 |
| BSE does not Granger Cause ISE | | 1.80708 | 0.14948 |
| | | | |
| BCI does not Granger Cause BSE | 128 | 1.51412 | 0.21431 |
| BSE does not Granger Cause BCI | | 1.46605 | 0.22722 |
| | | | |
| S&P-500 does not Granger Cause BSE | 128 | 2.06445 | 0.1085 |
| BSE does not Granger Cause S&P-500 | | 0.30404 | 0.82243 |
| | | | |
| FTSE-100 does not Granger Cause BSE | 128 | 3.32202 | 0.02213 |
| BSE does not Granger Cause FTSE-100 | | 0.40294 | 0.75114 |
| | | | |
| NIKKEI-225 does not Granger Cause BSE | 128 | 0.87017 | 0.45866 |
| BSE does not Granger Cause NIKKEI-225 | | 0.55029 | 0.6489 |
| | | | |
| CAC-40 does not Granger Cause BSE | 128 | 2.33514 | 0.07724 |
| BSE does not Granger Cause CAC-40 | | 0.46913 | 0.70436 |

| | | | |
|---|---|---|---|
| HSI does not Granger Cause SCI | 128 | 1.16792 | 0.32491 |
| SCI does not Granger Cause HSI | | 0.70403 | 0.55141 |
| | | | |
| SET does not Granger Cause SCI | 128 | 1.21729 | 0.30644 |
| SCI does not Granger Cause SET | | 0.62316 | 0.60136 |
| | | | |
| KLSE does not Granger Cause SCI | 128 | 0.74148 | 0.52934 |
| SCI does not Granger Cause KLSE | | 1.01979 | 0.38645 |
| | | | |
| JCI does not Granger Cause SCI | 128 | 0.51996 | 0.66934 |
| SCI does not Granger Cause JCI | | 1.28803 | 0.28165 |
| | | | |
| ISE does not Granger Cause SCI | 128 | 1.22304 | 0.30436 |
| SCI does not Granger Cause ISE | | 0.07333 | 0.97418 |
| | | | |
| BCI does not Granger Cause SCI | 128 | 1.78897 | 0.15288 |
| SCI does not Granger Cause BCI | | 1.48755 | 0.22136 |
| | | | |
| S&P-500 does not Granger Cause SCI | 128 | 1.04591 | 0.37491 |
| SCI does not Granger Cause S&P-500 | | 1.26926 | 0.28804 |
| | | | |
| FTSE-100 does not Granger Cause SCI | 128 | 1.52151 | 0.21239 |
| SCI does not Granger Cause FTSE-100 | | 1.33324 | 0.26678 |
| | | | |
| NIKKEI-225 does not Granger Cause SCI | 128 | 1.46417 | 0.22774 |
| SCI does not Granger Cause NIKKEI-225 | | 1.17392 | 0.32261 |
| | | | |
| CAC-40 does not Granger Cause SCI | 128 | 0.83887 | 0.4751 |
| SCI does not Granger Cause CAC-40 | | 0.79165 | 0.50082 |
| | | | |
| SET does not Granger Cause HSI | 128 | 2.67437 | 0.05033 |
| HSI does not Granger Cause SET | | 10.6592 | 2.90E-06 |

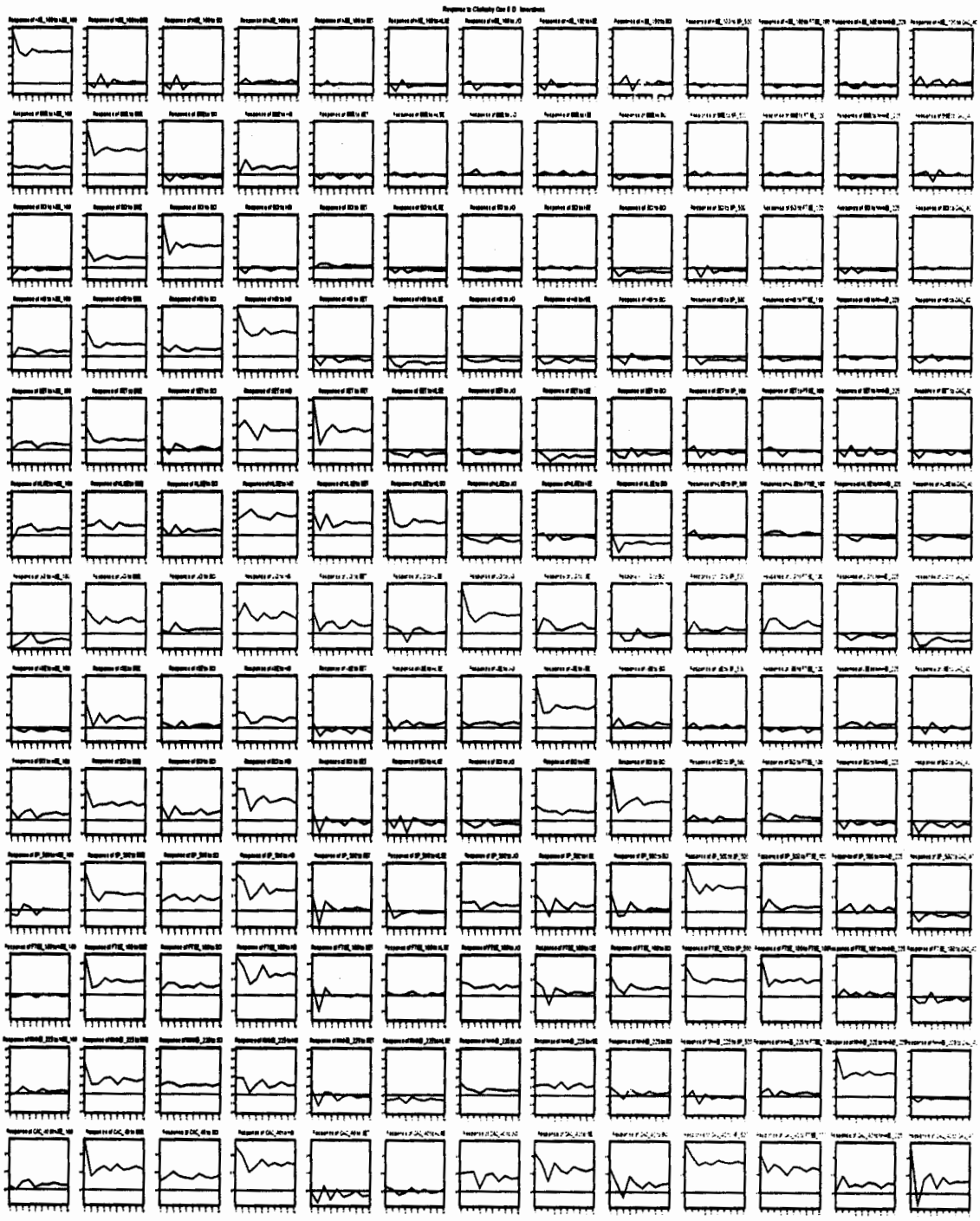
| | | | |
|---|---|---|---|
| KLSE does not Granger Cause HSI | 128 | 0.06435 | 0.9786 |
| HSI does not Granger Cause KLSE | | 6.485 | 0.00042 |
| | | | |
| JCI does not Granger Cause HSI | 128 | 1.05248 | 0.37205 |
| HSI does not Granger Cause JCI | | 6.02321 | 0.00074 |
| | | | |
| ISE does not Granger Cause HSI | 128 | 1.11597 | 0.34542 |
| HSI does not Granger Cause ISE | | 1.66213 | 0.17878 |
| | | | |
| BCI does not Granger Cause HSI | 128 | 1.81987 | 0.14713 |
| HSI does not Granger Cause BCI | | 4.52154 | 0.00484 |
| | | | |
| S&P-500 does not Granger Cause HSI | 128 | 2.11448 | 0.10191 |
| HSI does not Granger Cause S&P-500 | | 2.08049 | 0.10634 |
| | | | |
| FTSE-100 does not Granger Cause HSI | 128 | 2.11256 | 0.10216 |
| HSI does not Granger Cause FTSE-100 | | 1.33538 | 0.2661 |
| | | | |
| NIKKEI-225 does not Granger Cause HSI | 128 | 0.19635 | 0.89871 |
| HSI does not Granger Cause NIKKEI-225 | | 1.56334 | 0.20181 |
| | | | |
| CAC-40 does not Granger Cause HSI | 128 | 2.10818 | 0.10272 |
| HSI does not Granger Cause CAC-40 | | 1.07849 | 0.36093 |
| | | | |
| KLSE does not Granger Cause SET | 128 | 2.2289 | 0.08829 |
| SET does not Granger Cause KLSE | | 6.16002 | 0.00062 |
| | | | |
| JCI does not Granger Cause SET | 128 | 1.00804 | 0.39175 |
| SET does not Granger Cause JCI | | 4.11716 | 0.00807 |
| | | | |
| ISE does not Granger Cause SET | 128 | 0.97589 | 0.40655 |
| SET does not Granger Cause ISE | | 0.55132 | 0.64822 |
| | | | |

| | | | |
|---|---|---|---|
| BCI does not Granger Cause SET | 128 | 1.4398 | 0.23458 |
| SET does not Granger Cause BCI | | 1.24815 | 0.29539 |
| | | | |
| S&P-500 does not Granger Cause SET | 128 | 4.38871 | 0.00572 |
| SET does not Granger Cause S&P-500 | | 3.23108 | 0.02484 |
| | | | |
| FTSE-100 does not Granger Cause SET | 128 | 3.0065 | 0.03303 |
| SET does not Granger Cause FTSE-100 | | 1.56313 | 0.20186 |
| | | | |
| NIKKEI-225 does not Granger Cause SET | 128 | 0.52624 | 0.66508 |
| SET does not Granger Cause NIKKEI-225 | | 2.88793 | 0.0384 |
| | | | |
| CAC-40 does not Granger Cause SET | 128 | 2.25958 | 0.08495 |
| SET does not Granger Cause CAC-40 | | 0.46923 | 0.70429 |
| | | | |
| JCI does not Granger Cause KLSE | 128 | 0.7894 | 0.50207 |
| KLSE does not Granger Cause JCI | | 3.43856 | 0.01908 |
| | | | |
| ISE does not Granger Cause KLSE | 128 | 0.54664 | 0.65134 |
| KLSE does not Granger Cause ISE | | 2.09812 | 0.10402 |
| | | | |
| BCI does not Granger Cause KLSE | 128 | 1.74234 | 0.16195 |
| KLSE does not Granger Cause BCI | | 1.60094 | 0.19273 |
| | | | |
| S&P-500 does not Granger Cause KLSE | 128 | 0.30919 | 0.81871 |
| KLSE does not Granger Cause S&P-500 | | 0.81981 | 0.48535 |
| | | | |
| FTSE-100 does not Granger Cause KLSE | 128 | 0.76479 | 0.51594 |
| KLSE does not Granger Cause FTSE-100 | | 0.60156 | 0.61521 |
| | | | |
| NIKKEI-225 does not Granger Cause KLSE | 128 | 0.86832 | 0.45961 |
| KLSE does not Granger Cause NIKKEI-225 | | 0.65879 | 0.57898 |
| | | | |
| CAC-40 does not Granger Cause KLSE | 128 | 0.4603 | 0.71053 |
| KLSE does not Granger Cause CAC-40 | | 0.67434 | 0.56939 |

| | | | |
|---|---|---|---|
| ISE does not Granger Cause JCI | 128 | 1.19113 | 0.31611 |
| JCI does not Granger Cause ISE | | 0.0094 | 0.99874 |
| | | | |
| BCI does not Granger Cause JCI | 128 | 3.05584 | 0.03103 |
| JCI does not Granger Cause BCI | | 0.1803 | 0.90959 |
| | | | |
| S&P-500 does not Granger Cause JCI | 128 | 4.47487 | 0.00513 |
| JCI does not Granger Cause S&P-500 | | 1.65669 | 0.17998 |
| | | | |
| FTSE-100 does not Granger Cause JCI | 128 | 4.95154 | 0.00281 |
| JCI does not Granger Cause FTSE-100 | | 0.35835 | 0.78318 |
| | | | |
| NIKKEI-225 does not Granger Cause JCI | 128 | 1.73711 | 0.163 |
| JCI does not Granger Cause NIKKEI-225 | | 0.47257 | 0.70196 |
| | | | |
| CAC-40 does not Granger Cause JCI | 128 | 3.34903 | 0.02138 |
| JCI does not Granger Cause CAC-40 | | 1.45959 | 0.22901 |
| | | | |
| BCI does not Granger Cause ISE | 128 | 2.9383 | 0.03602 |
| ISE does not Granger Cause BCI | | 0.5566 | 0.64469 |
| | | | |
| S&P-500 does not Granger Cause ISE | 128 | 1.27233 | 0.28699 |
| ISE does not Granger Cause S&P-500 | | 0.30938 | 0.81857 |
| | | | |
| FTSE-100 does not Granger Cause ISE | 128 | 0.86925 | 0.45913 |
| ISE does not Granger Cause FTSE-100 | | 0.81632 | 0.48725 |
| | | | |
| NIKKEI-225 does not Granger Cause ISE | 128 | 1.52412 | 0.21171 |
| ISE does not Granger Cause NIKKEI-225 | | 0.27799 | 0.84119 |

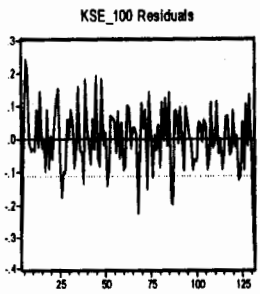
| | | | |
|---|---|---|---|
| CAC-40 does not Granger Cause ISE | 128 | 1.49135 | 0.22033 |
| ISE does not Granger Cause CAC-40 | | 0.24705 | 0.8633 |
| | | | |
| S&P-500 does not Granger Cause BCI | 128 | 0.97428 | 0.40731 |
| BCI does not Granger Cause S&P-500 | | 0.83071 | 0.47947 |
| | | | |
| FTSE-100 does not Granger Cause BCI | 128 | 1.45507 | 0.23027 |
| BCI does not Granger Cause FTSE-100 | | 1.08867 | 0.35666 |
| | | | |
| NIKKEI-225 does not Granger Cause BCI | 128 | 0.47319 | 0.70153 |
| BCI does not Granger Cause NIKKEI-225 | | 1.49324 | 0.21983 |
| | | | |
| CAC-40 does not Granger Cause BCI | 128 | 0.91196 | 0.43742 |
| BCI does not Granger Cause CAC-40 | | 0.9485 | 0.41954 |
| | | | |
| FTSE-100 does not Granger Cause S&P-500 | 128 | 0.40621 | 0.7488 |
| S&P-500 does not Granger Cause FTSE-100 | | 0.9282 | 0.4294 |
| | | | |
| NIKKEI-225 does not Granger Cause S&P-500 | 128 | 1.24973 | 0.29484 |
| S&P-500 does not Granger Cause NIKKEI-225 | | 3.18425 | 0.02636 |
| | | | |
| CAC-40 does not Granger Cause S&P-500 | 128 | 0.9858 | 0.40194 |
| S&P-500 does not Granger Cause CAC-40 | | 1.92697 | 0.1288 |
| | | | |
| NIKKEI-225 does not Granger Cause FTSE-100 | 128 | 0.66651 | 0.57421 |
| FTSE-100 does not Granger Cause NIKKEI-225 | | 4.25144 | 0.00681 |
| | | | |
| CAC-40 does not Granger Cause FTSE-100 | 128 | 1.65426 | 0.18052 |
| FTSE-100 does not Granger Cause CAC-40 | | 1.16825 | 0.32479 |
| | | | |
| CAC-40 does not Granger Cause NIKKEI-225 | 128 | 2.17354 | 0.09464 |
| NIKKEI-225 does not Granger Cause CAC-40 | | 1.42978 | 0.23744 |

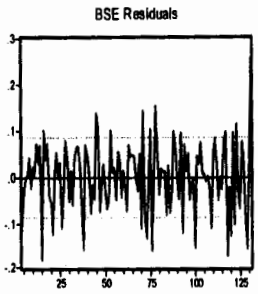
# APPENDIX D
# Impulse Response Analysis

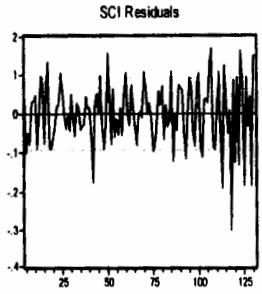


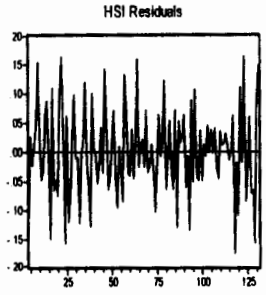
# APPENDIX E

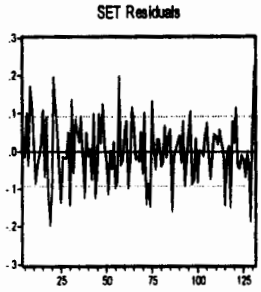
## Residual Curves

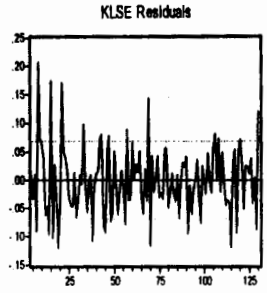


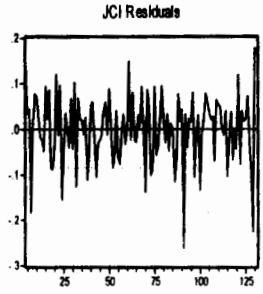



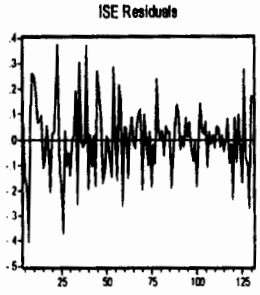



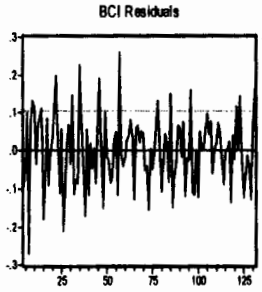



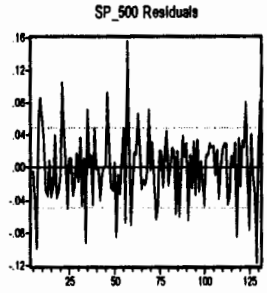



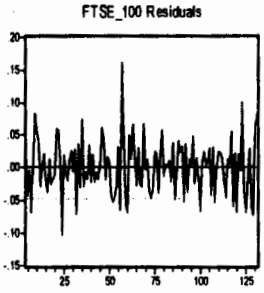



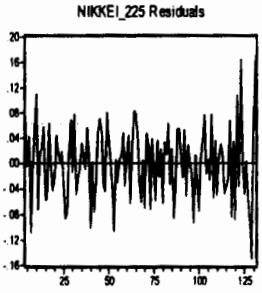



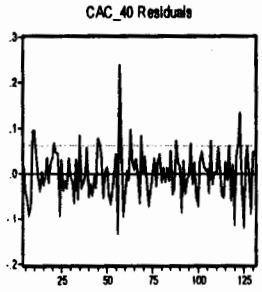



# APPENDIX F:

## Variance Decomposition Analysis

### i. Variance Decomposition of BSE

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0.09 | 0.10 | 0.11 | 0.13 | 0.14 | 0.15 | 0.16 | 0.16 | 0.17 | 0.18 |
| KSE-100 | 3.50 | 4.34 | 5.32 | 5.48 | 5.35 | 6.19 | 5.98 | 5.94 | 6.28 | 6.27 |
| BSE | 96.50 | 82.98 | 82.11 | 81.44 | 80.33 | 80.40 | 80.91 | 80.61 | 80.73 | 80.95 |
| SCI | 0.00 | 1.69 | 1.33 | 1.39 | 1.24 | 1.18 | 1.26 | 1.15 | 1.15 | 1.12 |
| HSI | 0.00 | 8.11 | 7.14 | 6.98 | 7.29 | 6.90 | 6.94 | 7.18 | 7.02 | 7.06 |
| SET | 0.00 | 0.71 | 0.59 | 0.48 | 0.75 | 0.66 | 0.59 | 0.74 | 0.69 | 0.64 |
| KLSE | 0.00 | 0.16 | 0.16 | 0.26 | 0.28 | 0.33 | 0.29 | 0.26 | 0.24 | 0.25 |
| JCI | 0.00 | 0.04 | 0.79 | 0.67 | 0.57 | 0.53 | 0.62 | 0.55 | 0.52 | 0.50 |
| ISE | 0.00 | 0.33 | 0.28 | 0.23 | 0.48 | 0.43 | 0.38 | 0.52 | 0.48 | 0.45 |
| BCI | 0.00 | 0.76 | 0.62 | 0.54 | 0.62 | 0.60 | 0.54 | 0.58 | 0.58 | 0.57 |
| S&P-500 | 0.00 | 0.52 | 0.51 | 0.59 | 0.50 | 0.46 | 0.42 | 0.38 | 0.38 | 0.35 |
| FTSE-100 | 0.00 | 0.20 | 0.21 | 0.24 | 0.35 | 0.34 | 0.30 | 0.37 | 0.34 | 0.33 |
| NIKKEI-225 | 0.00 | 0.02 | 0.37 | 0.31 | 0.44 | 0.39 | 0.38 | 0.40 | 0.38 | 0.39 |
| CAC-40 | 0.00 | 0.14 | 0.55 | 1.39 | 1.79 | 1.59 | 1.40 | 1.31 | 1.21 | 1.10 |

### ii. Variance Decomposition of SCI

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0.09 | 0.10 | 0.12 | 0.13 | 0.14 | 0.14 | 0.15 | 0.16 | 0.17 | 0.17 |
| KSE-100 | 2.36 | 2.02 | 1.69 | 1.44 | 1.37 | 1.25 | 1.18 | 1.12 | 1.04 | 0.98 |
| BSE | 16.30 | 15.61 | 14.19 | 15.65 | 15.32 | 15.01 | 15.41 | 15.42 | 15.52 | 15.49 |
| SCI | 81.34 | 76.30 | 75.98 | 74.39 | 74.77 | 75.13 | 75.11 | 75.32 | 75.35 | 75.57 |
| HSI | 0.00 | 1.08 | 0.86 | 0.75 | 0.66 | 0.74 | 0.67 | 0.61 | 0.59 | 0.55 |
| SET | 0.00 | 0.62 | 1.00 | 0.92 | 0.80 | 0.90 | 0.92 | 0.90 | 0.90 | 0.90 |
| KLSE | 0.00 | 0.81 | 0.62 | 1.02 | 0.98 | 1.03 | 0.97 | 0.96 | 1.01 | 1.02 |
| JCI | 0.00 | 0.06 | 0.28 | 0.41 | 0.52 | 0.52 | 0.50 | 0.57 | 0.58 | 0.61 |
| ISE | 0.00 | 0.06 | 0.14 | 0.12 | 0.12 | 0.18 | 0.20 | 0.18 | 0.17 | 0.16 |
| BCI | 0.00 | 2.40 | 2.13 | 1.94 | 2.03 | 2.04 | 1.97 | 1.98 | 2.04 | 2.02 |
| S&P-500 | 0.00 | 0.04 | 2.24 | 2.07 | 2.21 | 2.04 | 1.95 | 1.81 | 1.74 | 1.67 |
| FTSE-100 | 0.00 | 0.01 | 0.01 | 0.09 | 0.12 | 0.13 | 0.13 | 0.15 | 0.13 | 0.12 |
| NIKKEI-225 | 0.00 | 0.97 | 0.76 | 1.07 | 0.94 | 0.88 | 0.83 | 0.84 | 0.80 | 0.78 |
| CAC-40 | 0.00 | 0.02 | 0.10 | 0.14 | 0.17 | 0.16 | 0.16 | 0.14 | 0.13 | 0.13 |

## iii. Variance Decomposition of HSI

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0.08 | 0.10 | 0.11 | 0.12 | 0.13 | 0.14 | 0.15 | 0.16 | 0.16 | 0.17 |
| KSE-100 | 0.09 | 1.98 | 2.62 | 2.93 | 2.54 | 2.56 | 2.73 | 2.68 | 2.69 | 2.69 |
| BSE | 23.71 | 19.48 | 17.11 | 17.77 | 16.93 | 17.12 | 16.88 | 16.71 | 16.70 | 16.58 |
| SCI | 3.74 | 3.26 | 5.16 | 5.17 | 4.72 | 5.06 | 5.17 | 5.20 | 5.15 | 5.30 |
| HSI | 72.46 | 68.39 | 63.24 | 62.10 | 63.73 | 63.18 | 63.08 | 63.46 | 63.36 | 63.36 |
| SET | 0.00 | 2.03 | 1.63 | 1.41 | 1.70 | 1.62 | 1.53 | 1.43 | 1.50 | 1.47 |
| KLSE | 0.00 | 1.90 | 3.77 | 3.75 | 3.54 | 3.53 | 3.82 | 3.79 | 3.88 | 3.89 |
| JCI | 0.00 | 0.41 | 0.93 | 1.28 | 1.35 | 1.24 | 1.37 | 1.39 | 1.48 | 1.49 |
| ISE | 0.00 | 1.24 | 1.75 | 1.55 | 1.51 | 1.84 | 1.70 | 1.68 | 1.70 | 1.73 |
| BCI | 0.00 | 0.15 | 1.43 | 1.38 | 1.20 | 1.19 | 1.11 | 1.02 | 0.98 | 0.93 |
| S&P-500 | 0.00 | 0.00 | 1.24 | 1.24 | 1.20 | 1.19 | 1.17 | 1.24 | 1.21 | 1.23 |
| FTSE-100 | 0.00 | 0.18 | 0.15 | 0.40 | 0.49 | 0.49 | 0.48 | 0.50 | 0.49 | 0.53 |
| NIKKEI-225 | 0.00 | 0.07 | 0.15 | 0.25 | 0.21 | 0.19 | 0.19 | 0.20 | 0.19 | 0.17 |
| CAC-40 | 0.00 | 0.91 | 0.82 | 0.78 | 0.89 | 0.79 | 0.75 | 0.70 | 0.67 | 0.62 |

## iv. Variance Decomposition of SET

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0.09 | 0.11 | 0.12 | 0.13 | 0.14 | 0.15 | 0.16 | 0.17 | 0.18 | 0.18 |
| KSE-100 | 0.02 | 0.93 | 1.95 | 2.57 | 2.26 | 2.42 | 2.58 | 2.68 | 2.73 | 2.73 |
| BSE | 14.32 | 12.41 | 10.82 | 10.52 | 10.63 | 10.55 | 10.58 | 10.51 | 10.47 | 10.52 |
| SCI | 0.51 | 0.70 | 1.20 | 1.22 | 1.05 | 0.96 | 0.98 | 0.93 | 0.86 | 0.87 |
| HSI | 14.71 | 29.65 | 30.55 | 27.32 | 30.87 | 31.87 | 32.07 | 32.45 | 33.16 | 33.42 |
| SET | 70.43 | 51.81 | 46.87 | 48.53 | 45.46 | 44.59 | 43.97 | 43.60 | 43.06 | 42.88 |
| KLSE | 0.00 | 0.27 | 0.60 | 1.18 | 1.02 | 0.94 | 1.20 | 1.20 | 1.20 | 1.17 |
| JCI | 0.00 | 0.04 | 0.26 | 0.42 | 0.36 | 0.34 | 0.37 | 0.34 | 0.39 | 0.38 |
| ISE | 0.00 | 0.52 | 2.48 | 2.81 | 2.58 | 2.99 | 2.93 | 3.07 | 3.18 | 3.22 |
| BCI | 0.00 | 0.88 | 1.70 | 1.51 | 1.77 | 1.63 | 1.64 | 1.62 | 1.55 | 1.52 |
| S&P-500 | 0.00 | 0.43 | 1.32 | 1.12 | 1.21 | 1.09 | 0.99 | 1.03 | 0.97 | 0.93 |
| FTSE-100 | 0.00 | 0.18 | 0.14 | 0.65 | 0.56 | 0.50 | 0.47 | 0.44 | 0.41 | 0.42 |
| NIKKEI-225 | 0.00 | 0.86 | 1.07 | 1.25 | 1.39 | 1.35 | 1.33 | 1.31 | 1.21 | 1.15 |
| CAC-40 | 0.00 | 1.32 | 1.04 | 0.90 | 0.83 | 0.75 | 0.90 | 0.82 | 0.81 | 0.78 |

## v. Variance Decomposition of KLSE

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0.07 | 0.08 | 0.10 | 0.11 | 0.12 | 0.13 | 0.13 | 0.14 | 0.15 | 0.15 |
| KSE-100 | 1.66 | 2.52 | 3.09 | 4.49 | 4.13 | 4.05 | 3.84 | 3.95 | 4.01 | 4.02 |
| BSE | 3.54 | 5.39 | 7.77 | 7.81 | 7.29 | 8.40 | 8.42 | 8.47 | 8.65 | 8.78 |
| SCI | 2.20 | 1.49 | 2.89 | 2.58 | 2.83 | 2.66 | 2.57 | 2.54 | 2.58 | 2.55 |
| HSI | 10.47 | 19.76 | 26.02 | 27.97 | 28.68 | 28.51 | 30.62 | 31.42 | 31.88 | 32.40 |
| SET | 19.78 | 14.02 | 17.27 | 15.76 | 15.19 | 15.87 | 15.40 | 15.30 | 15.29 | 15.17 |
| KLSE | 62.35 | 46.14 | 32.07 | 28.81 | 28.67 | 27.62 | 26.43 | 25.51 | 24.43 | 23.89 |
| JCI | 0.00 | 0.46 | 0.85 | 1.67 | 2.38 | 2.30 | 2.15 | 2.33 | 2.57 | 2.60 |
| ISE | 0.00 | 0.04 | 0.64 | 0.55 | 0.76 | 0.89 | 0.81 | 0.74 | 0.73 | 0.77 |
| BCI | 0.00 | 9.16 | 7.23 | 7.50 | 7.29 | 7.13 | 7.25 | 7.22 | 7.29 | 7.30 |
| S&P-500 | 0.00 | 0.55 | 0.72 | 0.70 | 0.79 | 0.72 | 0.69 | 0.64 | 0.62 | 0.62 |
| FTSE-100 | 0.00 | 0.28 | 0.47 | 0.50 | 0.48 | 0.43 | 0.41 | 0.43 | 0.40 | 0.38 |
| NIKKEI-225 | 0.00 | 0.00 | 0.30 | 0.89 | 0.81 | 0.77 | 0.78 | 0.81 | 0.83 | 0.86 |
| CAC-40 | 0.00 | 0.19 | 0.70 | 0.78 | 0.68 | 0.65 | 0.62 | 0.64 | 0.71 | 0.66 |

## vi. Variance Decomposition of JCI

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0.08 | 0.11 | 0.12 | 0.13 | 0.14 | 0.15 | 0.16 | 0.17 | 0.17 | 0.18 |
| KSE-100 | 5.24 | 4.99 | 4.48 | 3.88 | 4.22 | 4.64 | 4.54 | 4.25 | 4.12 | 4.16 |
| BSE | 16.79 | 13.59 | 12.23 | 13.75 | 13.47 | 13.21 | 13.46 | 13.74 | 13.63 | 13.79 |
| SCI | 0.22 | 0.15 | 1.56 | 1.55 | 1.44 | 1.50 | 1.51 | 1.48 | 1.53 | 1.56 |
| HSI | 7.58 | 20.27 | 20.93 | 19.98 | 21.94 | 21.82 | 21.47 | 22.61 | 23.32 | 23.22 |
| SET | 13.22 | 7.99 | 7.90 | 8.54 | 7.77 | 7.37 | 8.01 | 7.68 | 7.48 | 7.48 |
| KLSE | 1.51 | 1.46 | 1.25 | 1.97 | 1.88 | 1.99 | 1.81 | 1.61 | 1.49 | 1.41 |
| JCI | 55.44 | 39.35 | 33.34 | 31.93 | 32.30 | 33.01 | 32.24 | 30.92 | 30.85 | 31.04 |
| ISE | 0.00 | 3.87 | 4.94 | 4.44 | 4.02 | 3.95 | 3.96 | 4.27 | 4.14 | 4.02 |
| BCI | 0.00 | 0.00 | 0.81 | 1.32 | 1.41 | 1.33 | 1.34 | 1.27 | 1.21 | 1.16 |
| S&P-500 | 0.00 | 2.25 | 1.92 | 1.83 | 1.65 | 1.53 | 1.66 | 1.59 | 1.54 | 1.53 |
| FTSE-100 | 0.00 | 3.29 | 5.66 | 5.82 | 5.32 | 5.07 | 5.25 | 5.75 | 5.73 | 5.65 |
| NIKKEI-225 | 0.00 | 0.06 | 0.78 | 0.83 | 0.74 | 0.69 | 0.72 | 0.80 | 0.78 | 0.77 |
| CAC-40 | 0.00 | 2.72 | 4.19 | 4.16 | 3.83 | 3.87 | 4.04 | 4.03 | 4.18 | 4.21 |

## vii. Variance Decomposition of ISE

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0.16 | 0.18 | 0.19 | 0.21 | 0.23 | 0.24 | 0.26 | 0.27 | 0.28 | 0.29 |
| KSE-100 | 0.02 | 0.23 | 0.72 | 0.61 | 0.72 | 0.85 | 0.79 | 0.75 | 0.86 | 0.89 |
| BSE | 20.01 | 15.88 | 18.61 | 15.91 | 15.74 | 16.05 | 15.20 | 15.04 | 15.09 | 14.70 |
| SCI | 0.99 | 1.02 | 0.87 | 1.58 | 1.37 | 1.27 | 1.30 | 1.32 | 1.22 | 1.22 |
| HSI | 9.49 | 14.29 | 12.58 | 11.09 | 11.85 | 12.16 | 12.17 | 11.75 | 12.05 | 12.01 |
| SET | 0.74 | 2.77 | 2.46 | 2.38 | 2.07 | 1.88 | 2.18 | 2.00 | 1.91 | 2.01 |
| KLSE | 3.17 | 2.89 | 2.86 | 3.36 | 2.95 | 2.93 | 2.75 | 2.62 | 2.55 | 2.64 |
| JCI | 1.32 | 1.20 | 1.50 | 1.69 | 1.98 | 2.09 | 2.00 | 2.09 | 2.27 | 2.25 |
| ISE | 64.26 | 57.82 | 55.30 | 57.40 | 57.43 | 56.51 | 57.65 | 58.10 | 57.87 | 58.31 |
| BCI | 0.00 | 2.63 | 2.24 | 2.04 | 2.31 | 2.19 | 1.98 | 2.20 | 2.17 | 2.10 |
| S&P-500 | 0.00 | 0.70 | 0.69 | 0.64 | 0.65 | 0.57 | 0.67 | 0.62 | 0.61 | 0.58 |
| FTSE-100 | 0.00 | 0.35 | 0.29 | 0.57 | 0.57 | 0.51 | 0.48 | 0.74 | 0.70 | 0.65 |
| NIKKEI-225 | 0.00 | 0.15 | 0.91 | 1.21 | 1.05 | 1.48 | 1.38 | 1.44 | 1.45 | 1.47 |
| CAC-40 | 0.00 | 0.06 | 0.98 | 1.51 | 1.31 | 1.50 | 1.44 | 1.33 | 1.25 | 1.17 |

## viii. Variance Decomposition of BCI

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0.11 | 0.12 | 0.13 | 0.15 | 0.16 | 0.17 | 0.18 | 0.19 | 0.19 | 0.20 |
| KSE-100 | 2.06 | 1.50 | 2.17 | 3.01 | 2.59 | 2.64 | 2.68 | 2.81 | 2.75 | 2.78 |
| BSE | 21.89 | 18.10 | 18.84 | 18.44 | 18.71 | 18.78 | 18.99 | 19.38 | 19.21 | 19.42 |
| SCI | 3.96 | 2.83 | 5.13 | 4.72 | 4.42 | 4.36 | 4.81 | 4.56 | 4.56 | 4.72 |
| HSI | 21.95 | 31.57 | 28.33 | 28.05 | 29.48 | 29.47 | 29.37 | 29.76 | 30.31 | 30.05 |
| SET | 1.34 | 3.04 | 2.74 | 2.31 | 1.96 | 1.99 | 1.82 | 1.63 | 1.61 | 1.51 |
| KLSE | 0.03 | 0.85 | 0.98 | 2.51 | 2.19 | 1.98 | 1.89 | 1.84 | 1.70 | 1.62 |
| JCI | 0.02 | 0.21 | 0.85 | 0.94 | 0.80 | 0.92 | 0.94 | 0.90 | 0.91 | 0.94 |
| ISE | 4.83 | 5.07 | 5.38 | 5.52 | 5.03 | 5.46 | 5.70 | 5.71 | 5.68 | 5.78 |
| BCI | 43.93 | 32.39 | 31.15 | 30.50 | 31.10 | 30.32 | 29.86 | 29.40 | 29.45 | 29.46 |
| S&P-500 | 0.00 | 0.50 | 0.44 | 0.44 | 0.40 | 0.54 | 0.50 | 0.46 | 0.44 | 0.43 |
| FTSE-100 | 0.00 | 0.87 | 1.13 | 1.03 | 0.89 | 1.06 | 1.05 | 1.04 | 1.02 | 0.99 |
| NIKKEI-225 | 0.00 | 0.95 | 0.83 | 0.84 | 0.81 | 0.73 | 0.79 | 0.79 | 0.74 | 0.72 |
| CAC-40 | 0.00 | 2.12 | 2.02 | 1.69 | 1.60 | 1.75 | 1.59 | 1.70 | 1.64 | 1.59 |

## ix. Variance Decomposition of S&P-500

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0.05 | 0.06 | 0.06 | 0.07 | 0.07 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 |
| KSE-100 | 0.34 | 0.59 | 0.84 | 0.78 | 0.87 | 0.79 | 0.72 | 0.66 | 0.60 | 0.56 |
| BSE | 22.65 | 18.71 | 17.34 | 17.54 | 17.49 | 17.67 | 17.36 | 17.44 | 17.56 | 17.50 |
| SCI | 1.40 | 3.03 | 5.26 | 5.41 | 5.90 | 5.84 | 6.63 | 6.82 | 6.83 | 7.19 |
| HSI | 22.79 | 25.63 | 23.78 | 22.86 | 25.30 | 24.54 | 24.83 | 25.14 | 25.26 | 25.36 |
| SET | 3.46 | 4.61 | 5.03 | 4.33 | 3.74 | 3.39 | 3.06 | 2.87 | 2.65 | 2.45 |
| KLSE | 1.69 | 1.82 | 1.73 | 1.47 | 1.27 | 1.16 | 1.07 | 1.00 | 0.93 | 0.87 |
| JCI | 1.33 | 1.73 | 2.44 | 2.08 | 2.04 | 2.32 | 2.28 | 2.30 | 2.26 | 2.28 |
| ISE | 4.88 | 4.16 | 3.95 | 4.84 | 4.44 | 3.98 | 4.06 | 3.89 | 3.70 | 3.62 |
| BCI | 5.16 | 3.71 | 3.43 | 3.63 | 3.18 | 2.84 | 2.62 | 2.44 | 2.27 | 2.12 |
| S&P-500 | 36.30 | 32.82 | 32.20 | 33.62 | 32.55 | 33.83 | 33.93 | 34.12 | 34.50 | 34.69 |
| FTSE-100 | 0.00 | 2.04 | 2.15 | 1.84 | 1.73 | 1.80 | 1.77 | 1.72 | 1.72 | 1.73 |
| NIKKEI-225 | 0.00 | 0.13 | 0.83 | 0.72 | 0.63 | 0.92 | 0.85 | 0.78 | 0.84 | 0.80 |
| CAC-40 | 0.00 | 1.02 | 1.02 | 0.87 | 0.85 | 0.90 | 0.84 | 0.82 | 0.89 | 0.83 |

## x. Variance Decomposition of FTSE-100

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0.05 | 0.05 | 0.06 | 0.06 | 0.07 | 0.07 | 0.08 | 0.08 | 0.08 | 0.09 |
| KSE-100 | 0.08 | 0.13 | 0.12 | 0.10 | 0.18 | 0.16 | 0.15 | 0.14 | 0.15 | 0.15 |
| BSE | 23.24 | 17.76 | 16.56 | 17.38 | 15.93 | 16.08 | 15.67 | 15.53 | 15.39 | 15.31 |
| SCI | 0.37 | 2.07 | 3.48 | 3.59 | 3.66 | 3.75 | 4.27 | 4.40 | 4.40 | 4.59 |
| HSI | 26.27 | 29.68 | 27.34 | 26.39 | 29.61 | 29.06 | 29.29 | 29.38 | 29.70 | 29.71 |
| SET | 1.60 | 4.71 | 4.70 | 4.12 | 3.45 | 3.11 | 2.81 | 2.61 | 2.40 | 2.22 |
| KLSE | 0.17 | 0.13 | 0.11 | 0.12 | 0.22 | 0.20 | 0.19 | 0.22 | 0.20 | 0.22 |
| JCI | 3.19 | 4.21 | 4.38 | 4.56 | 4.52 | 4.98 | 4.76 | 5.08 | 5.11 | 5.18 |
| ISE | 3.30 | 3.41 | 3.92 | 4.01 | 3.59 | 3.25 | 3.01 | 2.86 | 2.66 | 2.52 |
| BCI | 5.95 | 5.14 | 4.58 | 5.37 | 5.08 | 4.92 | 4.78 | 4.96 | 4.88 | 4.89 |
| S&P-500 | 14.34 | 14.49 | 15.14 | 14.92 | 14.93 | 15.55 | 15.66 | 15.79 | 16.03 | 16.13 |
| FTSE-100 | 21.49 | 17.15 | 18.28 | 17.86 | 17.22 | 17.27 | 17.81 | 17.55 | 17.55 | 17.62 |
| NIKKEI-225 | 0.00 | 0.65 | 0.58 | 0.66 | 0.56 | 0.65 | 0.63 | 0.59 | 0.62 | 0.60 |
| CAC-40 | 0.00 | 0.47 | 0.80 | 0.92 | 1.05 | 1.01 | 0.96 | 0.89 | 0.91 | 0.85 |

## xi. Variance Decomposition of NIKKEI-225

| Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0.06 | 0.07 | 0.08 | 0.09 | 0.10 | 0.11 | 0.11 | 0.12 | 0.12 | 0.13 |
| KSE-100 | 0.07 | 0.08 | 1.02 | 0.93 | 0.79 | 0.94 | 0.87 | 0.85 | 0.88 | 0.86 |
| BSE | 26.59 | 21.04 | 19.09 | 19.51 | 19.68 | 18.56 | 19.04 | 18.89 | 18.62 | 18.70 |
| SCI | 2.89 | 5.38 | 6.64 | 6.32 | 6.43 | 6.74 | 6.86 | 7.07 | 7.04 | 7.25 |
| HSI | 8.56 | 12.23 | 10.11 | 9.70 | 10.86 | 10.20 | 9.84 | 10.23 | 10.06 | 9.90 |
| SET | 0.88 | 3.51 | 3.01 | 2.51 | 2.58 | 2.31 | 2.05 | 1.91 | 1.77 | 1.64 |
| KLSE | 0.70 | 0.99 | 0.96 | 1.72 | 1.47 | 1.53 | 1.61 | 1.54 | 1.58 | 1.62 |
| JCI | 4.21 | 3.95 | 3.68 | 3.08 | 3.11 | 3.19 | 3.11 | 2.99 | 2.98 | 2.92 |
| ISE | 3.11 | 4.87 | 6.04 | 5.83 | 7.06 | 6.73 | 7.04 | 7.59 | 7.53 | 7.61 |
| BCI | 2.13 | 1.76 | 1.61 | 2.16 | 1.92 | 1.72 | 1.76 | 1.62 | 1.55 | 1.51 |
| S&P-500 | 0.05 | 0.74 | 1.70 | 1.47 | 1.32 | 1.18 | 1.06 | 0.98 | 0.90 | 0.84 |
| FTSE-100 | 0.41 | 1.73 | 1.42 | 1.57 | 1.42 | 1.31 | 1.31 | 1.33 | 1.29 | 1.26 |
| NIKKEI-225 | 50.38 | 43.21 | 44.31 | 44.80 | 43.01 | 45.28 | 45.15 | 44.70 | 45.52 | 45.61 |
| CAC-40 | 0.00 | 0.50 | 0.41 | 0.39 | 0.34 | 0.31 | 0.30 | 0.29 | 0.28 | 0.28 |

## xii. Variance Decomposition of CAC-40

| Period | 1.00 | 2.00 | 3.00 | 4.00 | 5.00 | 6.00 | 7.00 | 8.00 | 9.00 | 10.00 |
|---|---|---|---|---|---|---|---|---|---|---|
| S.E. | 0.06 | 0.07 | 0.08 | 0.09 | 0.10 | 0.10 | 0.11 | 0.11 | 0.12 | 0.12 |
| KSE-100 | 0.11 | 0.08 | 0.36 | 0.64 | 0.58 | 0.59 | 0.59 | 0.66 | 0.65 | 0.65 |
| BSE | 19.23 | 14.70 | 14.16 | 13.80 | 13.44 | 13.72 | 13.28 | 13.23 | 13.29 | 13.15 |
| SCI | 0.74 | 1.57 | 2.93 | 3.17 | 3.32 | 3.29 | 3.66 | 3.79 | 3.78 | 3.94 |
| HSI | 15.67 | 18.07 | 16.68 | 15.86 | 17.32 | 16.89 | 17.12 | 17.15 | 17.35 | 17.42 |
| SET | 0.03 | 0.88 | 0.85 | 1.04 | 0.93 | 0.94 | 0.89 | 0.81 | 0.80 | 0.78 |
| KLSE | 0.14 | 0.12 | 0.18 | 0.16 | 0.18 | 0.17 | 0.16 | 0.15 | 0.14 | 0.13 |
| JCI | 2.58 | 3.82 | 5.00 | 4.15 | 4.60 | 4.98 | 4.72 | 4.91 | 4.83 | 4.83 |
| ISE | 11.79 | 12.98 | 11.33 | 12.63 | 12.64 | 12.04 | 12.43 | 12.57 | 12.37 | 12.48 |
| BCI | 3.99 | 3.24 | 2.87 | 3.31 | 3.14 | 2.79 | 2.76 | 2.59 | 2.50 | 2.45 |
| S&P-500 | 18.83 | 20.67 | 20.74 | 20.66 | 20.92 | 21.48 | 21.60 | 21.82 | 22.06 | 22.14 |
| FTSE-100 | 11.14 | 10.17 | 12.46 | 12.56 | 12.10 | 12.58 | 12.91 | 12.90 | 13.14 | 13.21 |
| NIKKEI-225 | 0.08 | 1.65 | 1.56 | 1.56 | 1.52 | 1.67 | 1.74 | 1.65 | 1.72 | 1.76 |
| CAC-40 | 15.66 | 12.04 | 10.88 | 10.46 | 9.31 | 8.86 | 8.15 | 7.77 | 7.36 | 7.06 |