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Short-Run and Long-Run Dynamics Linkages among the Saudi Arabia Stock Market Indices

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ABSTRACT

Developing capital markets are complex and interesting. Although the Saudi Tadawul Stock Exchange is small compared to developed countries, such as the US, the UK, and Japan, it is fast growing among the GCC and MENA countries. The paper aims to empirically examine the dynamic linkages between sub-sector indices of Saudi Tadawul Stock Exchange using Johansen cointegration tests and the vector error correction model (VECM). The result shows that there is a long-run relationship between the sub-sector indices. In addition, there is also a long run casuality running from all sub-sector indices upon the market indices (TASI) and finance indices. In addition, there is univariate causality among some of the sub-sectors indices.

Keywords: Market indices; Cointegration; VECM; Saudi Arabia Stock Exchange

INTRODUCTION

In the modern economy, stock markets play an active role, since it acts as an intermediary between lenders and borrowers. An efficient stock market may accelerate the development process in an economy through two main channels of increasing savings and efficient allocation of resources. Over the last three decades, the investment on stock exchanges has become popular in developed countries, such as the US and European countries. Although these countries have even experienced fluctuations during stability, the investments increased especially in high tech sectors of stock markets. (Gallo.&Otranto. 2007)

Portfolio managers who follow the stock market approach in global investment usually select countries and sectors without paying much attention to the market behavior, such as interactions, and volatility transmission among the sectors. Therefore the investors randomly select those sectors that expect to give them more returns (Hammoudeh et al. 2009).

The globalization has a positive role on the integration of the financial markets especially stock markets. The growing dissemination of the information coupled with the factual deregulation and reconciliation has led to the increasing cross-border investment and capital flow (Gallo.&Otranto. 2007; Hassan&Malik 2007). During a depression, investors switch their investment funds to more protective stocks, such as non-cyclical consumer goods sector. The most serious international recession since the Second World War led to either oil price shocks or political instability has triggered by the MENA (Cheng et al. 2010; Hamilton 1983, 1996; Hamilton 2003, 2009; Hamilton&Herrera 2004).

The transmission of volatility and crisis between different sectors of a market is an important issue for investors, researchers, and even policy makers (De La Torre et al. 2007). There are a variety of studies that have considered the mechanism of the stock markets (Cheng et al. 2010; Evrim-Mandaci et al. 2011; Ewing 2002; Gallo.&Otranto. 2007). Emerging markets have gained enormous profits over the last three decades as they provide substantial investment opportunities in both real and financial sectors. Among the 23 MENA countries, Saudi Arabia is the biggest oil exporter country in the world, has the strongest stock exchange, and economy among the Gulf Council Countries (GCC). The Saudi stock market was established formally in 1984 and is one of the leading emerging markets in the Arab world. In fact, the Saudi stock market ranked first in the Arab world with capital of 319 U.S. billion dollars or 35% of the total market capitalization of Arab stock markets at the end of 2009. From 1993-2009, The Tadawul Stock Exchange (TSE) is more dynamic than ISE (Istanbul Exchange Market), ESE (Egypt Stock Exchange) and the other MENA's stock exchange markets. (SAMA Annual Report, 2007-2009).

Saudi Arabia is one of the twenty main oil producing countries and has the largest reserves of fossil fuels. In addition, the evidence suggests that Saudi Arabia experienced increasing economic growth, production volumes, and financial market index. Cheng et al. (2010) documented that Saudi

Arabia's stock returns had a market capitalization higher than that of South Korea in 2004-2005. According to the World Development Indicators (WDI) the market capitalization of Saudi Arabia stock exchange was bigger than South Korea between 2003 and 2007. It also shows that, the volatility in the MENA including Saudi Arabia is important for to academies and policy makers. As evidence on the importance of the Saudi Arabia, the Fortune Global ranked Saudi Basic Industries Corporation (SABIC) 331th out of 500 in 2006 and 210th in 2011 with the revenue of USD 27,481 billion.

Because of the sensitivity of stock exchange, it is necessary to examine the relationship between the sectors. A significant interactions cause spillovers between sectors and spread the risk and crisis. The investigation on the structure of the Saudi Arabia's stock market helps clarify the volatility of TSE, the long-run relationship and the granger causality between different sectors of the TSE. Previous studies have examined the volatility of TSE's sectors (Abdalla 2012; Bley 2011; Hammoudeh et al. 2009; Smimou&Karabegovic 2010).This study aims to examine the structure of the stock market in Saudi Arabia (TSE) and the relationship between different sectors. The findings of this study hopefully help investors and policy makers make efficient portfolios and policies. Section two of this paper is a brief review of the related literature. Section three is definition of data. Section for is methodology. Section five is empirical result and dissection. Finally Section six is conclusions of study

A BRIEF REVIEW OF THE RELATED LITERATURE

Financial markets are becoming ever more important for economic development. Their quality is a critical determinant of countries' economic stability and of their success in a world of financial globalization. Governments, central banks, regulators, and the private sector have a role to play in promoting strong, resilient, and innovative financial markets.(Rato 2007).

However, an efficient stock market may accelerate the development process in an economy through two main channels of increasing savings and efficient allocation of resources (Gallo.&Otranto. 2007). Furthermore, MENA's economy and financial market nowadays is very important tho the world wide, because these group country's financial market recorded high returns during the last ten years.(Cheng et al. 2010). While these countries have weak linkage between each other but they have strong integration with the developed financial markets. Neaime (2002) uses the Engle-Granger (1987) cointegration approach, during the nineties, with more stock markets from the MENA region and from developed markets. The results indicate a weak integration among the MENA markets (Morocco, Egypt, Jordan and Turkey) and strong integration between these markets and developed markets (the US, UK and France). Cheng and other (2010) concluded that there Israel and Turkey are most strongly integrated with world financial markets among the MENA zone comparisons to other member of MENA, by used different type of methodology. Over the last seven years, the market capitalization ratio increased at 110% of GDP, on average, each year, with an incredible increase of 208% in 2005, increase the number of companies listed on the Saudi stock market. Therefore, among the researcher and academies Saudi Arabia economy and financial market is very interesting to investigation especially stock market (SAMA; and Tadawul Annual Report, 2007-2010).

In addition, volatility an important issues nowadays. They are numbers of study has been done in the GCC countries including Saudi stock exchange (Abdalla 2012; Bley 2011; Cheng et al. 2010; French et al. 1987; Gallo.&Otranto. 2007; Hammoudeh et al. 2009; Hassan&Malik 2007; Nor et al. 2010; Smimou&Karabegovic 2010). Volatility refers to the spread of all likely outcomes of an uncertain variable. Typically, in financial markets, they are often concerned with the spread of asset returns. In 1984 Pindyck is the first time; consider that there is a strong correlation between expected returns and volatility. He argues that attributes much of the decrease in stock prices during the 1970s to raises in risk premiums arising from increases volatility (Pindyck 1984), and G. William Schwert (1990) defined that Volatility it means a measure of the changeability or randomness of asset price; in fact, it is possible to estimate the standard deviation or variance of rate of return.

French, Kenneth. William Schwert and Robert Stambagh, (1987) they examined the relationship between stock returns and stock market volatility. They also separated predictable and unpredictable volatility (French et al. 1987). While, there is a limited investigation has been done in the relationship between the stock market and sectors indices. Especially, possible long-run relationship and the direction of the causations between stock market sectors. Arbeláez et al (2001) they investigate for the Medellı´n in Colombia Stock Exchange to examine the short-term and long-term linkages among the several stock indices. In (2002) Bradley T. Ewing G, investigated for five main Standard and poor's stock indices, Such as (Industrials, Transportation, Utilities, Financials and Capital Goods).

The study covered he post-1987 crash period (1988:1- 1997:7). Moreover, in 2005 (Wang et al.), they investigated the dynamic relationships amongst key sectoral indices of the Chinese stock

exchanges Shenzhen, and Shanghai by using the daily and monthly returns during the period between 2001 and 1994. Their results show that a high degree of interdependence, implying that potential diversification benefits from sector-level investment may be quite limited. They also note that Industry is the most dominant sector in both exchanges, while Finance in Shenzhen offers the best diversification tool within the Chinese stock market since this sector is the least integrated with other sectors.

METHODOLOGY

In order to achieve the objectives of this study, this paper going to employ the econometric techniques of unit root tests, used the Augmented Dickey-Fuller (ADF) tests. The ADF tests are unable to discriminate well between non-stationary and stationary series with a high degree of autocorrelation (West 1988) and are sensitive to structural breaks (Culver&Papell 1997). In addition to the DF and ADF tests, this paper uses the Phillips-Perron (PP) test of (Phillips&Perron 1988), which gives the robust estimates when the series have a structural break. It also supplements the results by the maximum likelihood test suggested by (Johansen 1988) and (Johansen&Juselius 1990). The Johansen-Juselius test indicates the possibility of the existence of a third cointegrating vector. This battery of techniques gives the opportunity to investigate the nature of both the long-run and short-run inter-sectoral relationships in the Saudi Arabia stock market (Tadawul Stock Exchange) (TSE) by using the vector error correction model (VECM). Setting the stage for the empirical analyses, this section aims to provide a succinct description for these econometric methodologies.

Each weekly return is calculated as first difference in natural logarithm from each weekly index values:

$$R_t = [\text{Log}\,(I_t) - \text{Log}\,(I_{t-1})] \quad (1)$$

Since:

R_t = return on weekly t
I_t = index mean value on weekly t
I_{t-1} = index mean value on weekly t-1

Stationary Test

The stationarity of prices and returns is tested with the augmented Dickey–Fuller (1979), ADF test (Eq. (1)):

$$\Delta X_t = \lambda_0 + \lambda_1 T + \lambda_2 X_{t-1} + \sum_{i=1}^{N} \lambda_i \Delta X_{t-i} + \varepsilon_t \quad (2)$$

Where i =1, 2, 3,... N
The X_t represent the level (price) or the first difference (return) of the index. However, N is selected as large enough to render the residual ε_t as empirical white noise. The Eq. (2) involve regressing the first differenced series against a constant, the one period lag of the series, the differenced series at N lag lengths and a time trend. The null hypothesis of nonstationarity is $\lambda_2 = 0$. If the null hypothesis could not be rejected for the price but rejected for the return, then the time series of index prices is stationary in the first difference and it is said that prices are integrated of order one, denoted by I(1). The number of lags in this test, and the subsequent tests of causality and cointegration, is determined by the Akaike Information Criterion (AIC).(Mansur M. Masih&Winduss 2006)

The hypothesis tested:

H0: $\lambda 2 = 0$ (contain a unit root, the data is not stationary)
H1: $\lambda 2 < 0$ (do not contain a unit root, the data is stationary)

$$\Delta X_t = \vartheta_0 + \vartheta_1 T + \vartheta_2 X_{t-1} + \nu_t \quad (3)$$

The hypothesis tested:

H0: $\vartheta_2 = 0$ (contain a unit root, the data is not stationary)

H1: $\vartheta_2 < 0$ (do not contain a unit root, the data is stationary)

(The equation presented above includes both a drift term and a deterministic trend; the equation with a drift term but without a deterministic trend will also be tested accordingly)

Cointegration Test

Cointegration means that, even though the variables are not stationary individually but the linear combination between two or more variables may be stationary (Amiruddin. et al. 2007).

Granger(1981) for the first time explorer the cointegration theory is expanded by Engle and Granger (1987)) integrating the long and short term dynamic relationship. Element in vector Xt is said to be cointegrated at d and b degree, denoted by CI (d, b) therefore if:

All Elements of Xt is I (d), and there exist a none zero vector $\alpha = (\alpha_1, \alpha_2, \ldots\ldots\alpha_n)$ so that the linear combination of $\alpha X_t = \alpha_1 X_{1t} + \alpha_2 X_{2t} + \ldots\ldots\ldots + \alpha_n X_{nt}$ will be cointegration at (d, b) level where $b \succ 0$. Vector α is the cointegration vector. In the case of b=d=1 Xt is I (1) and their linear combination is I (0)(Amiruddin. et al. 2007)

However, they are number of researcher such as(Engle&Granger 1987; Granger 1981) concluded that a relationship between error corrections with cointegration thought through the Granger Theorem. Furthermore, Johansen (1991) and Johansen and Juselius(1990), produced the maximum likelihood approach using the Vector autoregression (VAR) model to estimate the cointegration relationship between components in vector k variable Xt. Consider VAR model for xi;

$$A(L)x_i = \varepsilon_t \tag{4}$$

The parameter can be presented in the form of Vector Autoregressive Error Correction Mechanism:

$$\Delta X = \sum_{i-1}^{p-1} \prod_i \Delta X_{t-i} + \alpha\beta^{'} X_{t-p} + \varepsilon_t \tag{5}$$

Where vector $\beta = (-1, \beta_{2,} \beta_3, \ldots\ldots\ldots\ldots, \beta_n)$ which contain r cointegration vectors and speed adjustment parameter is given as $\alpha = (\alpha_1, \alpha_2, \ldots\ldots\ldots\ldots, \alpha_n)$ when rank $\beta = r \prec k, k$ is the number of leading (endogenous) variables. If the number of cointegration relations is known, hypothesis testing on α and β can be performed. Appropriate number of lags length for the model can be determined by VAR equation using the Akaike information criterion (AIC) and Schwarz information criterion (SC) criteria.

Granger Causality Test

In 1981 Granger and 1987 Engle and Granger, indicated that If cointegration is found from the variable series, error correction term (ECT) obtained from cointegration regression must be taken into consideration in the causality test to avoid the problem of miss-specification. It is necessary to test for cointegration, before testing for causality. However, there are two fundamental approximations to examine the cointegration. From the Engle and Granger (1987) choosing two points, and in (1987-1990) johansen, johansen and Juselius also show that, Apart from being multivariate, the Johansen method has several appealing features. First of all, it allows more than one cointegrating relation between the variables being tested they will show the existence of long term relationship if the variables contain mutual stochastic trend, as such, there exist at least one Granger Causality either in one or bi-directional. Second, there are concerns about the small-sample bias in estimations from the Engle-Granger routine. Finally, Result from the cointegration relationship between variables has set aside the probability of spurious estimation.

Vector Error Correction Model (VECM)

Non stationary variables that are known to be cointegrated, can be used VECM which is a restricted VAR designed. VECM allowing for the short term adjustment dynamics, but originally VECM identification moderate for the long term behaviour of endogenous variables to converge to their co-integration relationships. In (1987) Engle and Granger argue that if the variables found to be cointegrated for example (Xt) and (Yt) there will be an error illustrative which is linked to the said function, which gives an illustrative that changes in dependent variable is a function of the imbalance in cointegration relation and by other explanatory variables.(Amiruddin. et al. 2007) However, naturally if Xt and (Yt) have same stochastic trend, dependent variables in Xt is in part, the outcome of (Xt) shift in line with trend value of independent variable (Yt). Therefore, via error correction term, VECM finding of Granger Causality relation which has been abandoned by Granger in (1968).
The VAR constraint model may derive a VECM model as shown below:

$$\Delta Y_t = \mu_i + \sum_{i-1}^{n} \prod_i \Delta Y_{t-i} + \sum_{i-1}^{n} \psi_i \Theta_{t-i} + \nu_i \qquad (6)$$

Where Y_t = in the form n x 1 vector
$\prod_i$ and ψ_i = estimated parameters
Δ = difference operator
ν_t = reactional vector which explains unanticipated movements in *Xt* and Θ (error correction term)

Through the *t* test for the lagged error correction term (ψ_i) can be identified the degree of exogeneity. Otherwise, for each variable separately of the non dependent variable ($\prod_i$), *F* test can applied to the lags of the coefficients. Furthermore to the above VECM technique allows the discrimination of the long-short run relationship. Error term with lagged parameter (ECT (*e*1, *t*-1)) is an adaptive parameter where it measures the short run dispersion from long run balance. In the short run disperse between the variables which cause in balance in the system. For this reason, the statistical significance of the coefficients associated with ECT provides proof of an error correction method that drives the variables back to their long term relationship.(Amiruddin. et al. 2007)

DATA

The data includes weekly returns computed from benchmarks (domestic) stock price indices of Saudi Arabia Stock Exchange. Using the weekly frequency information is more consistent than the daily data, since daily data have missing elements for weekends; this study selects five sectors namely (Financial and Banking (FIN), Industrial (IND), Telecommunication (TEL), and Real Estate (RE), including national stock market) for the Tadawul Stock Exchange. To examination this study has chosen those sectors which have high market capitalization and high trade value. They are an important and very active among the others sectors. The data was collected from DataStream with a time range from 23/4/2007 to 28/2/2012 and all the data will be transformed into natural logarithm. This analysis will be done using (EViews 7).

EPMIRICAL RESULTS

Table 1: Descriptive statistics of weekly sectoral index returns.

	TASI	TBN	TID	TPCH	TRE	TTEL
Mean	0.000216	-0.00044	0.001357	0.001012	-0.00053	-0.00026
Median	0.003672	0	0.004856	0.006239	0.001325	0.000226
Maximum	0.104603	0.123361	0.14501	0.133144	0.13749	0.11884
Minimum	-0.17281	-0.13551	-0.21656	-0.24446	-0.19101	-0.17162
Std. Dev.	0.036572	0.037727	0.043743	0.050906	0.039665	0.036134
Skewness	-1.03381	-0.25771	-0.99788	-0.90975	-0.61258	-0.81494
Kurtosis	6.739103	5.399572	6.368287	6.224263	6.669478	6.71913
Jarque-Bera	197.0119	65.00479	165.419	147.9151	161.5092	177.9377
Probability	0.00000	0.00000	0.00000	0.00000	0.0000	0.0000
Sum	0.055913	-0.11306	0.351478	0.261982	-0.13755	-0.06714
Sum Sq. Dev.	0.345068	0.367212	0.493673	0.668581	0.405923	0.336868
Observations	259	259	259	259	259	259

Note: Tadawul All Share(TASI), Financial Services (FIN), Industrial(ID), Petrochemical (TPCH), Real Estate (RE), Telecommunications (TTEL) Std Dev. is the standard deviation, an absolute measure for risk. J-B is the Jarque-Bera test for normality. Both mean and standard deviation are in percentage terms. Total observations for each index is 259 weeks.

As a starting point, it is appropriate at this stage to provide some perspective on the properties and trends of the individual sectoral indices of the Saudi Arabia stock market. The summary statistics of the weekly stock index returns presented in Table 1. The result show that the Petrochemical (TPCH), and Industrial (ID), and less sector's returns is Telecommunications (TTEL), Real Estate (RE) respectively.

Stationarity – Individual Stochastic Trend

Table 2: Stationary Test at Level and First Difference

Variable	ADF_{tc}	ADF_{tt}	PP_{zc}	PP_{zt}
	At Level			
Tadawul All share	-1.963	-2.005	-1.627	-1.642
Financial	-1.818	-2.2	-1.794	-2.21
Industrial	-2.615	-2.612	-1.899	-1.898
Petrochemical	-2.153	-2.144	-1.72	-1.715
Real Estate	-1.508	-1.638	-1.159	-1.833
Telecommunications	-1.541	-1.798	-1.477	-1.725
	At First Difference			
Tadawul All share	-5.138***	-5.141***	-14.433***	-14.416***
Financial	-14.034***	-14.008***	-14.036***	-14.009***
Industrial	-5.031***	-5.067***	-15.509***	-15.504***
Petrochemical	-4.881***	-4.872***	-13.75***	-13.724***
Real Estate	-5.399***	-5.447***	-15.805***	-15.803***
Telecommunications	-16.811***	-16.792***	-16.826***	-16.807***

Notes: ADF and PP denote the Augmented Dickey-Fuller test, Phillips-Perron test, also ADFtc denote that Augmented Dickey-Fuller test without trend, ADFtt with trend, PP (zc,zt) follows similar value as ADF's critical value. *** Significant at 1% level
The optimum lags are identified using AIC

The results of the unit root tests are presented in Table 2. Since the test statistics of the ADF and PP tests are higher than the critical values, the null hypothesis that the individual sector price indices contain a unit root in the log forms cannot be rejected at 1% significance level. However, there is no evidence to support the existence of a unit root in log first differences of the individual sector price

indices. Accordingly, since unit root tests establish that all sectoral index levels are individually integrated of order one (I (1)), I can proceed to cointegration analysis with these indices because they are all integrated of the same order as required for cointegration.

Cointegration Test

To begin with, before Johansen's multivariate cointegration analysis can be carried out, the optimal number of lags in the VAR system should be determined. On the basis of the Final Prediction Error (FPE) criterion and Akaike Information Criterion (AIC), a lag length of two is identified. The chosen lag length is sufficient to remove any serial correlation in the residuals of the VAR. As reported in Table 3, when r = 0 the computed values of the Trace statistic and Max eigenvalue statistic exceed the corresponding 1% critical values, indicating that at least one significant cointegrating vector exists for all the sectoral indices under scrutiny. For more than one cointegrating vector, however, both test statistics are found to be lower than the corresponding critical values, providing evidence of the existence of only a single cointegrating vector within the six capital market sectoral indices over the sample period, for the Tadawul stock exchange. The result of cointegration analysis are broadly consistent with the economic intuition that the capital market sectors within a certain economy share to a lesser or greater extent a long-run equilibrium relationship. That is, they have a tendency to move towards the same direction, at least in the long term.

Table 3: Johansen and Juselius Cointegration test

	Null Hypothesis	Statistics	1% Critical Value
λ_{Max}	r=0	47.09***	45.10
λ_{Max}	r≤1	28.98	38.77
λ_{Trace}	r=0	122.19***	103.18
λ_{Trace}	r=1	75.10	76.07

Note: *** Significant at 1% level

VECM and Granger Causality Test

In case of the presence or absence of a long-run equilibrium relationship, the possibility of a short-run relationship between the variables under scrutiny may still exist. To test for this possibility, the Granger's causality analysis is employed. The conclusions of this section suggest that the short-term causal relationships between the economic sectors of the Tadawul market are considerably limited and, where they exist, virtually unidirectional. These findings may sound typical, especially given that the Saudi capital market is in effect inefficient because trading is comparatively thin for the information to be disseminated timely and broadly. The implication of these observations is that an attempt to predict the stock price movements of a sectoral index based on the information content of the lagged values of another sectoral index in the Tadawul stock market is predictable to be fruitless in most cases. As we are can seen from the Table 4.

Table 4: VECM and Granger Causality Test

Dependent variable	Δ TASI	Δ TFIN	Δ TDI	Δ TPCH	Δ TRE	Δ TTEL	ECT(coefficient)
Δ TASI		3.95	2.94	7.2*	3.63	1.45	-0.14**
Δ TFIN	3.23		2.08	7.53*	3.02	1.16	-0.26***
Δ TDI	5.47	6.27*		11.29**	5.11	2.05	-0.11
Δ TPCH	5.6	6.8*	2.09		4.31	2.15	0.01
Δ TRE	1.07	2.42	2.36	1.4		2.13	-0.12
Δ TTEL	3.29	4.17	1.27	5.82	6.54*		-0.07

Notes: Tadawul All Share (TASI), Financial Services (FIN), Industrial (ID), Petrochemical (TPCH), Real Estate (RE), Telecommunications.
All numbers showed the F statistic, except the ECT.
*, **, *** Significant at 10%, 5%, 1% level.

CONCLUSIONS

This study contributes to the existing literature on domestic stock market linkages by investigating the linkages of sub-sector indices in Saudi Arabian stock exchange. This study used a Johansen cointegration tests and the vector error correction model (VECM) in examining the dynamic linkages among the sub-sector indices.

The results of the study revealed that there is a long run relationship between sub-sector indices in Saudis stock market. In addition, the results of Granger causality test indicate that there is a long run causality running from all indices upon the market index (TASI) and finance index (TFIN). However, in the short run, there is a univariate causality among some of the sub-sector indices.

The findings of this study provide some direction for investors. First, the investors have to consider the movement of petrochemical index in managing their investment strategy, particularly in maximizing the equity return or minimizing the risk. This is because the variation of petrochemical index seems to be more dominant than others sub-indices. Second, since the domestic markets are cointergrated, therefore there is no benefit of the diversification in the long run. This implies that in the long run, the investors will receive the same expected return. They can only get benefit from diversification only in the short-run.

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