Is Pakistani Equity Market Integrated to the Equity Markets of Group of Eight (G8) Countries? An Empirical Analysis of Karachi Stock Exchange

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This study looks at the dynamic relationship between the Pakistani equity market and equity markets of Group of Eight countries (G8) which includes Canada, France, Germany, Italy, Japan, Russia, UK and USA by using weekly time series data starting from June 2004 to May 2009. Multivariate Co-integration approach by Johnson and Julius (1990) shows there exists no long-term relationship between the G8 and Pakistani equity market. Vector error correction (VECM) model suggests that 100% of the lag periods disequilibrium has been corrected in the current period. Pairwise Granger Causality test shows that there exist a unidirectional causality between the equity market of Pakistan and the

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markets of France, Germany, Italy, Japan and United Kingdom. Impulse response analysis and variance decomposition analysis reveal that most of the shocks in Pakistani equity market are due to its own innovation and behave like exogenous. However, the markets of France, Japan, Germany and United Kingdom are exerting a little pressure on Pakistani equity markets. Therefore, by investing in Karachi Stock Exchange (KSE) the fund manager of G8 countries especially Canada, Italy, Russia and USA is capable of getting the advantage of portfolio diversification.
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Introduction

After the work of Markowitz (1952) the phenomena of portfolio selection become almost the core of all financial investments. Markowitz (1952) - mean variance optimization is still consider while the formulation of portfolio. Selection of portfolio is all about picking different securities form different markets in your investment baskets. According to Markowitz (1952), in the selection process the important consideration is co movement between different selected stocks. Due to increase in financial innovation, services proliferation, globalization, homogenizations, harmonization, competition, technology and changing demographic patters, phenomena of traditional investments has been changed. Now investors are looking cross boundaries investment and following the well known fact that investment always needs safe heaven either local plus/or cross boundaries. The relative risk and return of international portfolio diversification has been a key issue for those who hold financial portfolio.

The globalization and enhancement in the overall economic conditions stimulated the way in which the emerging markets in the world are integrated to each other and it also increased their co-movements with the developed equity markets. However, the

emerging markets are not homogeneous and their financial dynamics of integration is appreciably different (Bekaert and Harvey 1995). It can be said, nature and the speed of the financial process of integration both depend on the internal and external factors: economic, financial and policies of international, regional and specific variables.

The Capital Asset Pricing Model (1963) introduced by Sharp suggest that the systematic risk, (or 'market risk'), is impossible to be eliminated. As investors become more risk averse, further risk diversification continues to be their basic concern. The best measurement taken by investors is to invest in various countries under the concept of international diversification, where the general argument is made that the investments in abroad offer the additional potential of profit simultaneously with reducing total risk of the portfolio investment. In a globally integrated market, investors and academicians are concerned about monitoring and controlling contagion from one market to other markets to avoid the unwanted effects. It is observed that if different equity markets in the world have co-movement mean there exist long-term relationship, then one cannot get the benefit of diversification by investing in different markets. However, markets may have no co-movement in the short run hence portfolio diversification may exist for the shorter horizon.

Due to this reason it is worth seeing for both policy makers and investors to know about the co-movements of equity markets in the world. The inter linkage between equity markets has concerned for policy makers due to the following reason: the integration among the equity markets can transmit the innovation in one equity market to other equity market. The presence of trading linkages, the higher level of liberalization and the innovation in technology especially in telecommunication systems impressed upon investors and fund managers in G8 countries to consider the long-term as well as the short-term dependencies among the G8 and Pakistani equity markets.

In this research an endeavour is made to analyze the long-term as well as short-term relationship among the activities of equity prices of the G8 countries and their relations with Pakistani market to analyze whether one can diversify their risk in the equity markets of group of eight and Pakistani equity markets. G8 refers to the combination of Canada, France, Germany, Italy, Japan, Russia, United Kingdom (UK) and USA. Hitherto, there is no study especially in the finance literature addressing the long-term as well as short-term relation among the stock markets of G8 countries equity markets and Pakistani equity market. An additional contribution of our work is that we use most recent and weekly data of these equity markets which give us the possibility to integrate most modern dynamics. The objective of research is to assess whether the G8 countries equity markets and Pakistani equity market offer a precious diversification benefit for those of international investors and this also helps manager and those of policy makers to diversify their investment risk.

In the finance literature, Cointegration techniques are mostly used to explore the long-run interaction between the markets. The research about integration between the equity markets can be categorized in three different ways. First, some has focused only on the developed markets (Kazi 2008). Secondly, some has focused only on the developing countries (Worthington, Katsuura and Higgs 2004). On the other hand (Wong et. al. 2004) investigated the relationship between the developed and developing countries equity markets. This particular study investigates the long-term and short-term relationship between the stock markets in Pakistan and G8 countries.

The paper is structured as follow. First, we conduct a literature review. Next, we discuss the data and the methodology adopted. After this, the result of the study and conclusion is made.

Review of related literature

Globalization is changing the world in new direction. Due to this globalization, financial world is redesigning. Because of financial

liberalization and innovation in technology, the innovative market structures are playing central part in today's environment. Financial world is going to integrate because of the globalization. Since the 1980s, the emerging equity markets have been extensively observed as the most stimulating and potential area for investment, particularly they are hoped to produce high returns and to present the opportunity of portfolio diversification. Portfolio diversification is a key aspect of financial market. To avail this opportunity of portfolio diversification, global fund managers want to invest. So in the existing literature there are numerous studies who studied the long term relationship among world's different equity markets. Like, Aktan et al. (2009) investigated the co-movement between the equity markets of BRICA (Brazil, Russia, India, China, and Argentina) and US equity markets. They used daily prices starting from January, 2002 to February, 2009; Vector auto regression, Granger Causality Test and Impulse Response Analysis were used to explore the relationship. They found that US market had significant effect on the other markets under study. Russia and Brazil were found to be most integrated among BRICA markets whereas China and Argentina were least integrated with BRICA. The results of Granger Causality showed, the Russian equity market had influenced on the BRICA equity markets. It further showed that Argentina and Russia were influence by the Chinese market. The result of impulse response analysis indicated, all the markets under studied were recovered from shocks within one week time period.

In literature several attempt has been made to find out the benefit of portfolio diversification while considering various markets. Some studied only developing markets, some have focused on developed equity markets and there exists also the studied of developing with developed equity markets. Akin to, Guidi and Gupta (2010) analyzed the long run co-movement among Central and Eastern Europe (CEE) and German stock markets. CEE includes Czech, Hungarian and Polish stock markets. They used daily prices of 10 years starting from

January, 1999 to January, 2009. Johansen, Engle-Granger and Gregory-Hansen test co-integration tests were used to explore the relationship. Johansen and Engle-Granger co-integration test indicated that there was no long run co-movement among the countries under study whereas Gregory-Hansen test showed long run co-movement. They also used dynamic conditional correlation models to grasp the time varying correlation among markets of the countries under study. They empirically found that correlation of CEE countries increased after the inclusion in the European Union. Robbani, Rahimian and Islam (2005) explored the relationship of stock markets of Malaysia, Singapore and India. They used daily stock prices starting from July, 1997 to February, 2005. Granger causality and Johansen multivariate cointegration technique were used to analyze the relationship among countries under study. They found equilibrium relationship among the markets and further they found bidirectional causality between Indian equity market and Malaysian equity market and between Indian stock market and Singapore equity market. They also found unidirectional causality between Malaysian equity market and Singapore equity market.

Whether or not the portfolio diversification has been achieved in a country who is your major trading partner had also been studied. Long run relationship among a country with its major trading partner has been explored by Valadkhani and Chancharat (2007). They explored the long run relationship among the equity market of Thailand and its 11 major trading partners (US, UK, Taiwan, Singapore, Philippines, Malaysia, Korea, Japan, Indonesia, Hong Kong and Australia). They used monthly data of 19 years starting from December 1987 to December 2005. Engle-Granger and Gregory and Hansen (1996) test were used to explore the relationship. They found no co-integration among the equity market of Thailand and other countries under study whereas 3 short run unidirectional Granger causalities found among UK, Philippines Hong Kong with Thailand. Similarly, Kazi (2008)

investigated the long run co-movement among the Australian equity market and the equity markets of its major trading partners (UK, USA, the Canadian, German, French and the Japan). He used the annual data of 57 years starting from 1945 to 2002. He used Johansen cointegration technique to find long run relationship. He found all the markets of countries under study were interrelated but found few markets were not significantly related (USA, French and Japan). He found that UK, German and Canadian markets are significantly interrelated with Australian equity market. Azmi, shamsuddin and Haron (2004) also explored the co-movement between Malaysian equity market and its major trading partners (US, Japan and Singapore). They used data starting from January 1995 to June 1997. They used Cointegration, Vector Error Correction Model and Impulse response analysis to find relationship among countries under study. They found no long run stable co-movement before implementing capital control measures whereas they found stable co-movement after implementing capital control measures among countries under study.

Similarly an attempt has also been made to study the relationship between Malaysian equity market and Tiger equity markets. Marimuthu and Kok (2010) explored the relationship between Malaysian equity market and Tiger equity markets (South Korea, Taiwan, South Korea and Hong Kong). They used the daily data of 11 years starting from 1997 to 2007. They used Johansen cointegration test and Vector Error Correction Model to find the long run and short run relationship. They found the long run co-movement among Malaysian equity market and countries under study. They also found that Taiwan and Hong Kong markets were most influential markets.

The evidence to explore the relationship among emerging markets is also quite visible. In this regard, Worthington, Katsuura and Higgs (2003) explored the relationship between six emerging markets (Korea, Philippines, Thailand, Taiwan, Malaysia and Indonesia) and three developed equity markets (Japan, Singapore and Hong Kong). They

used data starting from January 1, 1988 to February 18, 2000. Cointegration and Vector auto regression techniques were used to find relationship. They found significant casual relationship among these equity markets. They also found lower causal co-movement between developed and Asian emerging equity markets. Arouri and Jawadi explored the long run and short run relationship between two developing countries (Mexico and Philippines). They used monthly data starting from December 1998 to December 2008. Multivariate cointegration technique was used to find long run co-movement between Mexico and Philippines equity market and world equity market. They explored that both developing markets were integrated with the world market, although Mexico was found to be highly integrated with world equity market as compare to Philippines equity market.

In other context the long term relationship between developed and developing equity markets have been analyzed. In this stare Wong et al. (2004) analyzed the relationship between developed (United States, United Kingdom, Japan, Singapore and Hong Kong) and Asian developing countries (Malaysia, Thailand, Korea, Taiwan) markets. They used weekly stock prices of 22 years starting from January 1981 to December 2002. By applying the Cointegration technique, they explored no long run relationship between developing markets of Thailand, Korea and Malaysia and the developed markets of the US, UK and Japan. Taiwan and Singapore equity markets are integrated with the equity market of Japan whereas the Hong Kong equity market is integrated with the equity markets of UK and US. In Pakistani environment, Hasan, Saleem and Abdullah (2008) analyzed the long run co-movement among Pakistani equity market and equity markets of US, UK, Germany, Canada, Italy, Australia, France and Japan. They used weekly data of 7 years starting from 2000 to 2006. They used Johansen and Juselius multivariate Cointegration analysis and Granger Causality test to find long run co-movement. They found

a long run co-movement among these markets. They found, Pakistani equity market was not interrelated with the equity markets of US, Germany, UK, Canada, Australia and Italy. They also found cointegration among Pakistani equity market and equity markets of Japan and France. They found only UK market was exerting some impact on Pakistani equity market.

From the above scattered range of existing available literature it can be summarized that some researchers had tried to uncover the portfolio advantage in the markets of developed countries while simultaneously some studied the emerging markets. There is also evidence of exploring the long term relationship between developing and developed equity markets. From Pakistani investor perspective there is still need to explore the cross boarder securities especially in the countries of group of eight. Hence this study is an effort to explore the long tern relationship between Pakistani equity markets and markets of group of eight (G8) countries. Further more this study applied well like econometrics to explore this relationship. Detail discussion regarding data description and methodology is describing follow

Data and Methodological Issues

This study uses the weekly closing values of the equity prices of the indices of the Group of Eight (G8) countries and Pakistan. It covers the data period of 5 year starting from June 2004 to May 2009 and these indices have been collected from the yahoo finance and from their respective stock exchanges. G8, referring to the combination of Canada, France, Germany, Italy, Japan, Russia, United Kingdom and USA. This particular study uses the following representative indices for the G8 and Pakistani equity markets.

Table 1

Indices of the G8 and Pakistani equity markets

Country Name	Index
Canada	TSX Composite Index
France	CAC 40
Germany	DAX
Italy	MIB30
Japan	NIKKEI 225
Russia	RTS index
Pakistan	KSE100 index
United Kingdom	FTSE 100
United States	S&P 500 Index

The weekly series of equity market return have been generated by using the following continuous compounded return equation.

$$R_t = ln\left(\frac{P_t}{P_{t-1}}\right)$$

Where R_t is the continuous compounded return for the week't' and P_t and P_{t-1} are symbols of closing values of the equity indices of the G8 as well as Pakistani markets for the week 't' and 't-1' respectively and 'In' stands for Natural Log.

The time series data of the equity markets of G8 countries and Pakistan are tested against different statistical models describe as follow:

Descriptive Statistics
Correlation Matrix
Unit Root test
Johansen and Juselius (1990) Co-integration Approach
Vector Auto Regression (VAR) test
Vector Error Correction (VECM) Model
Pairwise Granger Causality test

Variance Decomposition Analysis
Impulse Response (IR) Analysis

Descriptive statistics only discuss the data quantitatively. Generally correlation matrix considers a week measure to measure the relationship between the variable. Because it only discuss the strength and direction of the relationship among the variables under study and it does not talk about the cause and effect of relationship. So to analyze the long run and short relationship, this study uses the Cointegration and vector error correction model respectively.

Stationarity of the data is one of the basic and important features especially for economic time series. A series is said to be stationarity, if the mean, variance and covariance of the time series does not depend upon time i.e. these are time invariant. To test the stationarity of the time series, Augmented Dickey Fuller (1979) and Phillips-Perron (1988) test are consider to be most widely used in the literature. This particular study also performs the above renewed test for stationarity of the time series data. The stationarity of all the time series are tests separately having the null hypothesis that individual series has a unit root. The rejection of this null hypothesis confirms that the particular time series is stationary at that particular level. The ADF (1979) test uses an auto-regressive model to check the level of integration or stationarity of the time series. Mathematically basic and simple autoregressive i.e. AR (1) can be written as:

$$A_t = \psi A_{t-1} + \varepsilon_t$$

A_t, is the symbol of dependant variable, "t" and ε_t represents the time period and error term respectively. The regression equation for this study is given below:

$$\Delta A_t = (\psi - 1)A_{t-1} + \varepsilon_t = \delta A_{t-1} + \varepsilon_t$$

In the last equation, Δ represents the difference operator and this equation estimated in the ADF test for stationarity of the data. Generally speaking, ADF test consider a little bit rigid test for stationarity of the time series because it works on the two

assumptions. First one is that the error term in the model is independent and secondly they are homoscedastic. To relax this assumption, this study also applies the Phillips-Perron (1988) test for stationarity of the time series. The assumptions under Phillips-Perron are that it permits error term to be weekly dependant and distributed heterogeneously. In mathematics form:

$$A_t = \xi + \lambda_1 A_{t-1} + \lambda_t \left\{ t - \frac{T}{2} \right\} + \varepsilon_t$$

To analyze the long term relationship between the variables, most widely maximum-likelihood based Johnson-Juselius (1990) method is used. Johnson and Juselius (1990) present two likely-hoods ratio test i.e. maximal eigen-value test and trace test. Objective of both these is to find out the cointegrated vectors. This particular study applies both of the tests for the determination of long term relationship between the variable. The null hypothesis of maximal eigen-value test is that there is at most "r" cointegrating vectors having alternative of "r+1" vectors and in equation form:

$$\mathrm{Y}\,(\mathrm{r}) = -\mathrm{N} \sum \mathrm{In}(1 - \mathrm{Y}_{\mathrm{r+1}})$$

Here "N" shows the totality of the observation and $\mathrm{Y}_{\mathrm{r+1}}, \mathrm{Y}_{\mathrm{r+2}}, \ldots, \mathrm{Y}_{\mathrm{n}}$ denotes the (n – r) lowest squared canonical correlation. The other test of the Johnson and Juselius approach is the trace statistics. In trace test the null hypothesis i.e. there are "r" cointegrating vector having alternative of "r" or more cointegrating vector and in equation form it is written as:

$$Y\,(r) = -N \sum In(1 - Y_i)$$

After the stationarity of the time series, the second important step is the determination of proper lag length for the VAR model. There are several well recognize measure for the selection of the lag length like AIC, SIC and HQ. This particular study uses these criterions for the selection of appropriate lag length. The proper lag length is one where the values of SIC, AIC and HQ criterion minimum.

Since cointegration analysis analyze the long run relationship between the variable and to investigate the short run relationship this study uses the vector error correction model. Engle and Granger (1987) investigate that if there exist long term relation between the variables then add a term of error correction in the system of equation for the short term relation. Shocks in the dependant variable are a function of level of disequilibrium and also change in explanatory variable. Mathematically error correction model with two cointegrating variable can be written as:

$$\Delta Z_t = \xi + \eta\, \Delta X_t + \eta_1 \varepsilon_{t-1} + \vartheta_t$$

According to the Granger representation theorem if co-integration is found between two time series then granger causality must exist from at least one direction. Null hypothesis are tested at 5% level and its acceptance or rejection confirms the unidirectional or bidirectional granger causality among the equity markets. This particular study also uses the variance decomposition analysis and impulse response analysis for the entire data period. Variance decomposition analysis measures the total change in the explained variable in particular period. This change or shocks may be due to its own innovation or dynamics and may be due to other explanatory variable in the model. Lutkepohl (1991) comes with an analysis known as impulse response analysis. It shows that in what way innovation or shocks in financial time series are transmitted to the other times series.

Empirical Findings

The following plot shows the trend in the continuous compounded return of the KSE-100 index. KSE-100 index frequently uses as the proxy of Pakistani equity markets. It shows that there are certain periods where the volatility is higher than the other periods under studied.

Figure 1

Trend in the return of KSE-100 index

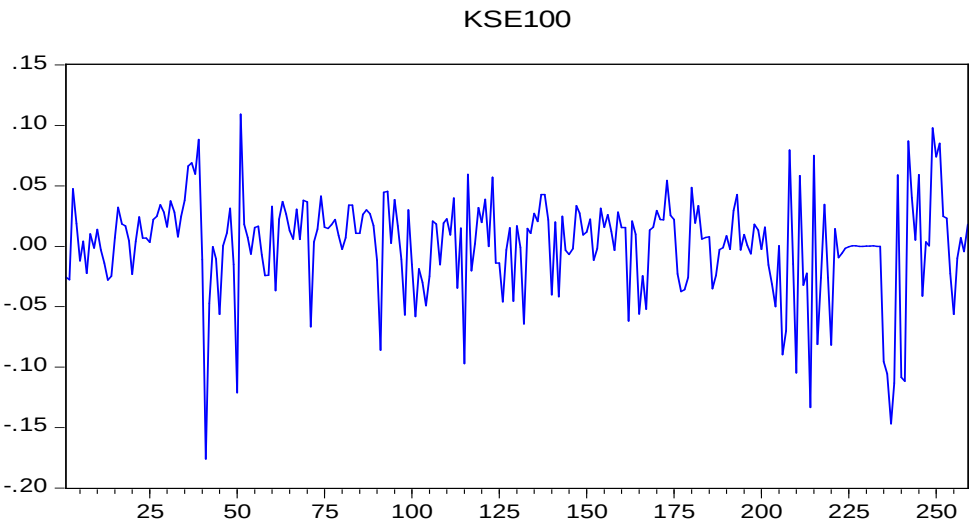


Figure 2 shows the trend in the log of weekly closing values of the indices of the G8 as well as of the equity markets of Pakistan for the period under studied.

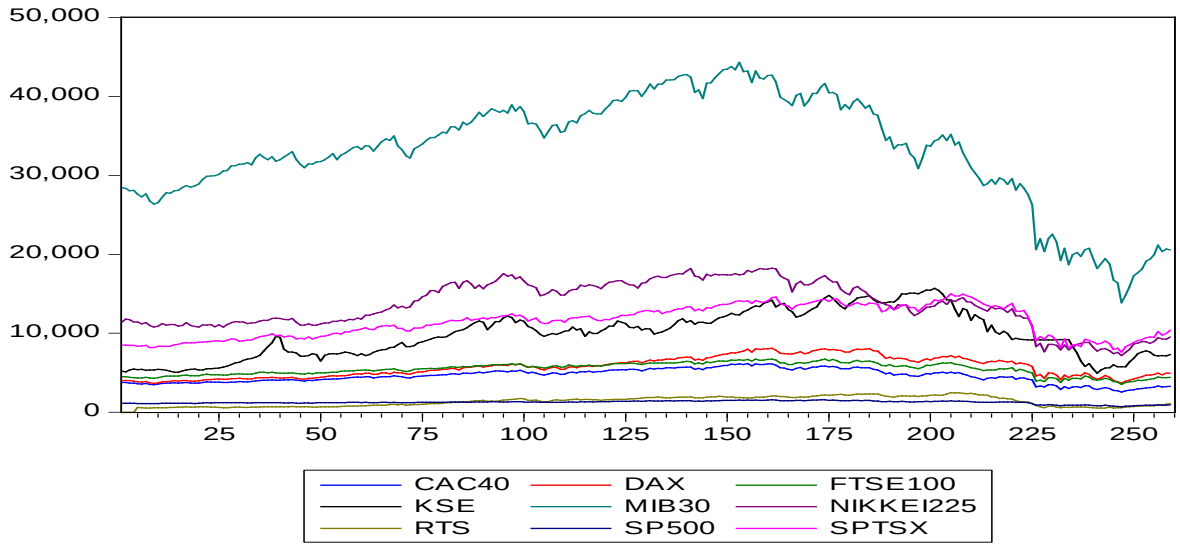


Figure 2

Plot of the trend in the G8 and Pakistani equity price indices

Descriptive Statistics

Table 2 demonstrates the results of descriptive statistics of equity indices of the G8 countries as well as the equity market of Pakistan. It includes the mean, standard deviation, skewness, kurtosis and range etc. Result shows that the weekly return of Karachi Stock Exchange is 0.116% with 4% standard deviation. The RTS index of Russia offers the highest level of return i.e. 1.5% with highest level of risk i.e. 22%. Among the G8 countries the markets of Italy, UK, US, Japan and France offer the negative weekly return and also having the approximately same level of risk under the entire study period. The value of skewness shows that the returns of all the markets except of RTS are negatively skewed.

Table 2

Descriptive Statistics

	Range	Minimum	Maximum	Mean	Std. D	Skewness	Kurtosis
R_KSE100	0.2854	-0.1762	0.1092	0.001163	0.041047	-1.059	2.587
R_MIB30	0.3253	-0.2441	0.0811	-0.00121	0.03304	-2.304	13.99
R_FTSE100	0.3621	-0.2363	0.1258	-0.00006	0.029387	-1.862	18.373
R_DAX	0.3929	-0.2435	0.1494	0.000802	0.034106	-1.44	12.199
R_SP500	0.3144	-0.2008	0.1136	-0.00082	0.028783	-1.167	10.744
R_SPTSX	0.3036	-0.1754	0.1282	0.000829	0.029986	-1.235	8.376
R_NIKKEI225	0.3933	-0.2788	0.1145	-0.00074	0.034065	-2.303	17.465
R_CAC40	0.3748	-0.2505	0.1243	-0.00047	0.032589	-1.939	14.491
R_RTS	3.6519	-0.2373	3.4146	0.01552	0.219813	14.426	223.851

Table 3 presents the results of correlation matrix. Correlation analysis shows the relationships between the variables. It also discusses the strength and direction of relationship. However, it is consider as a weak measure because it does not talk about any cause and effect. Correlation matrix shows that Karachi Stock Exchange has weak or no correlation with G8 countries equity markets. However, the equity markets of Group of Eight countries are strongly positively correlated with each other except those of Russia.

Table 3

Correlation Matrix

	Rtn_KSE	Rtn_MIB3	Rtn_FTSE	Rtn_DAX	Rtn_S&P	Rtn_TSX	Rtn_NIKKEI	Rtn_CAC	Rtn_RTS
Rtn_KSE	1.000								
Rtn_MIB	0.108	1.000							
Rtn_FTSE	0.075	0.897	1.000						
Rtn_DAX	0.087	0.882	0.913	1.000					
Rtn_S&P	0.067	0.819	0.860	0.863	1.000				
Rtn_TSX	0.062	0.797	0.825	0.759	0.807	1.000			
Rtn_NIKKEI	0.124	0.776	0.752	0.770	0.728	0.692	1.000		
Rtn_CAC	0.103	0.919	0.949	0.949	0.854	0.805	0.768	1.000	
Rtn_RTS	0.010	0.104	0.123	0.113	0.114	0.120	0.149	0.109	1.000

Unit Root test

Since, correlation analysis only discusses the strength and direction of relationship without discussing any cause and effect relationship. To better understand among the long run co-movement of the equity price indices, a Cointegration analysis has been performed. It shows the long run co-movement between the G8 and Pakistani equity markets. The first step in Cointegration analysis is to test stationarity of the time series. The following test are widely used to tests the stationarity of the equity prices.

Augmented Dickey Fuller test (1979)

Phillips-Perron test (1988)

The basic assumption behind the Cointegration analysis is that all the time series under study should be stationary at the same levels i.e. they are integrated of the same order. The result of ADF test from table 4 clearly shows that all the time series of equity price indices are not stationary at levels but their first difference are stationary i.e. I(1). The results of Phillips-Perron test (1988) also support the results of Augmented Dickey Fuller test (1979) which ultimately confirms that Cointegration analysis can apply.

Table 4

Unit Root Analysis

	ADF (Level)	ADF (1st Diff.)	PP (level)	PP (1st Diff.)
KSE100	-1.4610	-14.137	-1.6123	-14.309
MIB30	-0.2515	-9.8570	-0.1934	-17.053
FTSE100	-1.3904	-17.973	-1.3092	-17.948
DAX	-1.4411	-17.6414	-1.4411	-17.631
S&P500	-0.7988	-16.859	-0.7528	-16.857
TSX	-1.6257	-16.851	-1.6437	-16.832
NIKKEI225	-0.7810	-16.3034	-0.8611	-16.321
CAC40	-0.9057	-18.227	-0.8104	-18.214
RTS	-2.1034	-13.940	-2.1000	-14.239
Critical Value				
1%	-3.4555	-3.4556	-3.4555	-3.4556
5%	-2.8725	-2.8725	-2.8725	-2.8725
10%	-2.5727	-2.572	-2.5727	-2.572

Before the application of Johnson and Julius (1990) Approach, First of all a proper lag length must be selected. For this purpose unrestricted VAR is estimated and following criteria are used from 1 to 12 periods. The appropriate lag length is considered where Akaike information criterion, Schwarz information criterion, Hannan-Quinn information

criterion is found minimum. The result of table 5 reveals that the appropriate lag length for this study is 1.

Table 5

VAR Lag Order Selection Criteria

Lag	AIC	SC	HQ
0	130.9027	131.0306	130.9542
1	109.6282*	110.9070*	110.1431*
2	109.713	112.1425	110.6911
3	109.7373	113.3177	111.1788
4	109.905	114.6362	111.8098
5	110.0238	115.9059	112.392
6	110.1091	117.1421	112.9407
7	110.1862	118.37	113.4811
8	110.1811	119.5158	113.9394
9	110.3228	120.8083	114.5444
10	110.4546	122.091	115.1395

*Selected Lag length

Co-integration analysis

Johnson and Julius (1990) Co-integration requires that all the time series under study should be integrated of the same order. Co-integration analysis assumes that even if two time series are individually non-stationary but a linear combination of these might be stationary. Co-integration analyzes the long run relationship between two or more time series. This study uses the maximum likelihood based Johnson and Julius (1990) Co-integration approach.

Table 6 and 7 represent the results of Multivariate Co-integration Approach by using Johnson and Julius (1990) Approach. The results of Cointegration analysis are confirmed through two different types of test i.e. one are trace statistics and other is maximum Eigen value test. The trace statistics tests the null hypothesis if r co-integrating vectors against alternative of r or more co-integrating vectors. From the table 06, the result of trace statistics shows that there exist no co-integration

vectors at 5% level. To confirm the results of Cointegration, maximum eigenvalue test also used. The results of table 07 also confirm the results of table 06 that there exist no co-integration vectors at 5% level. Hence on the basis of Johnson and Julius (1990) Approach, we can say that there is no long run relationship between the G8 and Pakistani equity markets.

Table 6

Multivariate Cointegration test (Trace Statistics)

Hypothesis	Eigen value	Trace Statistic	Critical Value 5%	Prob.**
Lag Length = 1				
r = 0	0.148416	186.9204	197.3709	0.1456
r ≤ 1	0.117338	145.6316	159.5297	0.2209
r ≤ 2	0.11026	113.5548	125.6154	0.2142
r ≤ 3	0.104571	83.53051	95.75366	0.2565
r ≤ 4	0.079037	55.14416	69.81889	0.413
r ≤ 5	0.058991	33.98401	47.85613	0.5027
r ≤ 6	0.039588	18.35783	29.79707	0.5398
r ≤ 7	0.027155	7.976931	15.49471	0.4679
r ≤ 8	0.003502	0.90166	3.841466	0.3423

**MacKinnon-Haug-Michelis (1999) p-values

Table 7

Multivariate Cointegration test (Max-Eigen Value Statistics)

Hypothesis	Eigenvalue	Max-Eigen Statistic	Critical Value 5%	Prob.**
Lag Length = 1				
r = 0	0.148416	41.28874	58.43354	0.7434
r ≤ 1	0.117338	32.07681	52.36261	0.9159
r ≤ 2	0.11026	30.02433	46.23142	0.7789
r ≤ 3	0.104571	28.38635	40.07757	0.5344
r ≤ 4	0.079037	21.16016	33.87687	0.6721
r ≤ 5	0.058991	15.62618	27.58434	0.6973
r ≤ 6	0.039588	10.3809	21.13162	0.7083
r ≤ 7	0.027155	7.075271	14.2646	0.4803
r ≤ 8	0.003502	0.90166	3.841466	0.3423

**MacKinnon-Haug-Michelis (1999) p-values

Pairwise Granger causality test

Granger representation theorem says that if co-integration is found between two time series then granger causality must exist from at least one direction. Table 8 report the results of Pairwise Granger causality test. Null hypothesis are tested at 5% level and its acceptance or rejection confirms the unidirectional or bidirectional granger causality between the G8 and Pakistani equity markets. The result of the below table shows that there exist a unidirectional causality between the equity market of Pakistan and Canada, France, Germany, Italy, Japan, United Kingdom and USA. However the null hypothesis i.e. R_RTS does not Granger Cause R_KSE and vice versa has been accepted at 5% level. It means that information flows from the G8 countries equity market to Pakistani equity market.

Table 8

Pairwise Granger Causality Tests (Lags: 1)

Null Hypothesis:	F-Statistic	Prob.	Inference
R_KSE does not Granger Cause R_CAC40	0.26684	0.6059	Unidirectional causality
R_CAC40 does not Granger Cause R_KSE	5.46714	0.0202	
R_KSE does not Granger Cause R_DAX	0.29247	0.5891	Unidirectional causality
R_DAX does not Granger Cause R_KSE	5.27026	0.0225	
R_KSE does not Granger Cause R_FTSE100	0.31955	0.5724	Unidirectional causality
R_FTSE100 does not Granger Cause R_KSE	4.73321	0.0305	
R_MIB30 does not Granger Cause R_KSE	4.09017	0.0442	Unidirectional causality
R_KSE does not Granger Cause R_MIB30	0.90573	0.3422	
R_NIKKEI25 does not Granger Cause R_KSE	6.97391	0.0088	Unidirectional causality
R_KSE does not Granger Cause R_NIKKEI25	0.62596	0.4296	
R_RTS does not Granger Cause R_KSE	0.42607	0.5145	No causality
R_KSE does not Granger Cause R_RTS	0.88177	0.3486	
R_S&P500 does not Granger Cause R_KSE	5.45405	0.0203	Unidirectional causality
R_KSE does not Granger Cause R_S&P500	0.64512	0.4226	
R_S&P/TSX does not Granger Cause R_KSE	4.86826	0.0283	Unidirectional causality
R_KSE does not Granger Cause SPTSX	1.7772	0.1837	

Error Correction Model

After analyzing the long run relationship among the variables, to investigate the short term relationship, the error correction model is used. R-square refers to the explanatory power of the independent variable(s). Durbin-Watson statistic shows the normality of the data. Result of the VECM suggests that 100% of the lag periods (one week) disequilibrium has been corrected in the current period.

Table 9

Error Correction model

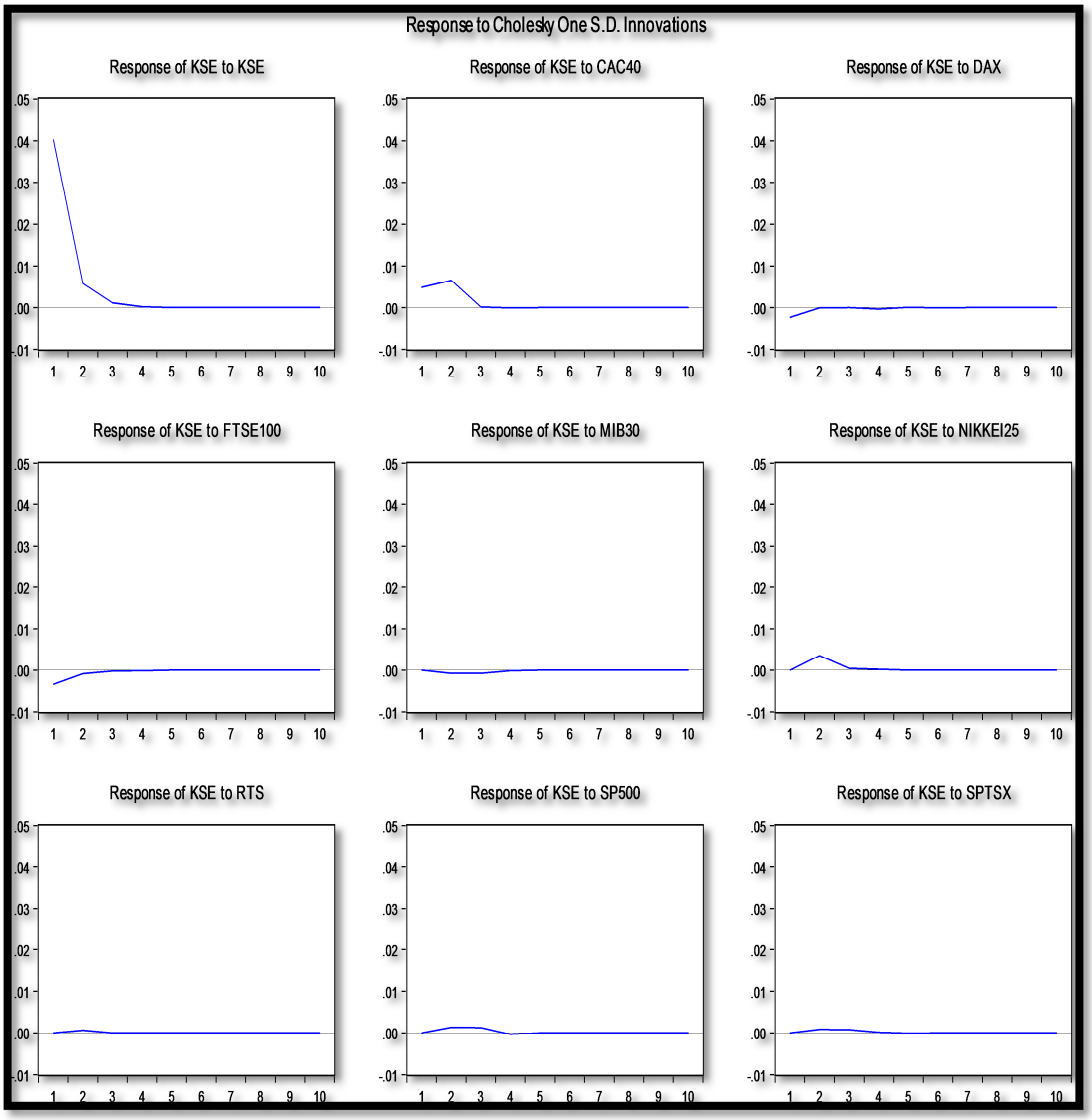
Regressor	Coefficient	StandardError	T-Ratio	Prob
MIB30	0.055018	0.20753	0.26511	0.791
FTSE100	-0.34532	0.29674	-1.1637	0.246
DAX	-0.15344	0.25279	-0.60698	0.544
S&P500	0.0041235	0.19875	0.020747	0.983
TSX	-0.062085	0.16337	-0.38002	0.704
NIKKEI225	0.15051	0.12488	1.2053	0.229
CAC40	0.47059	0.34371	1.3691	0.172
RTS	4.77E-04	0.011597	0.041112	0.967
ecm(-1)	-1	0	*NONE*	
R-Squared	0.43961	R-Bar-Squared	0.4216	
S.E. of Regression	0.040486	Equation Log-likelihood	465.84	
SB Criterion	440.8583	Akaike Info. Criterion	456.846	
F-stat.	24.417[.00]	DW-statistic	1.7183	

$$ECM = KSE100 + 0.055018 * \text{MIB30} - 0.34532 * \text{FTSE100} - 0.15344 * \text{DAX} + 0.0041235\ \text{S\&}P500 - 0.062085\text{TSX} + 0.15051 * \text{NIKKEI225} + 0.47059 * \text{CAC40} + 4.77\text{E} - 04 * \text{RTS}$$

Impulse response function (IRF) shows that one standard deviation (one S.D) change in one variable will bring what standard deviation (S.D) change in other variable. Impulse response analysis is mostly used to examine the random shocks on the equity markets. It also analyzes the response of one market to the innovation in its own market and those of innovation or shocks in other markets. Moreover, it (IRA) also graphically displays the speed of adjustment. The following figure displays the responses of Pakistani equity market towards the impulses of G8 countries. It is clear that most of the shocks in Pakistani equity market are due to its own innovation and it behaves like exogenous. However, it can further reveal that the markets of France, Japan, and United Kingdom (UK) are exerting pressure on the Pakistani equity markets.

Figure 3

Impulse Response Analysis



In simple words variance decomposition may be defined as the decomposition of variance in the variable which is being studied. It may results due to its own dynamic behavior or due to changes in the other variables. Table 10 represents the variance decomposition of Karachi Stock Market with the changes in its own market and with the equity markets of Canada, France, Germany, Italy, Japan, Russia, United Kingdom and USA. From the table, we can say that the variations in the returns of KSE are mostly due to its own dynamic behavior and it can be safely report that Karachi Stock Market looks like exogenous because most of the shocks in the Karachi Stock Market are due to the innovation in its own market. Whereas, from the below table it could be deduced that the markets of France, Japan, Germany and United Kingdom (UK) are exerting pressure on the equity market of Pakistan (KSE) during the entire study period.

Table 10

Variance Decomposition Analysis

Period	S.E.	KSE	DAX	FTSE	CAC	MIB	NIKKEI	RTS	S&P	TSX
1	0.0313	97.5180	0.3262	0.6772	1.4787	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0330	94.1473	0.3085	0.6762	3.9166	0.0314	0.7364	0.0263	0.1103	0.0469
3	0.0333	93.9876	0.3077	0.6759	3.9086	0.0620	0.7452	0.0264	0.2016	0.0850
4	0.0333	93.9708	0.3142	0.6768	3.9080	0.0630	0.7476	0.0264	0.2071	0.0861
5	0.0333	93.9700	0.3145	0.6769	3.9081	0.0630	0.7477	0.0264	0.2071	0.0865
6	0.0333	93.9699	0.3145	0.6769	3.9081	0.0630	0.7477	0.0264	0.2071	0.0865
7	0.0333	93.9699	0.3145	0.6769	3.9081	0.0630	0.7477	0.0264	0.2071	0.0865
8	0.0333	93.9698	0.3145	0.6769	3.9081	0.0630	0.7477	0.0264	0.2071	0.0865
9	0.0333	93.9698	0.3145	0.6769	3.9081	0.0630	0.7477	0.0264	0.2071	0.0865
10	0.0333	93.9698	0.3145	0.6769	3.9081	0.0630	0.7477	0.0264	0.2071	0.0865

Conclusion

This paper has examined the long term as well as the short term relationship between the Pakistani equity market and equity markets of Group of Eight countries (G8) which include Canada, France, Germany, Italy, Japan, Russia, United Kingdom and USA. Weekly time series data of the equity markets of all countries have been collected from yahoo finance. It covers the data period of 5 year starting from June 2004 to May 2009.

Among the G8 countries, RTS index of Russia offered the highest level of return i.e. 1.5% with highest level of risk i.e. 22% whereas, the markets of Italy, UK, US, Japan and France offered the negative weekly return and also having the approximately same level of risk under the entire study period. The weekly return of Karachi Stock Exchange was 0.116%, with 4% standard deviation. From the results of correlation matrix, it can be safely said that Karachi Stock Exchange has weak or no correlation with G8 countries equity markets. It communicates a message to fund manager that the benefits of diversification exist. However, the equity markets of Group of Eight (G8) countries are strongly positively correlated with each other except those of Russia, which might be an indicator of free flow of fund among these countries. Since correlation analysis only discussed the strength and direction of relationship without considering any cause and effect relationship. To better understand the long run co-movement of the equity price indices a Cointegration analysis had been performed. Before the application of Johnson and Julius (1990) Approach, First of all, the stationarity of all the time series were tested by applying the Augmented Dickey Fuller test (1979) and Phillips-Perron test (1988), which confirmed that the series were integrated at first difference i.e. I(1). The appropriate lag length was found by considering the AIC, SIC and HQ.

Multivariate Co-integration Approach by Johnson and Julius (1990) was used to investigate the long run co-movement. The results of

Cointegration analysis were confirmed through two different types of test i.e. one were trace statistics and other was maximum Eigen value test. The result of trace statistics showed that there exist no co-integration vectors at 5% level which was confirmed by the maximum eigenvalue test. Hence on the basis of Johnson and Julius (1990) Approach, it can be revealed that there was no long run relationship between the G8 and Pakistani equity markets. Results of the Vector error correction model (VECM) suggested that 100% of the lag periods (one week) disequilibrium has been corrected in the current period.

To further analyze the co-movement between the G8 and Pakistani equity markets, Impulse response function (IRF) and Variance decomposition analysis were used. It was cleared from their results that most of the shocks in Pakistani equity market were due to its own innovation and it behaves like exogenous. However, the markets of France, Japan, Germany and United Kingdom (UK) were exerting a little pressure on Pakistani equity markets during the entire study period. Therefore the fund manager of G8 countries especially Canada, Italy, Russia and USA is capable of getting the advantage of portfolio diversification by investing in Karachi Stock Exchange (KSE).

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Appendix 1:

Variance Decomposition of CAC40:

Period	S.E.	CAC	DAX	FTSE	KSE	MIB	NIKKEI	RTS	S&P	TSX
1	0.0313	100.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0329	91.8389	1.4829	0.0165	0.1569	0.0566	0.0250	0.0001	6.3487	0.0743
3	0.0332	90.3604	2.1264	0.0768	0.1712	0.0708	0.0260	0.0003	6.8748	0.2934
4	0.0332	90.1941	2.1998	0.0800	0.1709	0.0727	0.0380	0.0003	6.8650	0.3792
5	0.0332	90.1751	2.2055	0.0800	0.1710	0.0731	0.0405	0.0003	6.8645	0.3900
6	0.0332	90.1736	2.2060	0.0800	0.1711	0.0731	0.0408	0.0003	6.8644	0.3908
7	0.0332	90.1734	2.2061	0.0800	0.1711	0.0731	0.0408	0.0003	6.8644	0.3909
8	0.0332	90.1733	2.2061	0.0800	0.1711	0.0731	0.0408	0.0003	6.8644	0.3909
9	0.0332	90.1733	2.2061	0.0800	0.1711	0.0731	0.0408	0.0003	6.8644	0.3909
10	0.0332	90.1733	2.2061	0.0800	0.1711	0.0731	0.0408	0.0003	6.8644	0.3909

Variance Decomposition of DAX:

Period	S.E.	CAC	DAX	FTSE	KSE	MIB	NIKKEI	RTS	S&P	TSX
1	0.0329	89.9351	10.0649	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0345	83.0589	9.3012	0.0116	0.1864	0.1810	0.0780	0.0033	6.6596	0.5199
3	0.0348	81.8847	9.6231	0.0778	0.2066	0.1886	0.0770	0.0033	7.3315	0.6073
4	0.0348	81.7688	9.6678	0.0822	0.2066	0.1897	0.0848	0.0033	7.3256	0.6713
5	0.0348	81.7553	9.6704	0.0822	0.2066	0.1900	0.0866	0.0033	7.3258	0.6798
6	0.0348	81.7544	9.6705	0.0822	0.2067	0.1900	0.0868	0.0033	7.3258	0.6803
7	0.0348	81.7543	9.6705	0.0822	0.2067	0.1900	0.0868	0.0033	7.3258	0.6804
8	0.0348	81.7543	9.6705	0.0822	0.2067	0.1900	0.0868	0.0033	7.3258	0.6804
9	0.0348	81.7543	9.6705	0.0822	0.2067	0.1900	0.0868	0.0033	7.3258	0.6804
10	0.0348	81.7543	9.6705	0.0822	0.2067	0.1900	0.0868	0.0033	7.3258	0.6804

Variance Decomposition of FTSE100:

Period	S.E.	CAC	DAX	FTSE	KSE	MIB	NIKKEI	RTS	S&P	TSX
1	0.028026	89.09526	0.1253	10.779	0	0	0	0	0	0
2	0.029686	81.13984	0.8217	9.6133	0.2144	0.0062	0.1977	0.0083	7.9562	0.0424
3	0.029949	79.73126	1.388	9.5182	0.2334	0.0237	0.2129	0.0082	8.5953	0.2891
4	0.029981	79.56116	1.4698	9.5021	0.2329	0.0262	0.2305	0.0082	8.5845	0.3847
5	0.029985	79.54099	1.4774	9.4994	0.233	0.0267	0.2336	0.0082	8.5827	0.398
6	0.029986	79.53932	1.4781	9.4991	0.2331	0.0267	0.234	0.0082	8.5825	0.3991
7	0.029986	79.53912	1.4782	9.499	0.2331	0.0268	0.2341	0.0082	8.5824	0.3992
8	0.029986	79.53908	1.4782	9.499	0.2331	0.0268	0.2341	0.0082	8.5825	0.3992
9	0.029986	79.53907	1.4782	9.499	0.2331	0.0268	0.2341	0.0082	8.5825	0.3992
10	0.029986	79.53907	1.4782	9.499	0.2331	0.0268	0.2341	0.0082	8.5825	0.3992

Variance Decomposition of MIB30:

Period	S.E.	CAC	DAX	FTSE	KSE	MIB	NIKKEI	RTS	S&P	TSX
1	0.03166	83.6393	0.2612	0.7969	0.0125	15.29	0	0	0	0
2	0.03344	75.3075	2.9977	0.7156	0.4768	13.725	0.1014	0.0073	6.5882	0.0801
3	0.03367	74.3009	3.5643	0.7671	0.5204	13.559	0.1014	0.0079	6.8325	0.3468
4	0.03369	74.2047	3.6092	0.7674	0.5202	13.542	0.1123	0.0079	6.8238	0.4125
5	0.03369	74.1948	3.6121	0.7673	0.5203	13.54	0.1137	0.0079	6.8244	0.4193
6	0.03369	74.1943	3.6123	0.7673	0.5203	13.54	0.1139	0.0079	6.8243	0.4197
7	0.03369	74.1942	3.6123	0.7673	0.5203	13.54	0.114	0.0079	6.8243	0.4197
8	0.03369	74.1942	3.6123	0.7673	0.5203	13.54	0.114	0.0079	6.8243	0.4197
9	0.03369	74.1942	3.6123	0.7673	0.5203	13.54	0.114	0.0079	6.8243	0.4197
10	0.03369	74.1942	3.6123	0.7673	0.5203	13.54	0.114	0.0079	6.8243	0.4197

Variance Decomposition of NIKKEI225:

Period	S.E.	CAC	DAX	FTSE	KSE	MIB	NIKKEI	RTS	S&P	TSX
1	0.0335	59.1046	1.1	0.5435	0.1742	2.3201	36.758	0	0	0
2	0.0346	55.3651	1.1223	0.51	0.3905	2.808	34.647	0.0005	4.0992	1.0578
3	0.0347	55.0659	1.3124	0.5463	0.4191	2.7905	34.46	0.0007	4.3414	1.0642
4	0.0348	55.0554	1.3212	0.5474	0.4191	2.7894	34.446	0.0007	4.3413	1.0797
5	0.0348	55.0529	1.3212	0.5475	0.4192	2.7893	34.444	0.0007	4.3445	1.0807
6	0.0348	55.0528	1.3212	0.5475	0.4192	2.7893	34.444	0.0007	4.3447	1.0807
7	0.0348	55.0528	1.3212	0.5475	0.4192	2.7893	34.444	0.0007	4.3447	1.0807
8	0.0348	55.0528	1.3212	0.5475	0.4192	2.7893	34.444	0.0007	4.3447	1.0807

9	0.0348	55.0528	1.3212	0.5475	0.4192	2.7893	34.444	0.0007	4.3447	1.0807
10	0.0348	55.0528	1.3212	0.5475	0.4192	2.7893	34.444	0.0007	4.3447	1.0807

Variance Decomposition of RTS:

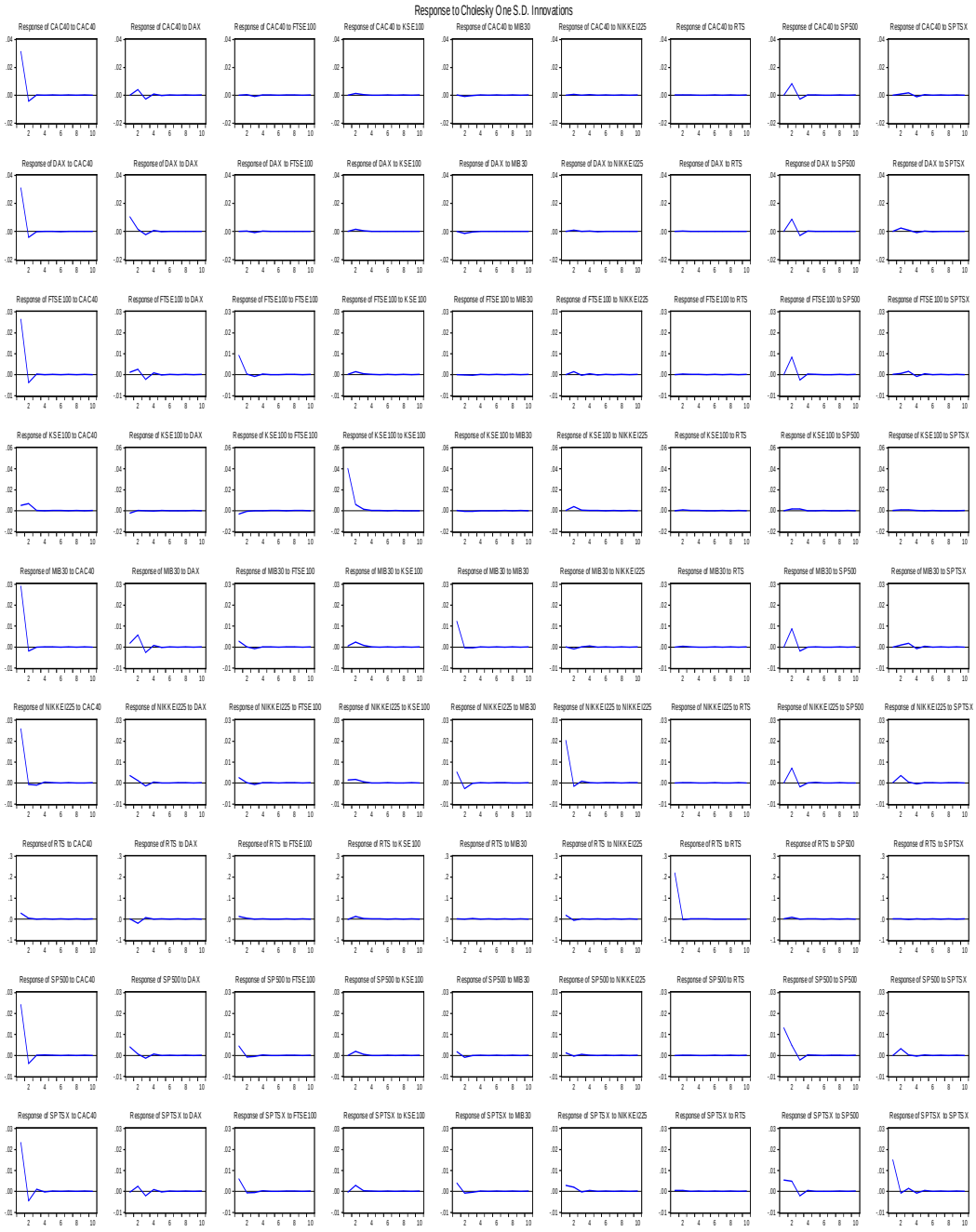
Period	S.E.	CAC	DAX	FTSE	KSE	MIB	NIKKEI	RTS	S&P	TSX
1	0.222	1.527	0.0007	0.3174	0.0055	1.13E-07	0.6511	97.498	0	0
2	0.224	1.541	0.8803	0.3342	0.2973	0.002283	0.7303	96.097	0.115	0.0024
3	0.224	1.539	0.9323	0.3353	0.3035	0.008309	0.7324	96.014	0.1168	0.0178
4	0.224	1.542	0.934	0.3353	0.3035	0.008655	0.7327	96.005	0.1175	0.021
5	0.224	1.542	0.9341	0.3353	0.3036	0.008657	0.7328	96.005	0.1175	0.0211
6	0.224	1.542	0.9342	0.3353	0.3036	0.008659	0.7328	96.004	0.1175	0.0211
7	0.224	1.542	0.9342	0.3353	0.3036	0.00866	0.7328	96.004	0.1175	0.0211
8	0.224	1.542	0.9342	0.3353	0.3036	0.00866	0.7328	96.004	0.1175	0.0211
9	0.224	1.542	0.9342	0.3353	0.3036	0.00866	0.7328	96.004	0.1175	0.0211
10	0.224	1.542	0.9342	0.3353	0.3036	0.00866	0.7328	96.004	0.1175	0.0211

Variance Decomposition of SP500:

Period	S.E.	CAC	DAX	FTSE	KSE	MIB	NIKKEI	RTS	S&P	TSX
1	0.03	73.4	2.1094	2.4414	0.001	0.3252	0.1744	0.0008	21.544	0
2	0.03	70.7	2.0236	2.3825	0.3865	0.4223	0.1773	0.0024	22.74	1.117
3	0.03	70.1	2.2127	2.3956	0.4072	0.4214	0.1931	0.0026	23.15	1.1106
4	0.03	70.1	2.2433	2.3979	0.4073	0.4213	0.1948	0.0026	23.143	1.1349
5	0.03	70	2.2456	2.3977	0.4072	0.4214	0.1954	0.0026	23.142	1.1397
6	0.03	70	2.2456	2.3977	0.4073	0.4214	0.1955	0.0026	23.142	1.14
7	0.03	70	2.2457	2.3977	0.4073	0.4214	0.1955	0.0026	23.142	1.14
8	0.03	70	2.2457	2.3977	0.4073	0.4214	0.1955	0.0026	23.142	1.14
9	0.03	70	2.2457	2.3977	0.4073	0.4214	0.1955	0.0026	23.142	1.14
10	0.03	70	2.2457	2.3977	0.4073	0.4214	0.1955	0.0026	23.142	1.14

Variance Decomposition of TSX:

Period	S.E.	CAC	DAX	FTSE	KSE	MIB	NIKKEI	RTS	S&P	TSX
1	0.03	63.3	0.0175	4.1426	0.0174	1.749	0.8861	0.0207	3.3827	26.474
2	0.03	61.1	0.6544	3.9219	0.8872	1.713	1.2522	0.0427	5.6521	24.735
3	0.03	60.4	1.1378	3.8943	0.8856	1.71	1.245	0.0421	6.0528	24.599
4	0.03	60.3	1.2111	3.89	0.8841	1.709	1.2573	0.042	6.0587	24.621
5	0.03	60.3	1.2201	3.8891	0.8839	1.709	1.2595	0.042	6.0571	24.626
6	0.03	60.3	1.221	3.8889	0.8839	1.709	1.2599	0.042	6.0569	24.627
7	0.03	60.3	1.2211	3.8889	0.8839	1.709	1.2599	0.042	6.0569	24.627
8	0.03	60.3	1.2212	3.8889	0.8839	1.709	1.2599	0.042	6.0569	24.627
9	0.03	60.3	1.2212	3.8889	0.8839	1.709	1.2599	0.042	6.0569	24.627
10	0.03	60.3	1.2212	3.8889	0.8839	1.709	1.2599	0.042	6.0569	24.627


Response to Cholesky One S.D. Innovations
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