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Causal linkages between the energy sector and islamic regional indexes: evidence from GCC, EU, US, emerging markets and Asia-pacific

Firoz Malayan¹ and Mansur Masih²

Abstract

The purpose of this paper is to investigate the Granger-causal relationship between conventional energy sector index and Islamic regional indexes of GCC, EU, U.S., Emerging markets and Asia-pacific. Also, the causality among U.S, China and the energy sector will be studied. The standard time series techniques are employed. The empirical results tend to indicate that there exists a Granger-causality from the GCC to the Islamic regional indexes and the conventional energy sector. The results also show that the U.S has the most leading position followed by the energy sector when taking China into context. Both the generalized variance decompositions and impulse response functions confirm the direction of causality. These findings have important policy implications for the regions and countries concerned. The Islamic regional indexes should monitor the trend of the Islamic GCC region, closely, while taking the conventional energy sector into account. The U.S. and the energy sector still have an influence over the Chinese oil and gas sectors.

Keywords: Islamic regional indexes, energy sector, Asia-pacific, Granger-causality, VECM, VDC

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Introduction:

The Middle Eastern nations are the largest producers of the energy needs for the global community (*IEA statistics- 2009*). The repercussions in the middle-east, starting with the regime change in Tunisia and the continuing unrest in Libya, Bahrain, Saudi Arabia etc. has an important implication to the world economy due to the middle-east countries' domination on the energy sector, especially Oil and Gas. To say the least, predicting the future of the GCC region remains murky at best for the time being as we witnessed historic, widespread levels of unrest across the region.

As quoted by Mohammed A. El-Erian, CEO of PIMCO, which manages the world's largest mutual fund¹, the unrest is sighted as one of the issues that are looming larger in importance and becoming more threatening in character. This has led to the need for a study on the influence of the biggest energy producers and the energy sector at a global scale based on the Islamic indexes. Such a study would enable policy makers to re-align their energy import strategies. This study is especially important as it provides a final ranking of the regions with the sector, after the subprime crisis. The crisis has had an impact on the sector and on the ability of the nations to meet their energy demands. Energy developments in 2009 were dominated by a global recession and, later in the year, a tentative recovery. For the year as a whole, *the global economy contracted for the first time since the Second World War*², and global energy consumption fell as well.

The paper will deal with the Islamic regional indexes of GCC, U.S., European Union, Asia-pacific and emerging markets. The growth of China as a probable regional superpower, also leads us to the need for the evaluation of its relation with the energy sector in the second part of this paper. The paper is divided into two parts; first one will handle the Islamic regions' analysis and the second part, the China issue.

Changing landscape:

The Global primary energy consumption fell in 2009, but like the broader economic downturn, changes varied greatly across regions. In the OECD, energy consumption fell faster than GDP – the sharpest decline in energy consumption on record. The OECD consumed less primary energy

¹ *money.usnews.com*; ² *British Petroleum (BP) statistical review of world energy– June 2010*

last year than 10 years ago, although GDP since then has risen by 18%. The developing world outside the Former Soviet Union, in contrast, saw energy consumption growing faster than GDP. Globally, the energy intensity of economic activity rose last year, fostered by slower growth and by many energy-intensive fiscal stimulus programs – but against the longer-term trend.

With consumption falling, energy prices declined in 2009, though again the pattern varied by fuel. Oil prices began the year below \$40 per barrel, and increased steadily during the year as OPEC production cuts were greater than the decline in consumption. Natural gas in competitive markets fell sharply and remained weak through most of the year due to falling consumption, continued development of unconventional resources in the US and rising LNG supply. And coal prices fell and then started to recover, while displaying regional variety.

The recession has taught us how interlinked the world really is. China became a large-scale coal importer, which prevented global coal consumption from falling; and, given the OPEC cuts, the world's largest increase in oil production by far came from the US, mainly from the Gulf of Mexico.

World primary energy consumption – including oil, natural gas, coal, nuclear and hydro power – fell by 1.1% in 2009, the first decline since 1982 and the largest decline (in percentage terms) since 1980. Consumption in OECD countries fell by 5%, the largest decline on record; OECD consumption reached the lowest level since 1998. Energy consumption declined in all regions except Asia Pacific and the Middle East; Chinese energy consumption growth accelerated to 8.7%.

Global oil trade fell by 3.1%, a second consecutive decline and the largest decline since 1987. The US accounted for 84% of the net decline in imports, driven by declining consumption and rising domestic production. Among exporters, the Middle East – with falling production and rising domestic consumption – accounted for virtually the entire decline. *This fact strengthens Middle Eastern countries' dominance in the sector.*

Global gas production declined for the first time on record. Production fell sharply in Russia (-12.1%) and Turkmenistan (-44.8%), driven by declining consumption – in Russia and much of the

rest of Europe – and the availability in Europe of competitively priced liquefied natural gas (LNG). Continued expansion of unconventional supplies allowed the US to record the world's largest increase in production for the third consecutive year, surpassing Russia as the world's largest producer. Production in the Middle East and Asia Pacific also increased, driven by growth in Iran, Qatar, India and China.

All of the above facts show the *changing landscape* of the energy supply and demand situations. And, hence, it is only prudent that a study is conducted to study the Islamic regional indexes especially after the impact of the crisis by including the crisis period also in the study. The recent growth of China also leads us to the need for the evaluation of the second part of this paper, which is to see as of which nation leads the energy sector. The U.S. has been the largest consumer from the beginning of the records and *any shift of such a pattern towards China could result in realignments of other nations' trade interests towards China, thus changing the world economic business scenario.*

As per IEA, China's energy use has more than doubled over the last decade to overtake the United States as the world's biggest user, according to preliminary data from the International Energy Agency (IEA). China did refuse this report during 2010. The IEA's head economist, Fatih Birol, told that the organization had used the same sources and methodology as always in compiling the 2009 statistics, which he said were in line with the trend for the past decade. "The trend is undeniable that the Chinese energy consumption is growing very strongly - which is very legitimate, by the way, considering their population - and the energy from the OECD countries, the U.S., Europe and Japan, is stagnating. They are two major undeniable trends," Birol said in a telephone interview. "There's nothing specific from this year, it's all the same methodologies we used before". He said that per capita, the United States still consumes five times more energy than China. China has invested heavily in hydroelectric dams, wind turbines and nuclear power plants in an attempt to cut rising reliance on imported oil and gas, which its leaders see as a national security risk. See the IEA statistics for "Total energy consumption: US and China (Million tons of oil equivalents)".

Objectives and Motivation:

The primary interest of this paper is to study the effects of the conventional energy sector. With this in focus, the paper tries to answer the following questions:

Part-A:

1. When it comes to the energy sector, does the GCC region have a leadership position among the other regions or is it the sector itself? The Islamic regional indexes will be taken into consideration for this purpose.
2. Among the Islamic regional indexes of the GCC, U.S., European Union, Asia-pacific and Emerging markets, which ones influence the energy sector and which ones get influenced by the sector?

Part-B:

With regard to a statistical report, as of July 2010, by the International energy association (IEA), China overtook U.S. as the world's largest energy consumer. China reacted by refuting the report and questioned the calculations and declared it as "unreliable". This part of the paper will aim to only find which variable among the China, U.S and the energy sector is the most leading in order to ascertain the relative importance of US and China with respect to the energy sector.

Literature review:

The paper by Arouri, M.E.H., et al. (2011) investigates the return links and volatility transmission between oil and stock markets in the Gulf Cooperation Council (GCC) countries over the period 2005–2010. A VARGARCH approach which allows for transmissions in return and volatility was used. The results point to the existence of substantial return and volatility spillovers between world oil prices and GCC stock markets, and appear to be crucial for international portfolio management in the presence of oil price risk.

Jones and Kaul's (1996) initial study focused on testing the reaction of advanced stock markets (Canada, UK, Japan, and US) to oil price shocks on the basis of the standard cash flow dividend valuation model. They found that for the US and Canada the reaction can be determined by the impact of the oil shocks on cash flows while the outcome for Japan and the UK were indecisive. Huang et al. (1996) applied unrestricted vector autoregressive (VAR) which confirmed a significant relationship between some US oil company stock returns and oil price changes. Conversely, they found no evidence of a relationship between oil prices and market indices such as the S&P500. In contrast, Sadorsky (1999) applied an unrestricted VAR with GARCH effects to US monthly data and found a significant relationship between oil price changes and aggregate stock returns. Recently, El-Sharif et al. (2005) examined the links between oil price movements and stock returns in the UK oil and gas sector. They found a strong interrelationship between the two variables.

The paper by Crompton et al (2004) studied the energy consumption by China. In 2003, China's energy consumption amounted to 1678 million tonnes coal equivalent (MtCE), making China the world's second largest consumer behind only the United States. China is now also one of the largest oil importers in the world. With an economy that is expected to maintain a rate of growth of 7–8% for decades, China's role in the world energy market becomes increasingly influential. The paper applies the Bayesian vector autoregressive methodology to forecast China's energy consumption and to discuss potential implications. The results suggest that total energy consumption should increase to 2173 MtCE in 2010, an annual growth rate of 3.8%, which is slightly slower than the average rate in the past decade. The slower growth reflects expected slower economic growth and a decline in energy consumption due to structural changes in the Chinese economy.

The researcher found no noteworthy literature on the topics related to the Islamic regional indexes. Hence, a few of them which were remotely relevant were studied.

Data source:

The Dow Jones Indexes were used for the study. Since, data for Dow Jones Islamic market GCC index is available only from 2003, 2003 is considered as the starting point of the data. The data ranges till December 2010. There are a total of 286 weekly observations. The *Dow Jones Total Return indexes* are used instead of *Price Return*, as Total Return Indexes are a type of equity indexes that tracks both the capital gains of a group of stocks over time, and assumes that any cash distributions, such as dividends, are reinvested back into the index. The Total return indexes displays a more accurate representation of the index's performance than a price return index. The data is in USD. The *Islamic* regions will be tested with the *conventional* sector. The list of Indexes is given below:

#	Codes	Index Name
1	.DJIGCT	Dow Jones Islamic Market GCC Index
2	.DJIEU	Dow Jones Islamic Market Europe Index
3	.DJIAP	Dow Jones Islamic Market Asia/Pacific Index
4	.IMUST	Dow Jones Islamic Market U.S. Index
5	.DJIEMGT	Dow Jones Islamic Market World Emerging Markets Index
6	.W1ENE	Dow Jones Global Oil & Gas Index

In order to assess the second part of the paper that deals with the Chinese dilemma, the author was able to find data only from September 2009 from the Dow Jones index. September 2009 is the start date as per Dow Jones for China oil and gas index. The data ranges until January 2011. Since, we have one year and four months of data, we use daily data so as to obtain maximum number of observations. Assuming that the statistics by IEA regarding China is true, the new consumption pattern of 2009 could get reflected in the 2010 data also. Needless to say, for an economy of China's size, it would be hard to control the consumption pattern in just a few months.

The list of Indexes is given below:

#	Codes	Index Name
1	.W1ENE	Dow Jones Global Oil & Gas Total Return Index
2	DJUSENT	Dow Jones U.S. Oil & Gas Total Return Index
3	DJCNENT	Dow Jones China Oil & Gas Total Return Index

For the second part of the study, only the *conventional* Dow Jones Oil and Gas indexes were used unlike for the first part, where the world energy sector index was studied along with the world

Islamic regions i.e., the *Islamic* regional stock markets. The data was collected from Dow Jones site and Reuters.

Methodology:

This study will use Time Series Techniques. The MICROFIT 4.0 software will be used for this method. The Islamic regional indexes, U.S. and China along with the conventional energy sector will be the variables used. Following are the time-series techniques, which will be executed in order:

#	Econometric tests
1	Non-stationary test (ADF test)
2	The order (or lags) of the VAR model
3	Cointegration
4	Long Run Structural Modeling (LRSM)
5	Vector Error Correction Model (VECM)
6	Generalized Variance Decompositions
7	Impulse response
8	Persistence Profile

Two most commonly used approaches to test for stationarity are Augmented Dickey and Fuller (ADF) test, proposed by Dickey and Fuller (1979), and the Phillips-Perron (P-P) test, proposed by Phillips and Perron (1988). These tests are referred to as unit-root tests as they test for the presence of unit roots in the series. ADF test is used for this paper. Akiake Information Criterion (AIC) is used in order to select an optimum number of lags. The cointegration method assumes that if any two variables contain a common stochastic trend, each can be described as an integrated variable. This paper uses the Johansen ML cointegration test. If a linear combination of variables is observed

stationary, then the variables are cointegrated. The benefit of the Johansen methods is its ability to find more than one cointegration vectors, if present.

LRSM is used to test the apriori theory, if available, using exactly-identifying and the over-identifying steps. Long run structure basically means the theory. If the index series are cointegrated, Granger representation theorem states that an error correction model (ECM) describes the dynamic relationship. The advantage of ECM framework lies in its strength of capturing both the short run dynamics and long run equilibrium relation between the two series. The VECM, however, cannot tell us which variable is relatively more exogenous or endogenous. The variance decomposition (VDC) technique is designed to indicate the relative exogeneity or endogeneity of a variable by decomposing the variance of the forecast error of a variable into proportions attributable to shocks (or innovations) in each variable in the system including its own. The proportion of the variance explained by its own past shocks can determine the relative exogeneity/endogeneity of a variable. The variable that is explained mostly by its own shocks (and not by others) is deemed to be the most leading of all. This paper uses generalized variance decomposition due to its advantage over Orthogonalized VDC. Impulse response is a graphical representation of the VDC. Persistence profile conducts a system wide shock on the long-run relations.

Part A – Causality between the conventional energy sector and Islamic regional indexes

Empirical results:

ADF tests:

The *null hypothesis* is that the variable is non-stationary. The results, in *appendix g1*, reveal that all the concerned variables are non-stationary - $I(1)$ at level form as the test statistic is lower than the critical value, whereby the movements of the index, over time, are purely random and unpredictable (white noise). Hence the *null hypothesis* cannot be rejected. The variables are found to be stationary - $I(0)$ at their first differences as the test statistic is higher than the critical value.

Hence, the *null hypothesis* is rejected. In the stock market literature, $I(1)$ is generally interpreted as a sign of market efficiency.

Order of VAR:

As the variables are level non-stationary and first difference stationary, the next step is to determine the order of the vector auto regression model in order to determine the number of lags. This is an important step because it will determine the correct number of cointegration(s). Also, including too few lags will not remove the autocorrelation, thus biasing the results, while using too many will increase the coefficient standard errors. The latter effect arises since an increase in the number of parameters to estimate uses up degrees of freedom.

The suggested lag order as per AIC criterion is 3, whereas SBC suggests Zero. The paper uses Lag Order of three. Below, is the result of serial correlation of each variable:

Variable	Chi-Sq p-value
DDJIGCCTT	[.939]
DDJIEU	[.313]
DDJIAPT	[.078]
DIMUS	[.158]
DDJIEMGT	[.096]
DWIENE	[.537]

From the above data, it can be seen that there is no serial correlation at a 5% level of significance. Hence, we proceed with three lags as the optimum order of lag as it has handled the serial correlation issue. Detailed results are shown in *appendix g2*.

Cointegration test:

For cointegration test, the log form of the variables is used as they are non-stationary and, hence retains the theoretical component in the data. The variables are

LDJIGCCTT, LDJIEU, LDJIAPT, LIMUS, LDJIEMGT, LWIENE and SUBP

In order to capture the affect of the sub-prime crisis, a dummy variable ‘SUBP’ has been used for the period 19th October 2007 till 20th march 2009. The null hypothesis is that there is no cointegration between the Islamic regions and the conventional energy sector.

Below is the result of the Johansen ML test for multiple cointegrating vectors:

Maximum eigen value statistics:

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r = 1	50.5818	43.6100	40.7600
r <= 1	r = 2	32.6337	37.8600	35.0400

It is evident that there is one cointegration between the variables from the maximum eigenvalue result. This shows that the variables are related or connected to each other. Below are the results for the Trace statistic:

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r >= 1	140.2482	115.8500	110.6000
r <= 1	r >= 2	89.6664	87.1700	82.8800
r <= 2	r >= 3	57.0327	63.0000	59.1600

Trace statistic shows 2 cointegration. Below is the result of model selection criteria:

Rank	Maximized LL	AIC	SBC	HQC
r = 0	4191.8	4107.8	3954.7	4046.4
r = 1	4217.1	4121.1	3946.1	4050.9
r = 2	4233.4	4127.4	3934.2	4049.9
r = 3	4247.0	4133.0	3925.2	4049.6
r = 4	4255.0	4135.0	3916.2	4047.3
r = 5	4260.4	4136.4	3910.4	4045.7
r = 6	4261.9	4135.9	3906.3	4043.8

As per the HQC, from the above result, one cointegration exists. Since, two out of three results show one cointegration, *the paper will consider one cointegration among the variables*. Detailed results are in *appendix g3*.

LRSM:

This step will estimate theoretically meaningful cointegrating relations. As the main objective of the study is to analyze the Energy sector, the WIENE variable will be the variable of interest and hence, will be used for the exactly identifying step of the LRSM by imposing the restriction one to normalize. The results are shown in *appendix g4*. The subsequent step which is the over identifying step is the LRSM step, while the exactly identifying step is still part of the cointegration.

When the *Trend* variable was restricted in the over-identifying step, it was found to be a valid restriction. The manually calculated t-ratios for vector 1 and vector 2 are shown below:

T-ratio	Vector 1	Vector 2
LDJIGCCT	9.5	7.41
LDJIEU	4.8	6.77
LDJIAPT	1.9	4.27
LIMUS	2.4	4.31
DJIEMGT	1.8	6.07

The rest of the steps will be executed with the aforesaid restriction on *trend* only. In order to be make sure that the rest of the variables were truly significant, over identifying restrictions were done for each variable for, one by one, and below is its Chi Sq p-value result:

Vector 2	Chi Sq p-value
LDJIGCCT	[.000]
LDJIEU	[.000]
LDJIAPT	[.000]
LIMUS	[.000]
LDJIEMGT	[.001]
Trend	[.580]

The null hypothesis is that the restriction is correct. But, as per the above results, the null hypothesis is rejected except for trend. The cointegrating equation, as a result of the LRSM step, is the following:

$$\boxed{\text{WIENE} \quad -.20308 \cdot \text{LDJIGCCT} \quad -2.3190 \cdot \text{LDJIEU} + 1.6012 \cdot \text{LDJIAPT} + \dots}$$

(0.03)
(.34)
(.37)

2.0134*LIMUS-1.0533*LDJIEMGT
(.47) (.17)

Vector 1 is the exactly identifying step with the energy sector variable normalized. Asia-pacific and emerging markets were found to be not-significant. But, owing to the importance of these regions in the global economy, we proceed with *vector 2*, where all variables are shown to be significant as per chi-square p- value, for the rest of the paper.

Error correction model (ECM):

Error-correction term (ECT) contains long term information since it is the differences or deviations of the variables in their original level form. VECM uses the concept of Granger causality that the variable at present will be affected by another variable at past. Therefore, if the coefficient of the lagged ECT in any equation is *insignificant*, it means that the corresponding dependent variable of that equation is *exogenous*. This variable does not depend on the deviations of other variables. It also means that this variable is a leading variable and initially receives the exogenous shocks which results in deviations from equilibrium and transmits the shocks to other variables. On the other hand, if the coefficient of the lagged ECT is *significant*, it implies that the corresponding dependent variable of that equation is *endogenous*. It depends on the deviations of other variables. This dependent variable also bears the brunt of short-run adjustment to bring about the long term equilibrium among the cointegrating variables. The null hypothesis is that the coefficient of the lagged ECT is equal to zero. Summarized results are shown below:

Variables	ECM(-1) t-ratio p-value	Exogenous
dLDJIGCCTT	[.241]	Yes
dLDJIEU	[.057]	No
dLDJIAPT	[.001]	No
dLIMUS	[.000]	No
dLDJIEMGT	[.007]	No
dLW1ENE	[.002]	No

From the results, it is evident that only GCC region is the exogenous variable at a *10% significance level*. The rest of the variables are endogenous or followers. GCC does not depend on the deviation of the other variables. This answers the *first question* as of whether is it the GCC or the energy sector that has an influence over the rest of the Islamic regions. It is GCC which has an influence on the other Islamic regions including the sector and not the energy sector. It also means that when it comes to the energy sector, Islamic GCC index should be monitored in order to know the performance of the sector. This is already evident from the current turmoil in the Muslim countries. The violence in Bahrain, Libya, Egypt etc. has spiked oil prices (*Reuters*). Even though, Saudi Arabia being the prominent oil & gas exporter, looks to be “calm”, its close proximity, economic relations and political relations with the violence-infested regions can be cited as the reasons for such trend in the energy sector.

The coefficient of the lagged ECT also indicates the speed of short term adjustment to bring about long term equilibrium. The number of periods (weeks) required for the various variables to bring about the long term equilibrium is shown below:

Variables	Coefficient of lagged ECT	Weeks
dLDJIGCCTT	.05824	17
dLDJIEU	.07590	13
dLDJIAPT	.12246	8
dLIMUS	.14567	7
dLDJIEMGT	.12148	8
dLWIENE	.14957	7

In order to answer the second objective of the paper, which is to find which regions lead and which ones follow the energy sector, the ECM results will not help as they do not tell which variable is the most exogenous. The Generalized Variance decomposition test will be conducted to get an answer for the second question.

Variance Decompositions (VDCs)

The VDC test will break down the variance of the forecast error of each variable into proportions attributable to shocks in each variable in the system including its own. The variable which is mostly explained by its own past shocks is considered to be the most leading variable of all. The

Table 1	LDJIGCCTT	LDJIEU	LDJIAPT	LIMUS	LDJIEMGT	LW1ENE
LDJIGCCTT	91%	2%	2%	4%	1%	2%
LDJIEU	0%	27%	16%	19%	20%	18%
LDJIAPT	0%	22%	24%	15%	25%	14%
LIMUS	0%	25%	13%	27%	19%	15%
LDJIEMGT	0%	22%	19%	16%	28%	14%
LW1ENE	0%	24%	13%	18%	18%	27%

result is shown in *table 1*, for the 10th period or week. The ranking for the table 1's result is shown below in *table R1*. The ranking is based on the proportion of shocks. It will help us to clearly identify the most contributing or less contributing variable, in terms of forecast variance, when one particular variable is shocked.

Table R1:

Ranking	LDJIGCCTT	LDJIEU	LDJIAPT	LIMUS	LDJIEMGT	LW1ENE
LDJIGCCTT	1	4	4	2	6	3
LDJIEU	6	1	5	3	2	4
LDJIAPT	6	3	2	4	1	5
LIMUS	6	2	5	1	3	4
LDJIEMGT	6	2	3	4	1	5
LW1ENE	6	2	5	3	4	1

When the GCC region is shocked, most of the shock (91%) comes from its own. The contribution of shock from the U.S comes next followed by the energy sector, EU and Asia-pacific. On similar lines, when the energy sector is shocked, its own shock contributes the major portion followed by EU, US, emerging markets, Asia-pacific and then the GCC region. The immunity of the GCC region can be seen as it contributes the least to the forecast variance of other variables, when other variables are shocked respectively; its rank stands at 6 throughout the about table, except when it comes to its own. One interesting factor is that when Asia-pacific is shocked, most of the shock comes from Emerging markets and not from itself; this shows the strong relation between Asia-pacific and emerging markets. The overlapping of certain countries like China, India, Indonesia, Malaysia etc., when it comes to Asia-pacific and emerging markets could be one reason for such a result.

Based on the forecast variance, the ranking of variables based on which contributes to its own shock, the most, is shown in table r2. The ranking are different even for similar variance due to rounding off the variance to the nearest decimal. Detailed results are in *appendix g6*.

Table R2:

Rank	Indexes	#
1	LDJIGCCTT	91%
2	LDJIEMGT	28%
3	LIMUS	27%
4	LW1ENE	27%
5	LDJIEU	27%
6	LDJIAPT	24%

Analysis of ECM & VDC results:

The Islamic GCC region turned out to be the most exogenous variable at 91%. There is a huge gap of 63% from GCC to the subsequently ranked variable; the Emerging markets, clearly showing GCC's dominance. The GCC established in 1981 includes six member countries of Bahrain, Oman, Kuwait, Qatar, Saudi Arabia and the United Arab Emirates (UAE). GCC countries share several common economic characteristics. In 2007, they produced in combination about 20% of all world crude oil, controlled 36% of world oil exports and acquired 47% of verified reserves. Oil exports largely determine earnings, government budget revenues, expenditures, and aggregate demand. In 2009, the GCC regions produced a combined 21% of the world crude oil while the U.S. , EU and Asia Pacific produced only 8.5% , 2.6% and 10% (*BP statistical review of world energy 2010*).

The GCC markets are important for several reasons:

- GCC markets have attracted increasing attention in the last decade. In the wake of high oil prices since 2003 and recently in 2008, they have each achieved high economic growth rates.
- GCC markets differ from those of developed and from those of major emerging countries in that they are predominately-segmented markets, largely isolated from the international markets and are overly sensitive to regional political events. (*Arouri and Rault (2010)*). *This isolation of GCC is*

proven by the VDC results as GCC tends to contribute no or negligible shock (almost 0%), as shown in table 1, to the other regions, when the other regions were shocked.

The BP statistics on the Oil and Natural gas for 2009 is shown in table O1 and table N1, respectively.

Table O1:

Oil	Production [#]	Consumption [#]	P/C
US	16.5	26.4	63%
EU	2.6	17.3	15%
AsiaPac	10	31.1	32%
GCC	21	4.4	477%
Emg mrkts*	30	34	88%

[#]% of total in million tonnes *Approximate

Table N1:

Natural Gas	Production [#]	Consumption [#]	P/C
US	20	22.2	90%
EU	5.7	15.6	37%
AsiaPac	14.6	16.8	87%
GCC	8.8	5.8	152%
Emg mrkts*	30	28.4	106%

[#]% of total in million tonnes oil equivalent *Approximate

Tables O1 and N1 prove that GCC produces more than it needs as per the production/ consumption (P/C) ratio. In terms of Oil and natural gas statistics, GCC is the clear leader. GCC produces almost 5 times more oil than it needs and 1.5 times gas. EU produces the least and consumes more. Asia-pacific produces more Natural gas than Oil. An interesting result to note here is that even though Asia-pacific looks to be at a better position than EU as it was able to produce most of its Oil & Gas needs than EU, it was ranked last in the *table R2*. EU was able to produce oil which satisfied only 15% of its consumption, whereas Asia-pacific produced 32%. When it comes to natural gas, EU was able to satisfy only 37% of its needs when Asia-pacific could satisfy 87%. A variation in our results and the statistics arises here. The variation is that EU was ranked above Asia-pacific in the *table R2* but it seems to be the other way round when we consider *table O1* and *N1* due to the

reason that EU is unable to satisfy its needs for oil and gas, unlike Asia-pacific, on its own. It looks like the ranking in *table R2* considers regions which are the biggest producers of oil and gas and also those which are self-sufficient to some appreciable extent, as is made evident from the following discussions. We will try to include only the oil and gas statistics for the explanation of the variation as it forms the main energy component of the index as per the ICB industry classification for Dow Jones' oil and gas index:

icb Industry Classification Benchmark		Industry Structure and Definitions		
INDUSTRY	SUPERSECTOR	SECTOR	SUBSECTOR	DEFINITION
0001 OIL & GAS	0500 Oil & Gas	0530 Oil & Gas Producers	0533 Exploration & Production	Companies engaged in the exploration for and drilling, production, refining and supply of oil and gas products.
			0537 Integrated Oil & Gas	Integrated oil and gas companies engaged in the exploration for and drilling, production, refining, distribution and retail sales of oil and gas products.
		0570 Oil Equipment, Services & Distribution	0573 Oil Equipment & Services	Suppliers of equipment and services to oil fields and offshore platforms, such as drilling, exploration, seismic-information services and platform construction.
			0577 Pipelines	Operators of pipelines carrying oil, gas or other forms of fuel. Excludes pipeline operators that derive the majority of their revenues from direct sales to end users, which are classified under Gas Distribution.
			0580 Alternative Energy	0583 Renewable Energy Equipment
0587 Alternative Fuels	Companies that produce alternative fuels such as ethanol, methanol, hydrogen and biofuels that are mainly used to power vehicles, and companies that are involved in the production of vehicle fuel cells and/or the development of alternative fuelling infrastructure.			

Also, oil and gas is a shariah-compliant sector as it is not included in the Dow Jones' shariah screen, as shown below:

Dow Jones' Non-Shariah sectors
.Conventional finance and insurance
.Gambling and gaming
.Alcohol production and sale
.Pork related products
.Tobacco manufacturing and sale
.Entertainment, media and broadcasting (cinemas, music, pornography)
.Hotels
.Weapons and defense
.Real estate holding and development

Hence, we proceed to use the conventional regions' statistics to explain the Islamic regional indexes' behavior to a reliable extent. As per *table 1*, when GCC was shocked, the contribution of shock from EU and Asia-pacific were more or less equal at 2%. When the energy sector was shocked, EU's contribution was more when compared to Asia-pacific. Also, when emerging markets and US were shocked, EU turned out to be the second biggest contributor of forecast variance; this underscores the importance of EU and hence could be a probable reason for EU's rank against Asia-pacific. This could imply that the variation may have been caused due to some other factor and not only due to the leading position of GCC. Let us scrutinize more statistics to find out.

It turned out that the Asia-pacific region and Emerging markets were the major trading partners of GCC as per the 2009 statistic from IMF, in *table II*. China, India and Japan together accounts for 31.6% where as EU accounts for only 16%. Hence, the influence of GCC on EU for such a variation may be minimal when compared to Asia-pacific, as it is not a major trading partner with EU. The trade may also include non-shariah compliant products and hence, this statistic may not be a true indicator.

In order to further scrutinize this variation, we also looked at the trade movements of Oil and gas in at a global scale from the BP 2010 report [*map Om1*]. The oil trade movement shows that the EU sources oil from GCC, Canada, Africa, Russian federation and South Central America. EU sources around 417 million tonnes from Russia, Canada and Africa and only around 106 tonnes from GCC. Asia-pacific sources oil only from GCC, Russia and Africa. Only 27 million tonnes comes from Russian federation and the bulk of it comes from GCC. The reliance on GCC for Oil by the Asia-pacific could be a possible reason for the variation. As observed, EU is well-

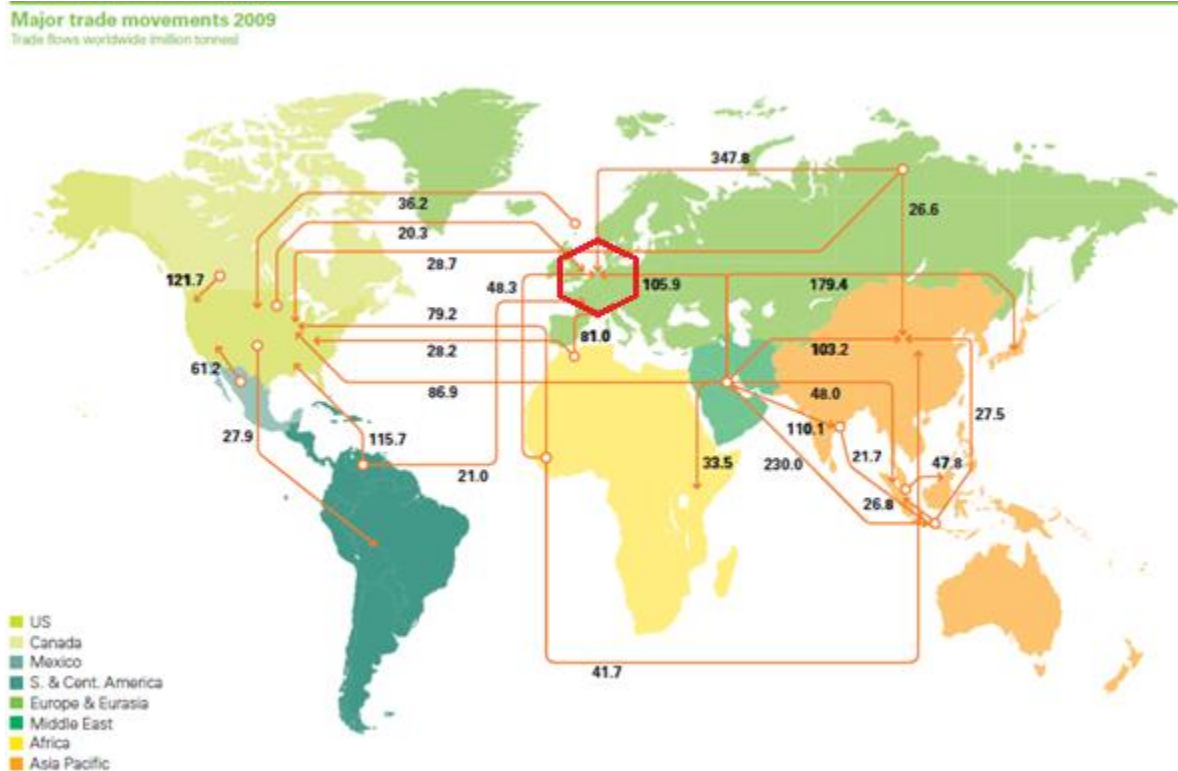
Table II:

GCC'S TRADE WITH MAIN PARTNERS (2009)

The Major Imports Partners				The Major Export Partners				The Major Trade Partners			
Rk	Partners	Mio euro	%	Rk	Partners	Mio euro	%	Rk	Partners	Mio euro	%
World (all countries) 223.535,1 100,0%				World (all countries) 296.856,7 100,0%				World (all countries) 520.391,8 100,0%			
1	EU27	63.064,7	28,2%	1	Japan	52.281,0	17,6%	1	EU27	83.393,8	16,0%
2	China	24.662,0	11,0%	2	South Korea	32.453,0	10,9%	2	Japan	66.170,8	12,7%
3	United States	23.215,2	10,4%	3	India	28.989,1	9,8%	3	India	50.175,1	9,6%
4	India	21.186,0	9,5%	4	China	23.669,6	8,0%	4	China	48.331,5	9,3%
5	Japan	13.889,8	6,2%	5	EU27	20.329,1	6,8%	5	United States	43.245,5	8,3%
6	South Korea	9.247,5	4,1%	6	United States	20.030,4	6,7%	6	South Korea	41.700,6	8,0%
7	United Arab Emirates	5.985,2	2,7%	7	Singapore	13.474,6	4,5%	7	Singapore	17.523,1	3,4%
8	Saudi Arabia	5.380,7	2,4%	8	Thailand	9.678,1	3,3%	8	Thailand	14.001,2	2,7%
9	Thailand	4.323,1	1,9%	9	Iran	6.535,8	2,2%	9	United Arab Emirates	10.511,1	2,0%
10	Turkey	4.256,6	1,9%	10	Pakistan	6.034,7	2,0%	10	Pakistan	7.906,2	1,5%
11	Singapore	4.048,5	1,8%	11	United Arab Emirates	4.525,9	1,5%	11	Iran	7.825,8	1,5%
12	Malaysia	3.840,5	1,7%	12	Oman	3.497,2	1,2%	12	Saudi Arabia	7.603,1	1,5%
13	Switzerland	3.825,8	1,7%	13	Indonesia	3.412,6	1,1%	13	Malaysia	6.298,1	1,2%
14	Brazil	3.507,2	1,6%	14	South Africa	2.961,1	1,0%	14	Oman	6.180,2	1,2%
15	Australia	3.132,3	1,4%	15	Malaysia	2.457,6	0,8%	15	Turkey	5.985,3	1,2%

Source: IMF (DoTS)

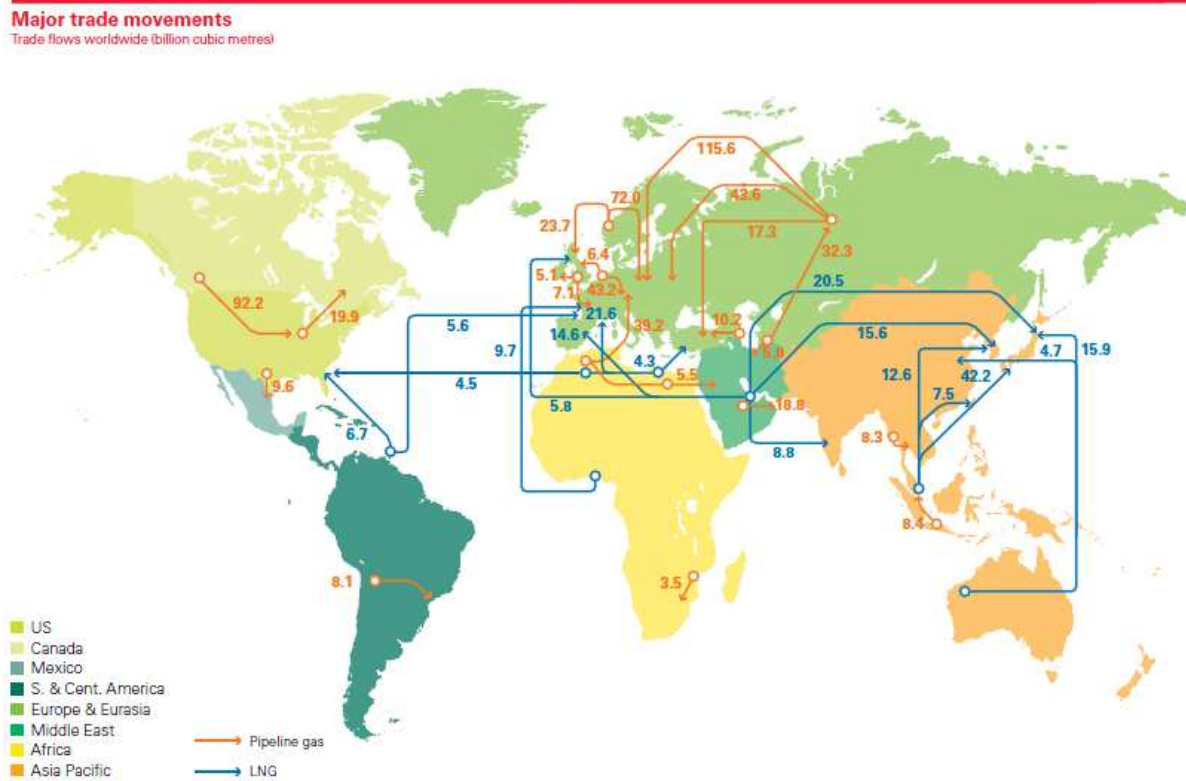
Map Om1:



diversified than Asia-pacific and relies relatively less on GCC for its oil supplies. We also checked the BP's gas trade movement's statistics for 2009 on a global scale. It is evident that, from the gas trade map (*map gm1*), a similar trend could be observed as we observed in the oil trade movements. The Asia-pacific sector seems to source from GCC and also from itself while EU sources less gas from GCC and more from others such as the Russian federation, Africa and south central America. The EU region is highlighted in a *red hexagon* in the map above.

From the above observations, the over reliance of the Asia-pacific region on GCC for its energy needs has made it the most endogenous variable compared to EU, which relies less on GCC as it is well-diversified on its sources. The policy implication, here, is that the Asia-pacific region should try and diversify its energy needs so as to not be lead entirely by one region; the GCC. It is only prudent to spread across the sourcing channels. The Islamic regional indexes should also monitor the trend of the Islamic GCC region, closely, while taking the conventional energy sector into concern.

Map Gm1:

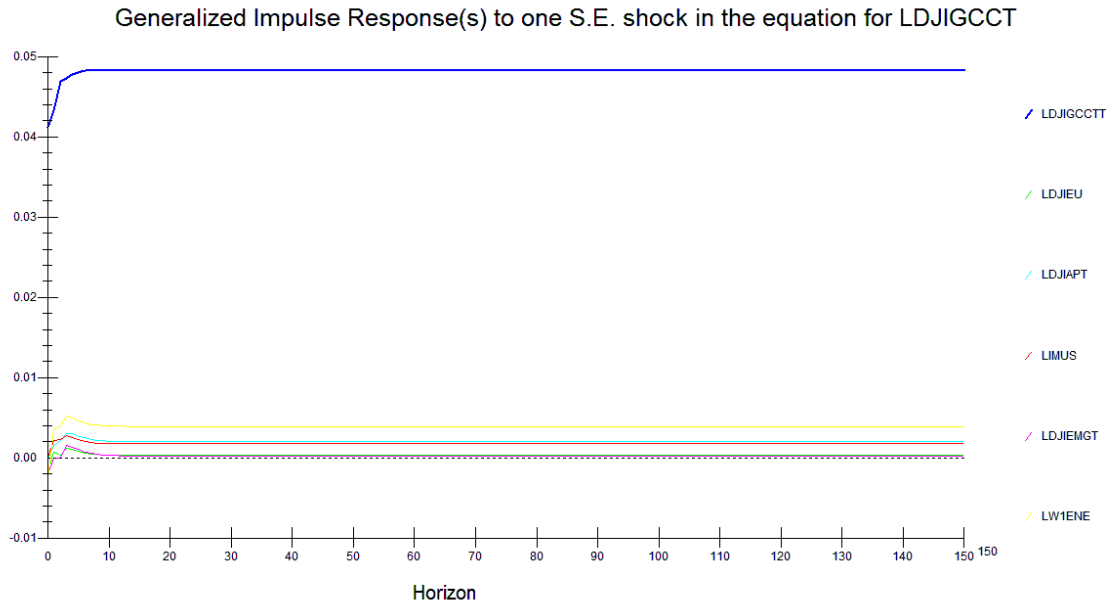


In order to ascertain whether the conventional energy sector had an influence over the Islamic regional indexes of U.S. EU, Asia-pacific and Emerging markets, a subsequent study was conducted by the researcher and it was found that the energy sector turned out to be the most exogenous variable in the VDC result. This shows that the Islamic regional indexes should, ultimately, monitor the Islamic GCC index more closely as it leads the energy sector, itself. Due to the limited scope of this paper, only the VDC results of this offshoot study is produced as shown below:

Rank	Indexes	#
1	LWIENE	29%
2	LDJIEMGT	29%
3	LDJIAPT	26%
4	LDJIEU	25%
5	LIMUS	24%

ECM result showed energy sector, emerging markets and EU as exogenous variables. The above result also may mean that Islamic finance does have a dependence on the oil wealth of the GCC-dominated energy sector to some notable extent as believed by many, globally. *Data will be made available, upon request, for this out-of-scope study.*

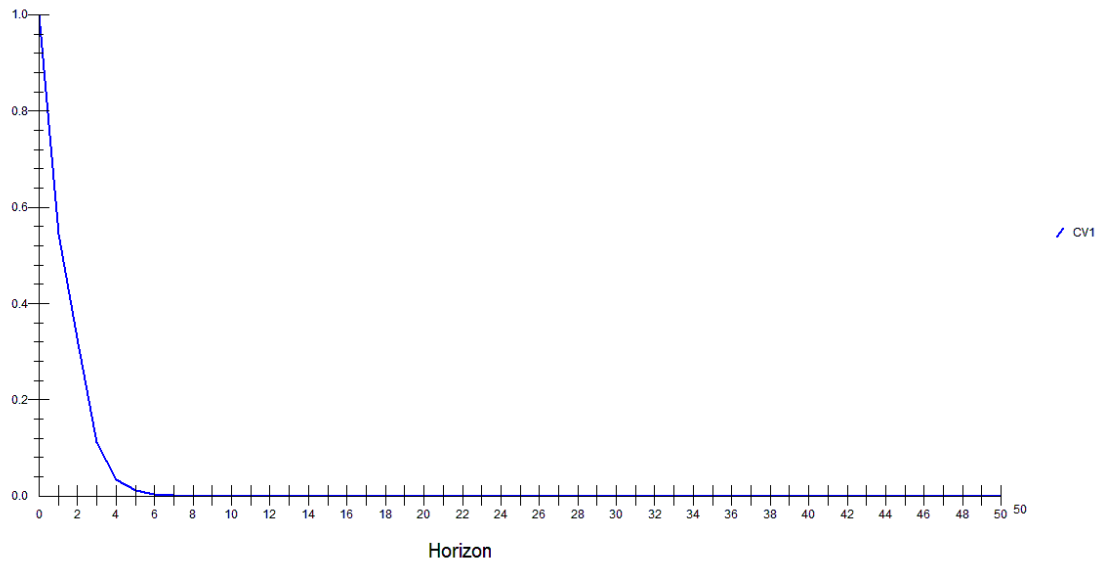
The *impulse response* graph for GCC index is shown below:



As observed, the graph shows that the gap between GCC and the other regions is quite big at .044 from equilibrium indicating its strength.

Persistence profile is shown below:

Persistence Profile of the effect of a system-wide shock to CV'(s)



From the persistence profile, it is evident that it takes approximately 6 weeks for the variables to reach equilibrium condition, when a system wide shock is applied.

Part B: Causality among the energy sector, U.S. and China

The variables for this study are China, US and World. The results of the 8 steps are discussed below:

ADF tests:

The results of the tests reveal that all the concerned variables are non-stationary - I(1) at level form. The variables are found to be stationary - I(0) at their first differences.

Order of VAR:

AIC and SBC statistic shows that the optimum number of lag as *one*; and order of the var is taken to be one for this study as the serial correlations were found to be not significant at 5% significance levels, as shown below.

Variable	Chi-Sq p-value
DChina	[.080]
DUS	[.579]
DWorld	[.122]

Cointegration test:

The cointegration test shows one cointegration at 95% critical level and hence, one cointegration will be assumed for the rest of this study.

Trace statistics

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r >= 1	39.5490	42.3400	39.3400
r <= 1	r >= 2	17.0659	25.7700	23.0800
r <= 2	r = 3	2.5421	12.3900	10.5500

LRSM:

The energy sector is the variable of interest and hence was equalized to 1 in the over-identifying step. Since, U.S. and China play an important role in the energy sector due to its large energy consuming behavior; none of these variables were restricted in the exactly identifying step. The trend was found to be significant in the exactly-identifying step. Below is the cointegrating equation:

$$1.0000*LWORLD \ .95043*LCHINA \ .041592*LUS + \ .4758E3*Trend$$

Error correction model (ECM):

The results of the ECM test are shown below:

Variables	ECM(-1) t-ratio	p-value	Exogenous
China	[.000]		No
US	[.169]		Yes
World	[.317]		Yes

Only China was found to be endogenous from the ECM test. An accurate test could be conducted to analyze the consumption behavior if only we had daily consumption data of U.S and China for 2009 and 2010. But, such data is not available and hence, we conduct our test with the oil and gas indexes of the respective variable, instead.

Variance Decompositions (VDCs)

The generalized VDC results are shown below followed by the ranking table of shocks' contribution from the variables to the respective variable:

VDC	CHINA	US	WORLD
CHINA	23%	33%	44%
US	14%	46%	40%
WORLD	19%	35%	45%

Ranking	China	US	World
China	3	2	1
US	3	1	2
World	3	2	1

An interesting phenomenon is that when China was shocked, most of the contribution came from the World followed by U.S and then itself. For US and World, China's contribution was the least. The final ranking based on the highest contribution of shock by its own, is shown below:

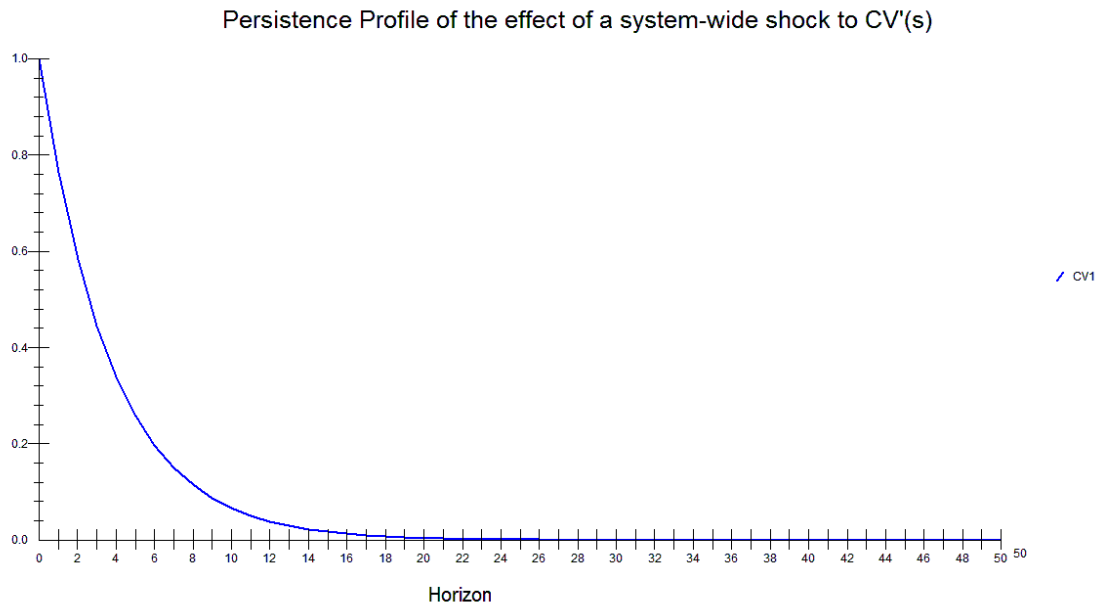
Rank	Indexes	#
1	US	46%
2	WORLD	45%
3	CHINA	23%

Impulse response:

Generalized Impulse response of other variables when we shock the ‘World’ oil and gas index, US and China is shown, respectively, in *appendix C*.

Persistence profile:

From the profile, it is evident that it takes around 21 days for the variables to reach equilibrium state when the whole system is shocked.



Results for the entire part-b including the impulse response graphs are shown in appendix c.

Conclusion and further research:

The Dow Jones Islamic GCC index is the most leading variable from the part- A results of this paper. The over reliance of the Asia-pacific region on GCC for its energy needs has made it the most endogenous variable compared to EU, which relies less on GCC as it is well-diversified on its sources. The policy implication, here, is that the Asia-pacific region should try and diversify its energy needs so as to not be lead entirely by one region; the GCC. It is only prudent to spread across the sourcing channels. The Islamic regional indexes should also monitor the trend of the Islamic GCC region, closely, while taking the conventional energy sector into concern. U.S turned out to be the most leading among the variable in the part-B research. It could be due to the U.S.'s ability to sustain its needs quite well compared to china. U.S. produces 63% of its oil needs and 90% of its gas needs whereas China produces only 47% of its oil needs and 93% of its gas needs as per the BP energy statistics for 2010, as shown below:

Oil	Production -P	Consumption -C	P/C
US	16.5	26.4	63%
China	4.9	10.4	47%
AsiaPac	10	31.1	32%

#% of total in million tonnes

Gas	Production -P	Consumption -C	P/C
US	20	22.2	90%
China	2.8	3	93%

#% of total in million tonnes oil equivalent

China is well-diversified in terms of sourcing oil, similar to U.S. Hence, this factor may not have any influence on the rankings. China's energy consumption is large in absolute terms, energy consumption per capita of about 0.5 tonne oil equivalent (TOE) in 2001 is very small relative to that in the developed economies (e.g., 5.4 TOE in the United States, 3.0 TOE in Germany, and 2.7 TOE in Japan during the same period). This difference implies great growth potential in energy demand in China.

The VDC rankings in this study seem to be based on the ability of the nations to sustain themselves, first, and then how much dependent they are on certain regions for their energy supplies. This is proven by GCC region and the U.S. occupying the top positions in the results. GCC's ranking could be because of its ability to produce more oil and gas than it ever needs. U.S. is able to support itself to some good extent with its own energy reserves.

Further research could be done on the topic by studying the causality between the conventional regions and the energy sector and comparing them with the Islamic regions' analysis. This could tell how differently Islamic regions behave when compared to their conventional counterparts.

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