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Sectoral Integration and Dynamic Linkages; Evidence from Pakistani Stock Market

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Abstract

This study investigates the sectoral integration in daily return indices of six sectors of Pakistani market. The study examined a seven years data from January, 2011 to January, 2018. Multivariate Co-integration test, Vector Error Correction Model (VECM), Impulse Response Function (IRF) and Variance Decomposition Analysis (VDA) were used for analyzing short- and long-run association among the sectors. The results indicated the presence of one long-run co-integrating vector. Results from VECM indicated a short-run relationship between some of the sectors influencing others. These results are further confirmed by Impulse Response Function and variance decomposition analysis. Commercial Banking and Media sectors dominated the selected sectors of KSE whereas other sectors were relatively independent. The results have implications for portfolio diversification in KSE as most of the sectors are least integrated with other sectors in Pakistani market. The current paper will help investors in domestic diversification to understand the sectoral linkages in the Pakistani market.

Keywords: Sectoral Integration, Portfolio diversification, Karachi Stock Exchange.

1. Introduction

According to portfolio theory, investors can maximize their return with a given level of risk by diversifying their investment into various assets. The benefit from diversification is thus associated with the linkages among the assets. A growing literature examined the impact of international linkages on portfolio diversification. According to Meric et al, (2008) low correlations among the stock markets are often considered as an evidence of the benefit of international portfolio diversification. During the most recent period, many researchers have indicated that integration among the markets has increased due to various deregulation and liberalization policies introduced across various markets (Lee and Jeong, 2016; Chow, 2017).

Although the existing literature has extensively focused on the international linkages among various markets, the domestic diversification benefits are largely ignored in the emerging markets especially in Pakistan. Ewing (2002) argued that understanding the inter-linkages among sectors is

important for investors seeking investment opportunities. In addition, numerous recent studies have shown that diversifying internationally across various sectors may provide more risk reductions than diversifying across countries (Schwob, 2000; Phylaktis and Xia, 2006).

According to Wang et al, (2005) the inter-linkages among various market sectors are of great importance for domestic portfolio diversification whereas the focus is mainly on national and sector indices in global diversification. In addition, the previous studies in sector indices largely emphasized on other developed and emerging markets, ignoring the Pakistani market for this important area of research.

The aim of this study is to examine inter-linkages among several sectors of KSE. This study empirically investigate the dynamic interactions among the indices of Automobile and Parts (AP), Commercial Banks (CB), Chemicals (CH), Media (MD), Oil and Gas (OGS) and Tobacco (TB). The selection of these sectors is mainly based on their importance in terms of their contribution to GDP of Pakistan and availability of data over the period of investigation[1].

The current study seeks to answer two important questions of whether the sectors under investigation are integrated in long run and secondly, whether short run causal relationship exists among the sectors. The results have implications for domestic as well as foreign investors interested in the Pakistani market.

The balance of the paper is organized as follows: Section 2 provides a brief overview of Karachi Stock Exchange (KSE). Section 3 summaries the relevant literature. Section 4 reports data and preliminary analysis. Section 5 provide methodology. Finally, section 6 shows empirical results. Finally, section 7 provides a brief conclusion.

2. An Overview of Karachi Stock Exchange (KSE)

According to Hussain et al, (2012), KSE is one of the vigorous and dominant stock exchange. In terms of listed companies and market capitalization, it is the biggest exchange in Pakistan[2]. Bekaert et al, (2003) argued that most of the emerging markets officially relaxed their restrictions on investment by foreign investors in 1991 and 1992. Pakistan followed the liberalization policy in February 1992, by relaxing restrictions for foreign investors.

Following the liberalization process, the performance of Pakistani market enhanced and subsequently it resulted in a significant increase in number of listed companies[3]. More recently, a period of peace and political harmony in Pakistan has also attracted more foreign investors. In addition, Pakistan enhanced regional trade and entered into various agreements, including SAARC in 1985 and SAFTA in 1995 for regional cooperation in trade and financial sectors reforms in the member countries. More recently, some member countries of the region established the South Asian Federation of Exchanges (SAFE) in 2000 for harmonizing the exchanges in the member markets[4].

In 2002, Pakistani market was ranked as one among the world's best performing market by "USA Today"[5]. The KSE index was increased by 56 per cent since the September 11 terror attack in contrast to the Standard and Poor's 500 decreased 19 per cent and the Bloomberg European 500 index declined about 27 per cent. In terms of listed companies, Pakistani market is second largest market in the South Asian region, India being largest in the region with total listed companies of 5615 on Bombay Stock Exchange in 2017[6].

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[1] According to Ahmad and Ahsan (2011) agriculture, industrial and services are the major sectors in Pakistan contributing 21.5, 25.2 53.3 per cent, respectively, in the GDP.

[2] The other two small exchanges are Lahore Stock Exchange and Islamabad Stock Exchange.

[3] At the time of establishment of the KSE, only five companies were listed. In 2015, total listed companies were 555 with a market capitalization of Rs. 6895599.15.

[4] In these agreements, the member countries are those of Bangladesh, Bhutan, India, the Maldives, Nepal Pakistan and Sri Lanka.

[5] Reported by DAWN on September19, 2002.

[6] World Bank; World Development Indicators.

In the more recent years, the listed companies increased due to the liberalization policies adopted and the technological advancements in the market. The listed companies were 573 in 2012 with total market capitalization of Rs. 4,242,278.04 million. In 2013, the number of listed companies reached to 560 on KSE having a total market capitalization of Rs. 6,056,506.03 million. In 2014, the number of listed companies were 557 and market capitalization reached to Rs. 7,380,531.74 million. Currently, 35 sectors and 555 companies are listed on Karachi Stock Exchange. The market capitalization in 2015 was Rs. 6,895,599.15 million and average daily turnover reached up to Rs. 11,556.08 million.

More recently, the stock market reached to an all-time high of 52876.46 in May, 2017. Currently the market operates in three indices; KSE 30 index, KSE 100 index and KMI 30 index[7]. According to Hira (2017), stock prices are adversely affected by the political instability in Pakistan. According to Ahmed et al., (2017) KSE was ranked third among the world's best performing markets by Bloomberg in 2014. In addition, MSCI listed the market in its list of emerging markets more recently. The recent improvement in stock market performance is due to political stability in the country which attracted both domestic and foreign investors towards the Pakistani market.

3. Literature Review

Numerous existing studies investigating integration among the emerging stock markets indicated that linkages among the markets increased due to various liberalization policies, Rejeb and Boughrara (2015). This trend is further enhanced by the latest communication and technological advancements that improved the flow of information across markets (Lee and Isa, 2014; Chow, 2017). The literature in integration studies may be divided in to three strands. First, numerous studies investigated global integration among the developed markets (Arshanapalli and Doukas, 1993; Moon, 2001 and Syriopoulos, 2004). Most of the earlier studies have been done on cross market correlations. Some studies investigated the integration between East Asian stock markets and European stock markets in the pre- and post-crisis period of 1997 (Moon, 2001; Daly, 2003). The correlation between South Asian equity markets and European markets was also examined (Lamba, 2005; Mushtaq and Shah, 2014). Some researchers have conducted their research on co-movements between developed and emerging European stock markets (Rockinger and Urga, 2001; Gilmore and McManus, 2002; Syriopoulos, 2004; Voronkova, 2004; Gilmore et al, 2005; Al-Fayoumi et al, 2009). Arouri et al, (2010) stated that there is inverse relationship between correlation and diversification gain, similarly, if the capital markets in various countries are not integrated then investors get more benefits from international diversification. In portfolio diversification more focus is given to investigate the integration between international capital markets. The main purpose for examining the capital markets' co-movement is to measure the gain from cross-border portfolio diversification (Ahmed, 2012).

Secondly, most of existing studies focused on the Pakistani market linkage with other emerging and developed stock markets (Narayan et al., 2004; Lamba, 2005; Hasan and Durrani, 2008; Ali et al., 2011; Shezad et al., 2014). The above stated studies revealed that correlation among world's capital market increased which in turn effect the international portfolio diversification.

Finally, some recent studies focused on co-integration among the sectors of a single market and implication of domestic portfolio diversification (Arbelaez et al., 2001; Gee and Karim, 2005; Meric et al., 2008; Al-Fayoumi et al., 2009; Cao et al., 2013; Yilmaz et al., 2015, Ahmad et al., 2018). The current study has undertaken the task of investigating the sectoral integration and its impact on Pakistani Stock Market to elaborate any potential linkages among the selected sectors.

Arbelaez et al, (2001) analyzed the short- and long-term integration among the Colombian stock market indices. They concluded that the six indices of Colombian market were vastly integrated

[7]The KSE-30 index was introduced in September, 2006 and is based on free-float of shares instead of paid-up capital and is dividend adjusted. KSE100 index was introduced in 1991. It represent the top 100 companies having highest market capitalization in general. KMI-30 index was introduced in 2009. It represent top 30 companies having Sharia compliance.

with one another in long-run. The indices also exhibited Granger causality in short-run. Ho and Tsui (2004) examined the co-movement among four sectors of Japan equity market including; Air Transportation, Electric Power and Gas, Precision Instruments and Other Product. The results showed significant correlation among the sectors that was changed over time. Gee and Karim (2005) concluded that causal relationship was present among the sectors of Malaysian stock market in short-run for entire period under investigation and both short- and long-run causal relationship were more observable. They examined the integration among five major sectors price indices of the Malaysian stock market. Mohamad et al, (2006) analyzed correlation among six sectors of Malaysian Stock Exchange including; Construction, Consumer, Finance, Plantation, Property and Trading Service. The results showed fluctuations in the correlation between the sectors of Malaysian market and found a high level of integration.

Fasnacht and Louberge (2007) examined seven international equity markets included; UK, USA, Germany, Canada, France, Japan and Switzerland and made the comparison between the sectoral integration within the single equity market and between the international equity markets. They found that integration between the equity markets was higher than the sectoral integration within each market. Constantinou et al. (2008) investigated short- and long-term linkages among twelve sectors of Cyprus Stock Exchange. The results revealed the presence of one significant long-term relationship among the sectors and found no short-term dynamic relationship among the sectors. Meric et al. (2008) conducted research on sectoral integration in France, Germany, UK, Japan and USA. This study investigated the linkages in the sectors by using both the bull market and bear market. The study showed that the utilities sector was less correlated in both the market conditions and provided more diversification benefits. Those sectors that provided less diversification benefits in the bull market and bear market were information technology and financial sector.

In Amman Stock Exchange (ASE), Al-Fayoumi et al., (2009) investigated correlation among indices of Financial, Industrial, General and Services. The results revealed that the long–run integration existed among the four indices but the Service sector was less correlated to other sectors. This research found the bidirectional causal relationship among the sectors. Balli and Balli (2011) found that Euro sectoral stock indices are less correlated than cross-border Euro equity market indices. Thus the diversification gain is higher from Euro sectoral stock indices. Ahmed (2012) found linkages among the twelve sectors price indices of Egyptian stock market. The Granger's causality test confirmed a presence of unidirectional causal relationship between sectors. The study concluded that diversification benefit were present in short-run. He conducted the research on both short- and long-run integration among twelve sectors of Egyptian market. Cao et al. (2013) investigated sectoral integration in equity market of China. The study revealed that the first period was the phase of severe shocks and showed that sectoral integration increased during this period than the second period. The more integration has seen between the market and energy, financials and industrial sectors. Noor et al. (2014) investigated the co-integration among different sectors of Indian Bombay Stock Exchange (BSE). They found the integration and long-run equilibrium among the sectors. Ozlen (2015) concluded five co-integrating associations among 11 different sectors of Turkish Stock Exchange.

More recently, Ahmed et al, (2018) examined Colombo Stock Exchange (CSE) sector and found no co-integration between the sectors. They argued that these sectors are feasible for diversification purposes as their weak integration have potential benefits for investors.

The current study investigated the co-integration between six selected sectors of single stock market in Pakistan by covering the period from January 2011 to January 2018. There are three main sectors that contribute to the economic growth of Pakistan that are; Agriculture sector, Industrial sector and Service sector (Ahmed and Ahsan, 2011). Each sector has its own proportion in the total GDP of Pakistan. The selected six sectors of this study can be categorized under Agriculture sector, Industrial sector and Service sector. Automobile and Parts (AP), Chemicals (CH), Oil and Gas (OGS) and Tobacco (TB) are the sub-sectors of Industrial sector and Commercial Banks (CB) and Media (MD) sectors are the sub-sector of Service.

The above studies concluded that the integration among the sectors of a single market effect the portfolio diversification which in turn effect the stock markets.

4. Data and Preliminary Analysis

4.1. Data

Time series data are used in this research comprising daily closing prices for six sectors of KSE; Automobiles and Parts (AP), Commercial Banks (CB), Chemicals (CH), Media (MD), Oil and Gas (OGS) and Tobacco (TB) over the period from January, 2011 to January, 2018. Daily price indices are calculated through price weighted index. This sample period covers the recent data for these sectors under examination. The rate of return is calculated by using the formula:

$$R_{it} = \ln(P_{it} / P_{it-1}) \quad \text{(I)}$$

Where $\ln P_{it}$ is the stock price index on day *t.*
= return on day "t"= = closing price on day "t-1"

4.2. Descriptive Statistics

Table 1 reports descriptive statistics for daily returns of six sectors. The table show that OGS sector has a lowest return of 0.001 and AP showed highest return of 0.003.

Table 1 also indicate that the standard deviation values varies across the sectors with lowest standard deviation value for Chemical sector (0.8 per cent) and highest for Media (3.9 per cent). The distribution for all sectors looks to be non-normal. The skewness values for all the six sectors are negative implying that the returns in these sectors are below the mean return. All the returns in the six sectors have kurtosis values higher than 3, hence they are leptokurtic. The Jarque-Bera statistics confirmed the results of skewness and kurtosis and showed that the data is non-normal. All the values of Jarque-Bera statistics are significant at five percent level of significance.

Table 1: Descriptive Statistics for Six Sectors over the Period from 2011 to 2018

	AP	CB	CH	MD	OGS	TB
Mean	0.003	0.002	0.002	0.002	0.001	0.003
Median	0.002	0.002	0.002	0.001	0.001	0.003
Maximum	0.045	0.034	0.030	0.273	0.045	0.204
Minimum	-0.069	-0.065	-0.049	-0.439	-0.163	-0.331
Std. Dev.	0.011	0.010	0.008	0.039	0.013	0.027
Skewness	-0.416	-0.606	-0.693	-3.115	-2.699	-1.696
Kurtosis	7.633	6.411	6.094	43.595	35.963	34.797
Jarque-Bera	799.69*	472.75*	414.82*	60864.77*	40258.16*	36897.27*
Observations	1456	1456	1456	1456	1456	1456

Note: Table 1 show the descriptive statistics of the six sectors of Karachi Stock Exchange including; automobile and parts (AP), commercial banks (CB), chemicals (CH), media (MD), oil and gas (OGS) and tobacco (TB) from 3 January, 2011 to 2 January, 2018. This table shows mean, median, maximum, minimum, standard deviation, skewness, kurtosis, Jarque-Bera statistics results and number of observations. (*) represents that values are significant at 5 percent level

4.3. Correlation Analysis

Table 2 reported the Correlation matrix of the six sectors under investigation. Correlations among the sectors showed in general a positive pair-wise association among the sectors with an exemption of two negative values between the AP-MD and between TB-CB sectors. The result implies that the sectors indices have a tendency to move in same direction, simultaneously reacting to the market forces and reacts to arrival of relevant information.

Table 2: Correlation Matrix for the Sectors over the Period from 2011 to 2018

	AP	CB	CH	MD	OGS	TB
AP	1					
CB	0.06	1				
CH	0.08	0.37	1			
MD	-0.05	0.01	0.02	1		
OGS	0.07	0.53	0.37	0.04	1	
TB	0.03	-0.02	0.01	0.01	0.04	1

Note: Table 2 represents the values of correlation coefficients among the six selected sectors of KSE from 2011 to 2018

4.4: Unit Root Tests

Unit root test is applied to test that whether the data is stationary or not. Before applying the co-integration approach, it is necessary to check the order of integration among the series. The Augmented Dickey Fuller (ADF) of 1979 and Phillips and Perron, (P-P), of 1988 tests are employed. The results in table 3 indicate that the series are non-stationary at level- and stationary at first differenced form at 5 per cent level of significance. The series are therefore, integrated of order 1, or I (1).

Table 3: Unit Root Test for the Six Sectors over the Period from 2011 to 2018

Variables	ADF Test		P-P Test	
	Level (T-Stat)	1st Diff: (T-Stat)	Level (T-Stat)	1st Diff: (T-Stat)
AP	2.17	-23.87*	1.89	-24.85*
CB	-0.74	-26.56*	-0.77	-26.71*
CH	1.50	-25.77*	1.43	-25.91*
MD	-0.41	-25.42*	-0.35	-25.27*
OGS	-1.07	-28.52*	-1.04	-25.76*
TB	0.85	-30.02*	0.73	-30.14*

Unit root tests are conducted using ADF, (1979) and P-P, (1988) test. Critical values used are taken from MacKinnon (1991). The (*) indicates the rejection of null hypothesis at 5 percent level of significance.

As the results indicated that all series are integrated of same order, i.e. order 1, hence all the series were I (1), so the study can use co-integration tests for analysis.

5. Methodology

5.1. Johansen Co-integration Test

To examine the long-run inter-relationship between selected sectors, Co-integration test is employed. Co-integration test can only be applied when all sectoral series are non-stationary and must be integrated of same order i.e I(1). The current study used the VAR based co-integration test testing for long-run and short-run relationship by applying the procedure developed by Johansen (1988) and Johansen and Juesleius (1990) by adopting the maximum likelihood mechanism to multivariate autoregressive model. The procedure suitable to explore long-run relationship between the six selected sectors of KSE. The general form of VAR model used is as:

Let Z_t be a vector of individually non-stationary sectoral indices and all are of order (1) integrated, i.e. I(1). A general unrestricted VAR model involving up to *n* lags is applied:

$$Z_t = \mu + A_1 Z_{t-1} + A_2 Z_{t-2} + A_3 Z_{t-3} + \ \ldots\ldots + A_n Z_{t-n} + \varepsilon_t \quad (2)$$

Where $Z_t$is a n×1 matrix of I(1) sectoral series, $A_n$is a 6×6 matrix of parameters, t =1,2,3,4,5,....T. ε_t is a vector of white noise error terms. The VAR (n) model in equation (2) can be reformulated as a Vector Error Correction Model (VECM) which takes the following form:

$$\Delta Z_t = \mu + \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \Gamma_3 \Delta Z_{t-3} + \ \dots\dots + \Gamma_{n-1} \Delta Z_{t-n} + \Pi Z_{t-n} + \varepsilon_t \quad (3)$$

Where an operator for first difference isΔ, Γ are 6×6 short-term matrix of coefficients indicating short-term dynamic relationship and is expressed as:

$$\Gamma_m = -I + \sum_{i=1}^{m} A_i \qquad m = 1,2,3,4,5 \dots\dots\dots n-1 \quad (4)$$

Π is a 6×6 is a long-term matrix of coefficients representing long-term association among the sectors and is defined as:

$$\Pi = -I + \sum_{i=1}^{k} A_i \quad (5)$$

Π is a matrix represents long-term coefficients where its rank r indicates number of co-integrating vectors. Π can be of full rank i.e. (r =6), this will imply the absence of any stochastic trends among the series. The number of co-integrating vectors will show the extent to which the sectoral indices are integrated. If Π has zero rank, this will imply the absence of long-term stationary equilibrium among the variables of Z_t. For Π having a rank of (0 < r < 6) this will indicate a presence of r co-integrating vectors, hence, $n-r$ common trends. In that case, Π is factorized as $\alpha\beta'$, hence both α and β are 6×r matrices. The β matrix indicates co-integrating vectors and α represents the speed of adjustment among the elements in the VECM equation.

Johansen (1988, 1991) proposed the trace test (λ_{trace}) and the maximum eigenvalues (λ_{max}) test methods for estimating the number of co-integrating vectors. The two equations are formulated as follows:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} In\left(1-\hat{\lambda}_i\right) \quad (6)$$

and

$$\lambda_{max}(r, r+1) = -TIn\left(1-\hat{\lambda}_{r+1}\right) \quad (7)$$

r is indicating the number of co-integrating vectors, λ_i is estimated value from Π matrix for ith order of eigenvalues. Intuitively, a larger value of λ_i represents a bigger negative value for $(In(1-\hat{\lambda}_i))$ and hence, shows a higher magnitude of test statistic. Each eigenvalue is related to a different co-integrating relationship, which is represented by the corresponding eigen-vector. A significant eigen-value implies a co-integrating vector. Trace statistic (λ_{trace}) shows a test of H_0 jointly for number of co-integrating vectors being $\leq r$ against a general H_1 of $> r$. The Maximum eigenvalue test (λ_{max}) statistic assumes a unique test on each eigenvalue. The H_0 in this later case is that the number of co-integrating vectors is r against H_1 that there are $r+1$ co-integrating relationships.

Trace test (λ_{trace}) and maximum eignevalues test(λ_{max}) test both have non-standard asymptotic distributions and the critical values depend on non-stationary components. In addition, it depends on the inclusion of constants and trends in each equations (Brooks, 2008)[8]. Critical values for

[8] The constant and trend terms can either be included in the co-integrating vectors or as an additional term in the VAR model.

these tests are provided by Johansen and Juselius (1990), Osterwald-Lenum (1992), Doornik (1998) and MacKinnon-Haug-Michelis (1999). In this study, the critical values of MacKinnon-Haug-Michelis (1999) are used. If the test statistic were found to be greater than critical values, H_0 of r co-integrating vectors will be rejected in favor of H_1 that there are $r+1$ (λ_{trace} test) or more than r (for λ_{max} test) relationships among the sectoral indices.

The advantages of Johansen (1988) and Johansen and Juselius (1991) VAR estimation procedure are that it takes into account the error structure of the underlying process along with taking into consideration multiple long- and short-run equilibrium relationships can be estimated. As the current research is investigating six sectors of the Pakistani market, hence, the procedure adopted in this research is appropriate.

Johansen's multivariate co-integration analysis is applied in the current study to investigate the inter-linkages among six sectors. Sectors sharing a common stochastic trend have limited gains from diversifying into this market and will depend on the presence or absence of common stochastic trends. This study examined the integration among six sectors over the time period of January, 2011 to 2018 and has potential implications for international as well as national investors investing in the Pakistani market.

6. Empirical Results

6.1. Multivariate Johansen Co-integration test Results

Table 5 presents the appropriate rank of the co-integration vectors. The null hypothesis indicating no co-integration, (r=0) is rejected against the alternate hypothesis that sector indices are co-integrated by one or more co-integrating vectors (r>0). The Trace and Maximum eigen-values tests statistics suggested one co-integrating vector where critical values of (95.75) and (40.08) are both less than the tests statistics values of (123.46) and (65.06) respectively at 5 per cent level of significance. These results imply that the six sectors share common along-term equilibrium; hence, investors have limited diversification benefits while considering these sectors for long-term investment.

Table 5: Johansen's Multivariate Co-integration Test results for the Sectors in KSE

H_0	H_A	Eigenvalues	Trace Test		Max-Eigen	
			Statistic	Critical Value	Statistic	Critical Value
r = 0	r >1	0.07	123.46*	95.75	65.06*	40.08
r ≤ 1	r > 2	0.03	58.40	69.82	29.76	33.88
r ≤ 2	r >3	0.02	28.65	47.86	16.56	27.58
r ≤ 3	r > 4	0.01	12.09	29.80	8.49	21.13
r ≤ 4	r > 5	0.00	3.61	15.49	2.96	14.26
r ≤ 5	r = 6	0.00	0.64	3.84	0.64	3.84

Maximum Eigen Values Test and Trace Test indicate one Co-integrating vector among the six Sectors at KSE. The Critical values are taken from MacKinnon-Haug-Michelis (1999). An (*) indicates the rejection of the hypothesis at 5 per cent significance level.

These results are in line with Ahmed (2012) who examined correlation among twelve sectors of Egyptian Stock Exchange and also found one long run co-integration among the sector at 5 percent level.

6.2. Vector Error Correction Model (VECM)

The result of Johansen Co-integration model indicated a long-run relationship among the sectors. To investigate short-run association within the sectors, VECM is applied. Table 6 reports results from applying VECM. The results indicate that most of variations in the share prices of the six sectors are

explained by their own previous price changes such as the stock prices of Automobile and Parts (AP) sector have causal short-run impact on its own current stock prices at lag one but have no effect on other sectors. The stock prices of Commercial Banking Sector have no causation for the short-run with any other sector. However, the previous stock prices of Chemical sector explain its own current prices and that of Oil & Gas. The stock prices of Media sector have short-run impact on its own stock prices as well as it influence the stock prices of Auto and Parts and Oil & Gas sectors. The stock prices of Oil & Gas sector are found to be more exogenous in short-run.

Table 6: Vector Error Correction Model for the Sectors

	D(AP)	**D(CB)**	**D(CH)**	**D(MD)**	**D(OGS)**	**D(TB)**	**Lagged ECT**
D(AP(-1))	0.17	0.01	0.02	0.06	0.05	-0.05	0.00
	(5.00*)	(0.35)	(0.66)	(0.45)	(1.31)	(-0.60)	(2.66*)
D(AP(-2))	0.05	0.01	0.02	0.27	0.01	0.08	
	(1.46)	(0.24)	(0.77)	(2.21*)	(0.16)	(0.91)	
D(CB(-1))	0.02	0.05	0.01	0.11	0.07	-0.10	-0.00
	(0.41)	(1.14)	(0.43)	(0.69)	(1.28)	(-0.84)	(-4.07*)
D(CB(-2))	0.01	-0.05	0.01	-0.06	-0.03	-0.00	
	(0.24)	(-1.27)	(0.38)	(-0.34)	(-0.65)	(-0.00)	
D(CH(-1))	0.08	0.07	0.11	0.20	0.15	-0.09	-0.00
	(1.67)	(1.58)	(2.94*)	(1.12)	(2.53*)	(-0.68)	(-0.01)
D(CH(-2))	-0.01	-0.05	-0.00	-0.05	-0.06	0.23	
	(-0.12)	(-1.22)	(-0.05)	(-0.26)	(-1.04)	(1.75)	
D(MD(-1))	0.01	-0.01	0.00	0.15	-0.02	-0.01	-0.01
	(0.72)	(-1.18)	(0.15)	(4.56*)	(-1.42)	(-0.57)	(-5.97*)
D(MD(-2))	0.02	0.01	0.01	0.02	0.03	0.02	
	(1.99*)	(0.96)	(0.77)	(0.52)	(3.02*)	(0.82)	
D(OGS(-1))	-0.01	0.05	0.02	0.02	0.09	0.05	-0.00
	(-0.35)	(1.63)	(0.84)	(0.15)	(2.17*)	(0.60)	(-3.53*)
D(OGS(-2))	0.01	0.05	-0.01	-0.05	0.04	0.01	
	(0.22)	(1.69)	(-0.28)	(-0.43)	(1.07)	(0.11)	
D(TB(-1))	0.02	-0.02	-0.00	0.01	-0.04	-0.02	-0.00
	(1.18)	(-1.63)	(-0.30)	(0.10)	(-2.38*)	(-0.56)	(-0.00)
D(TB(-2))	0.00	0.00	0.02	-0.03	0.01	0.08	
	(0.08)	(0.15)	(1.64)	(-0.68)	(0.65)	(2.33*)	

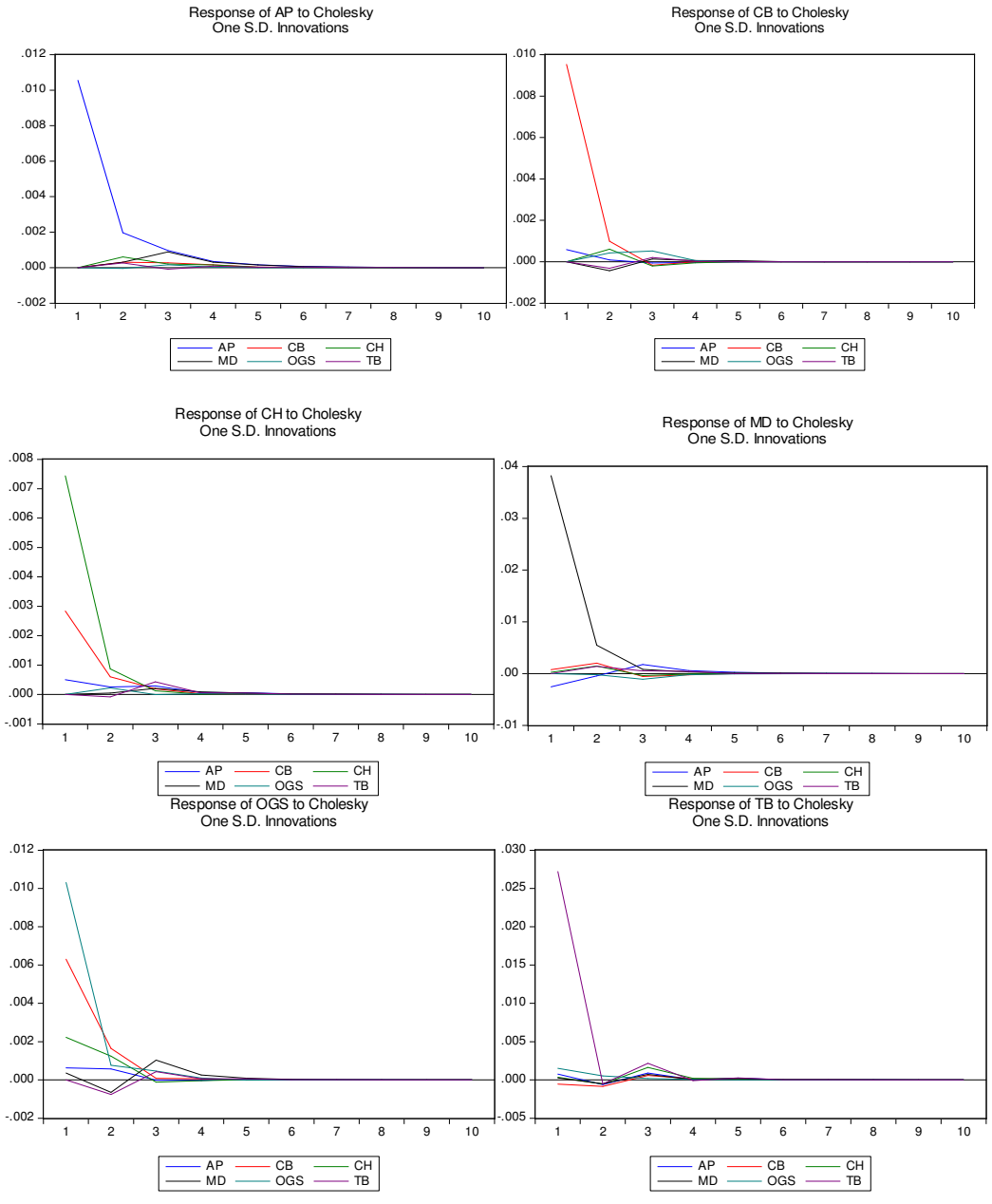
Note: Table exhibit the results of VECM and shows the short-run association among six selected sectors of KSE. The column of ECT (Error Correction Term) show the presence of long-run causal relationship. Values in parenthesis ( ) represent t-statistics. * represents a presence of short-run causation between sectors at 5 per cent significance level.

The stocks prices of Tobacco have short-run influence on own previous prices and that of the Oil and Gas. Finally, the t-statistic value on the right hand side for Error Correction Term (ECT) is significant for Auto and Parts, Commercial Banks, Media and Oil and Gas which indicates that speed of adjustment toward the equilibrium. The results indicate a low speed of adjustment towards equilibrium.

6.3. Impulse Response Function Results

Impulse response function is used to graphically show responses of sectors to variation in other sectors. The results are shown graphically in figure 1. The figure shows the dynamic response of the sector to one standard deviation innovations over the forecasted time horizons from 1 to 10 days. The results indicate that shocks in the sectors are generally responded by the variation in that sector's own innovations. It implies that most of the variations are explained by the sector's own innovations. In addition, the innovation in almost all sectors are explained by the variations in the Commercial banking sector which is more obvious in Chemical and Oil and Gas sectors where the shocks dies out from three to four days. The impact of Commercial Banking Sector over other sectors appears to be slightly larger than those of other sectors. The responses of other sectors to innovation in Banking Sector seem to be insignificant. These results confirms the results of Variance decomposition analysis indicating that Commercial Banking sector is most influential sector in the KSE and that the other sectors are least integrated in short-term, hence short-term diversification benefits may be achieved.

Figure 1: Impulse Response Function analysis of Sectors to One Standard Deviation Innovation



6.4. Results of Variance Decomposition Analysis

The variance decomposition analysis measures the relationship between the sectors quantitatively. It indicates the percentage of variation explained by the sectors own changes as well as variations in other sectors. Table 7 reports the VDA for time horizon of 1, 5 and 10 days ahead of forecast in each sector. The table indicates the per cent of forecast error variance of a sector on the left hand side is explained by another sector on the top. The table indicated that a highest per cent of error variance is accounted for by the innovation in its own share prices. In most of the sectors, the variations are explained by the sector's own changes. From the table, it is evident that commercial banking sector is the most dominant sector in terms of percentage of variation explained by the commercial bank in other sectors particularly in Chemical sector and Oil and Gas sector. This indicates that Commercial banks have the strongest impact on other sectors. These results are not surprising due to large size of the commercial banking sector in the KSE. The commercial banking sector is the largest sector of KSE in terms of market capitalization and number of companies with highest capitalization. The Automobile and Parts sector is least affected sector by the variation in other sectors. The findings in this study are in line with Wang et al, (2005) and Al-Fayoumi et al, (2009) who found that financial sector was the most dominant sector in China and Jordan, respectively.

Table 7: Error Variance Decomposition forecast of the six sectors of KSE

Sectors	Days	Percentage of forecast Error Variance by Innovation in;					
		ΔAP	ΔCB	ΔCH	ΔMD	ΔOGS	ΔTB
ΔAP	1	100	0	0	0	0	0
	5	98.52	0.16	0.37	0.85	0.03	0.07
	10	98.52	0.16	0.37	0.85	0.03	0.07
ΔCB	1	0.37	99.63	0	0	0	0
	5	0.37	98.33	0.44	0.23	0.48	0.15
	10	0.37	98.32	0.44	0.23	0.48	0.15
ΔCH	1	0.4	12.65	86.95	0	0	0
	5	0.63	12.94	85.96	0.09	0.08	0.3
	10	0.63	12.94	85.96	0.09	0.08	0.3
ΔMD	1	0.45	0.04	0.01	99.5	0	0
	5	0.68	0.33	0.16	98.57	0.08	0.17
	10	0.69	0.33	0.16	98.57	0.08	0.17
ΔOGS	1	0.26	26.25	3.27	0.09	70.13	0
	5	0.47	26.68	4.08	1.07	67.23	0.48
	10	0.46	26.68	4.08	1.07	67.23	0.48
ΔTB	1	0.08	0.04	0.02	0.01	0.32	99.54
	5	0.24	0.18	0.41	0.12	0.35	98.7
	10	0.24	0.18	0.41	0.12	0.35	98.69

The Table show the Cholesky Ordering; AP CB CH MD OGS &TB for the variance decomposition of the six sectors of the KSE. The time horizon is taken as 10 days; further days contributed nothing in the variance of the sectors.

7. Conclusion

This study examined the dynamic linkages among six sectors of KSE over the period from January, 2011 to January, 2018 using daily data. To examine co-movements among the sectors, Johansen Co-integration, VECM, IRF analysis and Variance Decomposition Analysis were employed. The univariate series of each sector was non-stationary and showed a unit root. The multivariate Johansen Co-integration tests indicated that the six sectors share one long-run relationship. In the short-run, the sectors showed an existence of co-movement among each other indicating that variation in one sector is explained by changes in other sectors. These results imply that share price variation may be predicted in variation in their counterparts. The results implied that investors have limited long-term diversification benefits while investing in these sectors. The results of IRF analysis and Variance Decomposition showed that Commercial Banking Sector was the most influencing sector among the

six sectors under investigation. The variation in other sectors is explained mostly by the innovation in Commercial Banking sector, being the most dominant sector in KSE in terms of market capitalization. These results imply that investors who diversify their portfolio across sectors in KSE might have modest diversification benefits in this market specifically in long-run. In short-run, the sectoral portfolio may provide best diversification opportunities as most of the sectors are least integrated to other sectors. A future study in this regard might take in to account more sectors of the KSE over a longer period and might use high frequency models like ARCH and GARCH to look deeper in to the relationship among the sectors of KSE.

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