Systemic Risk of Dual Banking Systems

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July 31, 2016

Abstract

This study compares systemic risk of conventional and Islamic banks using market based measures such as MES, SRISK and ΔCoVaR, and relate them to structural characteristics. We use publicly traded banks, within the GCC region, for the period from 2005 to 2014. Banks are classified into fully-fledged Islamic banks (IB), conventional banks (CB), and conventional banks with an Islamic window (CBw). The empirical findings indicate the presence of a difference between the two banking systems in terms of systemic risk, which can be explained by different levels of capitalization and leverage.

Keywords: Dual banking systems, Islamic banks, Systemic risk measures.

*The authors gratefully acknowledge *the financial support from the PhD program in Economics and management of technology at Pavia University.*

1 Introduction

The late 2007-2008 credit crunch financial crisis has boosted the debate on the role that the Islamic banking system has in supporting financial stability.

This is related to the notice that the Islamic banking system continued through the financial crisis with a growth rate of 20% (IFSB 2014). Although this rate is slower than what this system has registered before, it is still far beyond what the conventional counterpart has achieved.

The Islamic banking system is rapidly diffusing not only through the increasing establishment of fully fledged Islamic banks, but also through the integration of Islamic banking services within conventional banks, through an Islamic banking window. We refer to countries with banking sectors comprised of fully fledged Islamic banks (IB), conventional banks (CB) and conventional banks with Islamic banking window (CBwin) as Dual Banking Systems.

The spread of Islamic banking services can be noticed not only in the middle and far east, but also in non Islamic countries, as in the case of several European ones. This implies that the Islamic banking sector is increasing its systemic importance role. However, to our knowledge, the contribution of Islamic banks to the systemic risk level of a country has not yet been investigated, as current studies on Islamic banking mainly focus on individual risks comparison (see e.g. Abedifar et al. 2013; Baele et al. 2014), In addition, the role of CBwin in stabilizing the financial system as a whole needs further investigation.

The main aim of this paper is to investigate the systemic importance of Islamic banking services and their role in stabilizing financial systems during distress periods. We achieve this aim through the comparison of each banking sector contribution to systemic risk within dual banking systems. The systemic risk contribution of each banking sector is determined using market based measures known as MES and SRISK, in addition to ΔCoVaR.

The comparison is undertaken using data from publicly traded banks (deposit-taking institutions) within the Gulf Cooperation Council (GCC) region for the period from 2005 to 2014.

The results of the analysis are expected to be country specific, in terms of the contribution of the different baking systems to systemic importance.

To address the above issues, the second section of the paper provides a review on Islamic Banking, in relation to Systemic Risk. The third section reviews the employed systemic risk measures and introduce a novel measure, that replaces correlations with partial correlations. The fourth section includes the context and data description. The fifth section ends up with a brief conclusion.

2 Islamic banks

An Islamic bank is a financial institution that is engaged in all banking activities at a zero-interest rate according to Islamic Shariah rules (see e.g. Shafique et al. 2012). There are five pillars upon which Islamic banking is based, the first and most prevailing one is the prohibition of interest payment or receipt within borrowing or lending transactions, which is known as riba, and is defined as a premium paid by a borrower within a lending transaction. The second is the risk sharing feature represented by profit and loss sharing (PLS) accounts in which the risk is shared between the provider of funds (depositor or investor) and the user of funds (borrower or entrepreneur). The third pillar refers to the integration of Islamic banking activities with the real economy, as all transactions are to be backed by real tangible assets. The fourth is the prohibition of excessive uncertainty (gharar) as in short selling transactions, and excessive risk taking (maysar) as in gambling, which means that all Islamic contractual agreements must have clear certainty in their clauses. The fifth and final pillar is the prohibition of financing the production and sales of any business activities that are not ethically accepted (halal).

The governor of the Malaysian central bank (Aziz 2008) stated that Islamic banks are protected from high exposure to excessive leverage and risk taking as a result of being equity based, with a risk sharing feature. However, Betz et al. (2014) found that a strong connection to the real economy increases the exposure of Islamic banks to systemic contagion effects. Thus, the stability of Islamic banks becomes challenged in a novel way.

The effect of systemic contagion on islamic banks could be indirectly inferred through comparative risk analysis with conventional banks.

In particular, Hasan and Dridi (2011) found that Islamic banks contributed to financial system stability during the late crisis, in terms of better credit and asset growth, which allowed them to receive a more favorable risk assessment from external rating agencies. A related study concluded that profit sharing within Islamic banking can reduce market risk but, however, Islamic banks need to develop risk mitigation techniques to be effectively stable in front of future financial crisis (Karim et al. 2012). Baele et al. (2014) indicated that, in the case of Pakistan, loan default rates of conventional banks are almost twice those of Islamic ones. Čihák and Hesse (2010) found that bank size affects risk level as small Islamic banks are financially stronger than small conventional ones, whereas large conventional banks are stronger than Islamic ones. Using the z-score indicator, another paper has shown that Islamic banks are more stable than conventional ones but the difference vanishes for large banks (Abedifar et al. 2013). Finally, Beck et al. (2013) found a lower distance to insolvency for Islamic banks and confirmed the size effect, but highlighted large cross country differences of the considered banks.

Overall, Imam and Kpodar (2013) suggested that Islamic banks can complement, rather than substitute, conventional banks, allowing for the diversification of the banking sector, which may be helpful to the overall financial stability. On the other hand, Bourkhis and Nabi (2013) showed that in general, the two banking models have no substantial difference and that, as Islamic banks have deviated from the original Islamic finance model towards a conventional one, their resilience is at risk during financial crisis exactly as that of conventional banks.

An important gap in the research literature concerns the understanding of the systemic risks carried by Islamic banks, and understanding them for countries that include hybrids of conventional and Islamic banking activities. Our aim is to fill this gap, studying the systemic risk contribution of bank types in different dual banking countries. This is in line with Beck et al. (2013) findings, as we aim to take into account the presence of cross country differences in terms of Islamic banks governance and Islamic products compliance with Shariah, in addition to the different financial and economic development levels of each country.

In addressing our research aim, we take into consideration the two prevailing research viewpoints present in the literature of Islamic banking stability. The first questions the existence of a real difference between Islamic and conventional banking systems (see e.g. Chong and Liu 2009; Khan 2010). The second suggests that the two models are different, and may be complementary once the relative strengths and weaknesses are understood (Sundararajan and Errico 2002; Iqbal and Llewellyn, eds 2002; Solé 2008; Ariffin et al. 2009).

To answer these viewpoints, we will measure the systemic risk for dual banking countries that operate both Islamic and conventional banking systems. If no difference is found between the two systems then the two systems are alike; on the other hand, if differences were found, the two systems will be deemed as different.

3 Methodology

The systemic risk definition itself has no consensus until now. From a policy making point of view, IMF/BIS/FSB (2009) report defined the risk of a systemic event as "the disruption of the flow of financial services that is (i) caused by an impairment of all or parts of the financial system and (ii) has the potential to have serious consequences for the real economy". Another definition refers to it as the "risk that many market participants are simultaneously affected by severe losses, which then spread through the system" (Benoit et al., 2015).

In general, systemic risk definitions include a financial system comprised of a network of connected institutions with business linkages that allow the transfer and magnification of institutional level liquidity, insolvency and loss problems during times of financial crisis (Billio et al., 2012).

Kaufman and Scot (2003) provided a literature review for the definitions of systemic risk. The available concepts can be categorized into three main definition clusters. The first refers to systemic risk as a likelihood of a large unexpected major macroeconomic level shock that has an adverse effect on the business system and the economy as a whole, with funds being mis-allocated rather than directed to the most productive institutions, without specifying the shock process or sequence, and the institutions that will be mostly affected (see e.g. Bartholomew and Whalen 1995; and Mishkin 1995).

The second characterizes systemic risk as the probability of having a cumulative loss event that takes a chain reaction diffusion pattern from one business institution to other participants within a network of institutional system, pointing out the correlation and direct causation that exists within a network of financial institutions and financial markets in identifying systemic risk (see e.g. Bank for International Settlement 1994; Kaufman 1994; Crockett 1997; George 1998; and Board of Governors of the Federal Reserve System 2001).

The third identifies systemic risk as microeconomic level events, and takes into consideration their propagation and diffusion, along with the spillover effect from individual institutions to other business units (see e.g. Kaminsky and Schmukler 1999; Aharony and

Swary 1996; Kaminsky and Reinhart 2000; and Kaufman 1994).

In this paper, we take into consideration the previous definitions (especially the second and the third) and assess the systemic risk impact on the real economy through evaluating and observing the interaction between the banking sectors specific risk level and their interconnectedness within the financial system. From this perspective, we use a variation to the systemic risk measures that allow for a multivariate risk estimate, that takes into account the interconnectedness in determining the risk contribution of the different banking sectors through the partial correlation structure, and we also compare this approach to the standard risk measures under the univariate correlation structure to investigate the difference in the sectorial risk that is spread within the dual banking system.

There are two ways to measure a financial institution contribution to systemic risk, the first uses confidential information on positions and risk exposure provided from the institution to the regulator, while the other uses publicly available data such as stock market returns, total assets returns, option prices and CDS spreads, under the assumption that they reflect all the available information of the publicly traded institutions.

Focusing on bank-level measures based on stock market data, the Systemically Important Financial Institutions $SIFIs$ are defined by the Finanacial Stability Board (2011) as the "financial institutions whose distress or disorderly failure, because of their size, complexity and systemic interconnectedness, would cause significant disruption to the wider financial system and economic activity." For this identification purpose, we use the most common metrics for systemic risk at the banking sector level, which are the Marginal Expected Shortfall (MES), proposed by Acharya et al. (2010), the SRISK measure proposed by Acharya et al. (2012), and Brownlees and Engle (2012), and the Delta Conditional Value-at-Risk ΔCoVaR introduced by Adrian and Brunnermeier (2011). These measures fulfill our aim to quantify each banking sector contribution to the systemic risk of the financial system portfolio, and are an extension of two standard individual risk measures, the Value at Risk (VaR) and the Expected Shortfall (ES), that aim to asses the contribution of the financial institution to the market risk of a portfolio.

Marginal Expected Shortfall: MES

The original MES measure was proposed by Acharya et al. (2010) and was extended by Brownlees and Engle (2012) to a conditional one. MES extends the concept of Expected Shortfall (ES) to account for the marginal contribution of firm i to the financial market portfolio systemic risk, and is considered an extension of the concept of marginal VaR proposed to the ES by Jorion (2007). MES allows to asses the sensitivity of the financial system risk to a unit change in the firm ES, in other words, it is the one day loss expected if market returns are less than a given threshold C (originally $C = -2\%$). However, MES does not account for the idiosyncratic characteristics of the firm such as size and leverage, which means that it does not account for the Too Big to Fail logic (TBTF). As a small firm may be assessed to be more systemically risky than a big one, MES is in favor of Too Interconnected To Fail logic (TIF).

We assume that the financial system aggregate risk is quantified by the conditional ES, which quantifies the expected market loss conditioned on the return being less than

$\alpha\%$ quantile level (VaR_α). In a general case, the loss is defined by the return exceeding the given threshold C. Formally, the conditional ES of the system with respect to the information available at time $t-1$ is defined as:

$$ES_{m,t-1}(C) = -\mathbb{E}_{t-1}(r_{mt}|r_{mt} < C) = \sum_{i=1}^{N} w_{it} - \mathbb{E}_{t-1}(r_{it}|r_{mt} < C)$$

$MES_{it}(C)$ corresponds to the change in the market expected shortfall $ES_{mt}(C)$ as a result of one unit change in a financial institution weight w_{it}. This is denoted by the partial derivative of $ES_{m,t-1}(C)$ with respect to the firm weight w_{it} in the system portfolio (Scaillet, 2004).

$$MES_{it}(C) = \frac{\partial ES_{m,t-1}(C)}{\partial w_{it}} = -\mathbb{E}_{t-1}(r_{it}|r_{mt} < C)$$

This enables to redefine MES in terms of a weighted function of tail expectations for the market standardized residual and tail expectations for the firm standardized idiosyncratic residual:

$$MES_{it}(C) = \sigma_{it}\,\rho_{it}\,\mathbb{E}_{t-1}(\varepsilon_{mt}|\varepsilon_{mt} < \frac{C}{\sigma_{mt}}) + \sigma_{it}\,\sqrt{1-\rho_{it}^2}\,\mathbb{E}_{t-1}(\xi_{it}|\varepsilon_{mt} < \frac{C}{\sigma_{mt}})$$

Note that, the higher the firm MES, the higher is the individual contribution of the firm to the risk of the financial system.

Systemic Risk: SRISK

The second measure that we use is SRISK which was introduced by Brownlees and Engle (2012) and Acharya et al. (2012). SRISK further extends MES in order to take into account idiosyncratic firm characteristics as it accounts for the leverage and size of the financial institution which is can be seen as a compromise between the TITF and the TBTF paradigms. SRISK index measures the expected capital shortage faced by a financial institution during a period of distress for the financial system when the market declines substantially. The measure combines high frequency market data (daily stock prices and market capitalization) and low frequency balance sheet data (leverage) to provide a daily forecast SRISK index, but it assumes that the liabilities of the firm are constant over the period of crisis.

We follow Acharya et al. (2012) in SRISK quantification, but we do not restrict SRISK to zero because negative values of SRISK are meaningful to us as they provide information on the relative contribution of the institution to systemic risk, while the original methodology is mainly interested in estimating capital shortages that by definition cannot take on negative values.

SRISK quantification requires the use of $k = 8\%$ as the minimum fraction of the prudential capital ratio for total assets that each firm needs to hold, D_{it} as the book value of the firm's debt or total liabilities, w_{it} as the market value of the firm equity , from which leverage is defined as $L_{it} = (D_{it}+W_{it})/W_{it}$. The average of the future expected loss of the system due to a crisis over the next six month is defined as the long-run marginal expected shortfall ($LRMES$) which is approximated using daily MES as $LRMES \simeq 1 - exp(-18 \times MES_{it})$, and the given threshold C is set to -40%. We start by defining SRISK as:

$$\begin{aligned} SRISK_{it} &= max\Big((Required\ Capital_{it} - Available\ Capital_{it})|\ Crisis_{it}\Big) \\ &= max\Big((k(Debt_{it} + Equity_{it}) - Equity_{it})|C_{it}\Big) \\ &= max\Big(\underbrace{k(D_{it} + (1 - LRMES_{it})W_{it})}_{Required\ Capital} - \underbrace{(1 - LRMES_{it})W_{it}}_{Available\ Capital}\Big) \\ &= max\big(\big[kL_{it} - 1 + (1-k)LRMES_{it}\big]W_{it}\big) \end{aligned}$$

From the previous expression, note that higher leverage and market capitalization will increase SRISK. The firms with the largest SRISK, and hence capital shortfall, are assumed to be the greatest contributors to risk especially during crisis periods, and are the institutions considered as most systemically risky.

Delta Conditional Value at Risk: ΔCoVaR

The third systemic risk measure that we use is ΔCoVaR which was introduced by Adrian and Brunnermeier (2011). The term Co in CoVaR stands for Conditional, Co-movement or Contribution as suggested by its developers. The term VaR stands for Value at Risk which is the maximum loss within the given $\alpha\%$-confidence interval (Kupiec 2002; Jorion 2007), in other words, α is the probability level of the conditional probability distribution. However, the use of VaR includes limitations as it is not considered a coherent risk measure, it ignores the measurement of the 1% worst case loss, it fails to detect portfolio concentration risk, and does not differentiate between the diverse outcomes in the q-tail (Artzner et al. 1999). The VaRα measure for the return of an individual firm i in isolation from the financial system is defined as:

$$\Pr\Big(r_{it} \leq VaR_{it}^{\alpha}\Big) = \alpha$$

CoVaR is an upgrade to VaR that allows to override the idiosyncratic risk and determine risk spillovers between financial institutions. CoVaR is used to specify the VaR of the market portfolio return conditional on a tail event $C(r_{it})$ observed for firm i as it becomes under financial distress and its stock return deteriorates to become at its bottom 5% probability level. The CoVaR measure is defined as:

$$\Pr\Big(r_{mt} \leq CoVaR_{it}^{m|\mathbb{C}(r_{it})}|\mathbb{C}(r_{it})\Big) = \alpha$$

The ΔCoVaR of a firm i reflects its contribution to systemic risk by assessing the difference between the VaR of the financial system conditional on firm i being under financial distress and the VaR of the system conditional on firm i being in its median state. Adrian and Brunnermeier (2011) use the quantile regression method in which they consider the financial distress $C(r_{it})$ or firm i loss to be equal to its VaR. They define the $\Delta CoVaR_{it}(\alpha)$ as:

$$\Delta CoVaR_{it}(\alpha) = CoVaR_t^{m|r_{it}=VaR_{it}(\alpha)} - CoVaR_t^{m|r_{it}=Median(r_{it})}$$

Dynamic Conditional Correlations

It is well known that market returns are dependent, and that volatility increases during crisis times, leading to a heteroskedasticity problem. To take this into account, we follow Brownlees and Engle (2012) and use a bivariate GARCH model for the demeaned returns process, in addition to Engle (2012) as we consider the capital asset pricing model (CAPM) with time-varying conditional *betas* defined in the following:

$$r_t = H_t^{1/2} \epsilon_t$$

where $r_t = (r_{mt}\ r_{it})'$ represents the vector of market and firm returns. $\epsilon_t = (\varepsilon_{mt}\ \xi_{it})'$ represents a vector of *i.i.d.* standardized innovations that are assumed to be unknown with no assumptions regarding the bivariate distributions. ϵ_t has a mean $\mathbb{E}(\epsilon_t) = 0$ and an identity covariance matrix of $\mathbb{E}(\epsilon_t \epsilon_t') = I_2$. The time varying conditional variance-covariance matrix H_t is defined as:

$$H_t = \begin{pmatrix} \sigma_{mt}^2 & \sigma_{mt}\, \sigma_{it}\, \rho_{it} \\ \sigma_{mt}\, \sigma_{it}\, \rho_{it} & \sigma_{it}^2 \end{pmatrix}$$

where σ_{mt} and σ_{it} represent the conditional standard deviation for the system and the firm respectively. ρ_{it} represents the time varying conditional correlation which is assumed to capture the complete linear dependency between the returns of the firm and the market, implying that the standardized innovations ε_{mt} and ξ_{it} are independently distributed at time t. The non-linear dependencies in the calculation of MES are captured by the conditional expectations $\mathbb{E}_{t-1}(\xi_{it}|\varepsilon_{mt} < C/\sigma_{mt})$. We use the dynamic conditional correlation model of Engle (2002), Engle and Sheppard (2001) to obtain ρ_{it} for each market firm pair, in addition to the standardized innovations ϵ_t.

In the application section, we use three approaches in the estimation of MES, SRISK and ΔCoVaR. We first use the standard method with the stock market return index for each dual banking system (country) against each banking sector included in that system: we refer to this as the return index approach. Second, we repeat the process using partial correlations instead of correlations, as in the work of Giudici and Spelta (2016). The estimated partial correlations are used to replace the standard correlations in the dynamic conditional correlation estimation for MES, SRISK and ΔCoVaR. The advantage of doing so is to use a multivariate estimate that takes the effect of interconnectedness into consideration, based on the true direct correlation between two sectors, rather than on correlation that contains also indirect (spurios) effects: we refer to this as the partial correlation approach. Third, we repeat the first standard method but with crude oil return index (WTI), instead of the market index, which we refer to as the oil index approach.

The Partial Correlation Extraction

Following a multivariate normal distribution, the relation between regression and partial correlation is based on the close connection between the inverse of the covariance matrix $K = \Sigma^{-1}$ (also known as the concentration matrix) and the multiple linear regression coefficients. Formally, K is defined as:

$$K_{nn} = \Sigma^{-1} = \begin{pmatrix} k_{11} & k_{12} & \dots & k_{1n} \\ \vdots & \vdots & \ddots & \vdots \\ k_{n1} & k_{n2} & \dots & k_{nn} \end{pmatrix}$$

Considering that all subsets of a multivariate normal random vector are themselves normally distributed, we denote $a \subset \Gamma$ and $b = \Gamma / a$. This defines a partitioning on the set y, on its mean μ, the variance covariance matrix Σ and the concentration matrix K:

$$y = \begin{pmatrix} y_a \\ y_b \end{pmatrix}, \quad \mu = \begin{pmatrix} \mu_a \\ \mu_b \end{pmatrix}, \quad \Sigma = \begin{pmatrix} \Sigma_{aa} & \Sigma_{ab} \\ \Sigma_{bb} & \Sigma_{ba} \end{pmatrix}, \quad K = \begin{pmatrix} K_{aa} & K_{ab} \\ K_{bb} & K_{ba} \end{pmatrix}$$

where $y_a | y_b \sim \mathcal{N}(\mu_{a|b}, \Sigma_{a|b})$ and thus:

$$\mu_{a|b} = \mu_a + \Sigma_{ab}\Sigma_{bb}^{-1}(y_b - \mu_a), \quad \Sigma_{a|b} = \Sigma_{aa} + \Sigma_{ab}\Sigma_{bb}^{-1}\Sigma_{ab}$$

The inverse of the partitioned matrices denotes that the quantities can be rewritten in terms of K as:

$$\Sigma_{ab}\Sigma_{bb}^{-1} = -K_{aa}^{-1}K_{ab}\ , \quad and \quad \Sigma_{aa} - \Sigma_{ab}\Sigma_{bb}^{-1}\Sigma_{ab} = -K_{aa}^{-1}$$

Then, we denote a multiple regression of a dependent variable y_1 on $y_2, ..., y_n$ independent variables as:

$$y_1 = a_1 + \beta_{13}y_2 + ... + \beta_{1n}y_n + \epsilon_1 \quad where \quad \epsilon_1 \sim \mathcal{N}(0, \sigma_1^2)$$

with a residual volatility $\sigma_1^2 = 1/k_{11}$ and regression coefficients $\beta_{12}, ..., \beta_{1n}$ as:

$$(\beta_{12}, ..., \beta_{1n}) = -(k_{12}, ..., k_{1n})/k_{11}$$

and the resulting conditional covariance matrix for(y_1, y_2) given $y_3, ..., y_n$ is:

$$\begin{pmatrix} k_{11} & k_{12} \\ k_{21} & k_{22} \end{pmatrix}^{-1} = \frac{1}{k_{11}k_{22} - k_{12}^2} \begin{pmatrix} k_{22} & -k_{12} \\ -k_{21} & k_{11} \end{pmatrix}$$

It can also be shown that the partial correlation coefficient ρ_{ijV} is equal to the correlation of the residuals from the regression of X_i on all other variables (excluding X_j) with the residuals from the regression of X_j on all other variables (excluding X_i)as in the following:

$$\rho_{ijV} = (\ \varepsilon_{X_i|X_{V\setminus\{j\}}}, \varepsilon_{X_j|X_{V\setminus\{i\}}})$$

In other words, the partial correlation coefficient measures the additional contribution of variable X_j to the variability of X_i not already explained by the others, and vice versa. The resulting partial correlation is used to replace the correlation for the MES, SRISK and ΔCoVaR estimation.

4 Application

4.1 Data Description

In this subsection we focus on data extraction. To construct our sample, we start from all GCC banking financial institutions present in Bureau Van Djik's Bankscope and we gather quarterly data on liabilities, equity and total assets from the beginning of 2005: this provides us with 130 institutions. We exclude those that are not publicly traded, as our measures of systemic risk are based on equity returns: this reduces the number of institutions to 83. We also exclude the ones that have disappeared before the end of our sample period in December 2014, leading to 79 publicly traded deposit-taking institutions, from six GCC countries, that are Bahrain (BH) with 13 institutions, Kuwait (KW) with 15, Qatar (QA) with 9, United Arab Emirates (AE) with 23, Saudi Arabia (SA) with 12 and finally Oman (OM), with 11 institutions.

For the 79 chosen institutions, we extract daily stock market closing prices and corresponding market capitalization from Thomson Reuters Data-stream, for a total of 2608 observations, in the study time line from January 2005 to December 2014.

We construct stock market return time series under the stationary assumption that the mean $\mu = 0$. To achieve stationarity, we transform daily stock market closing price into returns that are expressed, as usually, in time variation. Formally, if V_t and V_{t-1} are the closing stock prices at times t and $t-1$, the return is the variation represented by $r_{it} = (V_t - V_{t-1})/V_{t-1}$, where $V_{t-1} \neq 0$, and is prepared using log return (continuously compounded returns).

Then, for each country, we classify institutions into sectors, according to their bank type, and construct aggregate sectorial returns. Let $(i = 1, \ldots, n_s)$ indicate a list of banks N_s in the sector S of a country. We define aggregate sectorial returns r_{st} as the value-weighted average:

$$r_{st} = \sum_{i=1}^{n_s} w_{it} r_{it},$$

in which $w_{it} = mv_{it}/\sum_{i=1}^{n_s} mv_{it}$ represents the weight of the i-th bank in the specified banking sector s at time t, given by its market capitalization mv_{it} relative to the sector aggregate capitalization $\sum_{i=1}^{n_s} mv_{it}$.

The aggregation of banking returns for the six gulf countries, based on the banking sectors classification, results in 16 sectoral return series, in which each of AE, BH, KW, and OM has the three banking sectors which are CB, IB and CBwin, while QA and SA have only two banking sectors which are IB and CBwin. Table 1 provides the descriptive statistics for the resulting 16 banking sectors along with each country return index. The descriptive statistics cover three successive time periods, the pre-crisis period of 2005-2006, the crisis period of 2007-2008 and the post-crisis period of 2009-2014.

Table 1 about here.

From Table 1 note that mean returns approach zero, as expected. The standard deviations indicate that, during the pre-crisis period, the most volatile countries are AE,KW, SA. During crisis times, their volatility increases, along with that of QA, with the exception of AE who decreases the volatility. Post crisis, instead, countries have a comparable volatility, smaller than during crisis times. Across most countries, the CBwin sector is the most volatile. Last, the skewness generally indicates that negative daily returns occur more often than positive ones.

To further compare the three banking sectors at the aggregate country and the GCC systemic risk level, we follow the concept of the CES measure provided by Banulescu and Dumitrescu (2015) which represents a weighted MES by market capitalization for each financial institution. In our context, institutions are replaced by sectors so that a country global measure is a weighted average of the MES of the sectors of that country j. We refer to this as the global marginal expected shortfall $GMES_{jt}$ as follows:

$$GMES_{jt} = \sum_{s=1}^{n_j} w_{st} MES_{st}, \tag{1}$$

in which $w_{st} = mv_{st} / \sum_{s=1}^{n_j} mv_{st}$ represents the weight of the banking sector s at time t, given by its market capitalization mv_{st} relative to the aggregate banking capitalization of that sector $\sum_{i=1}^{n_s} mv_{jt}$. Formulas similar to equation 1 can be constructed also for SRISK and ΔCoVaR.

The same construction can be used to aggregate country GMES into a GCC global marginal expected shortfall.

The list of countries and bank types (Banking Sectors), along with the corresponding percentage of assets are described in Table 2 on a yearly basis.

Table 2 about here.

From table 2, we note that the countries with the largest total banking assets (including listed and unlisted banks) is AE, followed by SA, QA, KW, BH and OM, in a descending order. Indeed AE increased its size through time, more than the others. All other large countries increase, even during the crisis period, and decrease 2011, with the exception of BH, that had a decrease during crisis, followed by an increase. Note also that the CB-Win sector is the largest one overall and also in the banking sector of each of the GCC countries. Furthermore, the CB sector is larger than the IB sector in both OM and AE and IB is larger than the CB sector in SA, QA, KW and BH.

4.2 Empirical findings

Systemic Risk Measures Results

In this section, we identify the highest systemic risk sectors as those whose systemic risk measures have the highest ranks. The MES and SRISK measures provide the effect of a change in the market risk level on the banking sector risk, while ΔCoVaR reflects the banking sector contribution to the market systemic risk. To ease the interpretation of the results, all measures have been converted from the return to the loss scale (negative returns). Before comparing sectors in terms of systemic risk, we compare them in terms of market capitalization (MV) and quasi leverage (LVG) defined as the book value of debt over the market capitalization plus one. Table 3 and Table 4 contain the results of such comparisons.

Table 3 about here.
Table 4 about here.

From Table 3 we can draw similar conclusions as from Table 2: the countries with the largest market capitalizations are SA, AE, QA and KW, followed by OM and BH. Indeed AE has a relatively large amount of unlisted banks, which explain the difference in its ranking between the two tables. The CB-Win sector is the largest one also in capitalization, overall and also in the banking sector of each of the GCC countries, with the exception of the IB sector of SA which ranks very high too.

Table 4 shows that, consistently through time, the banking sectors of smaller countries (such as BH and OM) are the most leveraged, followed by AE, KW and SA. Sector wise, the CBWin and the CB sectors are more leveraged than the IB sector.

Table 5 provides MES systemic risk measure per banking sector using the return index approach, Table 6 provides the measures obtained using the partial correlation approach, and Table 7 presents the risk measure using the oil index approach. Figure 1 summarizes the findings, representing the MES measure per banking sector for the three approaches.

Figure 1 about here.
Table 5 about here.
Table 6 about here.
Table 7 about here.

From Figure 1 note that, for all three approaches, the CBwin sector is the one that generally dominates the top MES ranks in the crisis period.

Table 5 contains specific results for the MES-Return Index. In the pre-crisis period, the IB sector of large market capitalization countries dominates the higher ranks. In the crisis-period, the CBwin sector achieves higher ranks, however no longer dominated by large market capitalization sectors, but rather by high leverage, whether large or small. The post-crisis period continues with a dominance for the CBwin sector.

Table 6 contains the MES Partial Correlation results. In the pre-crisis period, the IB sector of large market capitalization countries dominates the higher ranks as in the return index approach. In the crisis period, the top ranks are dominated not only by the CBwin sector but also by the IB sector, in addition, the dependence on leverage is confirmed only for small sectors. The post-crisis period top ranks dominance continues as in the crisis period.

Finally, for the MES-oil index, we find that the rank dominance of the pre-crisis period is similar to that of the return-index approach. Furthermore, the CBwin sector dominates the crisis period especially for the sectors with high leverage. In the post-crisis period, differently from the previous approaches, the IB sector of KW and SA, that largely dependent on oil, considerably move upwards.

We now move to the findings obtained with the SRISK measure, presented in Figure 2. Note that, for the ease of graphical representation, we reconverted the SRISK sign in this Figure, which means that the banking sectors that are closer to the horizontal axes are the ones with the lowest capital buffer and higher SRISK systemic rank. The Figure corresponds to Table 8 in which we use the stock market index, Table 9, with the partial correlation approach, and Table 10 for the crude oil index.

Table 8 about here.
Table 9 about here.
Table 10 about here.
Figure 2 about here.

Looking at Figure 2, along with each of the three SRISK tables, we note that the results of the three approaches are consistent between each other with minor changes in the magnitude of the measure between them. In general, the CB sector is the one that dominates lower buffer ranks for the pre-crisis and crisis periods, while the IB sector dominates the lower buffer ranks for the post-crisis period. More generally, top ranks are dominated by high leverage and low market capitalization banking sectors.

Concerning ΔCoVaR, Table 11 provides the measure based on return index, Table 12 those based on partial correlation, and Table 13 those for the measure based on crude oil index. Figure 3 graphically summarizes ΔCoVaR measure per banking sector for the three approaches.

Table 11 about here.
Table 12 about here.
Table 13 about here.
Figure 3 about here.

From Figure 3 for the three approaches, along with each of the three corresponding ΔCoVaR tables, we find that the previously vulnerable sectors based on SRISK measure are not necessarily the main contributors to market systemic risk. In general, ΔCoVaR measure top rankings between the three approaches are based on the banking sector size in terms of market capitalization rather than leverage, similarly to the MES measure.

Specifically, the ΔCoVaR based on return index presented in Table 11, reflects that all periods are dominated by large market capitalization banking sectors, with the top rank occupied by the CBwin sector. The crisis period reflects an increase in the ranks of the CBwin sector at the expense of the IB one. The post-crisis period shows further movement in this direction for the CBwin sector.

Table 12 shows ΔCoVaR based on Partial-Correlation. All periods ranks are dominated in the same way as in the previous approach. The pre-crisis period top ranks are dominated by the IB sector followed by CBwin. The crisis and post-crisis periods reflect the same interplay in rankings as for the previous approach.

Finally, Table 13 provides ΔCoVaR based on Oil-Index. The Table is consistent with the previous approaches. The three periods reflect the same interplay in rankings between CBwin and IB sectors.

Overall, the results on ΔCoVaR with each of the three approaches are consistent with those obtained with the MES measure, but are different from those obtained from the SRISK measure (which is strongly dominated by leverage).

Given the strong similarity between MES and ΔCoVaR findings, and the strong dependence of SRISK on leverage, in the rest of the paper we focus on the MES measure providing its Global version (GMES)that we defined before.

Country Level Global MES Systemic Risk Measure

We apply the Global MES (GMES) for each of the six countries to determine the banking sector that drives the systemic risk level within the specified country banking system using the three approaches. Figure 4 describes the GMES analysis for AE. Figure 5 for BH, Figure 6 for KW, Figure 7 for OM, Figure 8 for QA and Figure 9 for SA. In Table 14 we report, for the return-index, the correlation among the six countries GMES and the sixteen banking sectors MES for each of the three considered periods.

Figure 4 about here.
Figure 5 about here.
Figure 6 about here.
Figure 7 about here.
Figure 8 about here.
Figure 9 about here.

From Figure 4 top we note that the global systemic risk level for AE is driven by the CBwin sector under all three approaches. Indeed the MES of the CBwin sector has a higher market capitalization weight than the IB sector, and both have higher weights than the CB one.

The partial-correlation approach in Figure 4 middle should provide a more correct representation of GMES as it correctly takes spurious correlations into account. Indeed it reflects a diversification benefit on the GMES of AE due to the presence of the IB sector that lowers the effect of the CBwin one.

The oil-index approach in Figure 4 bottom, results are similar to the return-index one. This is expected as the only difference between the standard return index approach and the oil approach is the replacement of the market index with the oil index without considering partial correlations.

Concerning the time evolution of systemic risk, all three graphs in the Figure show a high risk synchronized with the crisis period of 2008, with an even higher risk level for 2009 when the risk of IB sector becomes aligned with the CBwin and CB ones.

The figures 6, 7 and 8 of KW, OM and QA follow the same behavior of AE in Figure 4 with the CBwin sector being the main driver of the country GMES and a diversification benefit reflected by the partial-correlation graph.

As for BH and SA figures 5 and 9, they reflect a difference from the other countries in the driver of their GMES, which is the IB sector instead of the CBwin. However, the other findings remain the same as in the other countries.

For completeness, Table 14 reports, for each country, the correlations of the GMES with its MES component.

Table 14 about here.

The correlations in Table 14 indicate that GMES is driven by the CBwin sector, for most countries. As expected, correlations are higher during crisis times. In addition, Table 14 detects high correlation of the CB sector in AE, KW and OM, regardless of their limited capitalization size.

Gulf Region Level and Global MES Systemic Risk Measure

To further compare the three banking sectors at the GCC systemic level, we first present MES, SRISK and ΔCoVaR risk measures on a periodic basis for the three approaches. In this respect Figure 10 reports the Gulf region average measures using the return-index approach, the partial correlation approach and the oil index approach.

Figure 10 about here.

From Figure 10 the standard return index in the top part of figure 10 shows that the GCC risk is dominated by the CBwin sector for all periods and measures with the only exception being for the IB sector of the MES measure in the pre-crisis period.

The partial-correlation approach in the middle part of figure 10 shows that the GCC risk is also dominated by the CBwin sector for all periods and measures with the exception in this case being for the IB sector of both MES and ΔCoVaR measures in the pre-crisis period.

The Oil-index approach in the bottom part of figure 10 shows that the GCC overall risk is driven by the CBwin sector for the three systemic risk measures and through all periods.

We now consider the Global MES measure at the GCC overall risk level. Figure 11 reports the changes through the years for the three approaches.

Figure 11 about here.

The return index from Figure 11 top part, we note that the region was under a local crisis during 2005, and was affected by the global credit crunch crisis during 2008, with the crisis effect being increased in 2009 as the IB and CBwinn banking sector risks became aligned. In addition, the partial correlation graph from Figure 11 middle part shows the presence of a diversification effect as for the individual countries GMES. Furthermore, the CBwin sector has a larger effect on the GCC systemic risk level as measured by the GMES, and it indicates the higher volatility of the CB sector through 2008 and 2009. The oil index approach provides similarities with the return index graph but with the three sectors being aligned during the 2008 crisis, and the CBwin and IB sector having higher GMES during

2009.

Table 15 about here.

Table 15 reports the correlation between the GMES of the GCC and the GMES of the region banking sectors.

Table 15 confirms that the driver of the overall risk in the region is the CBwin sector for all periods. In addition, the correlation between the three sectors increases in the crisis period, with the change in the correlation for the CB sector being the highest between all sectors, followed by the CBwin and by the IB sector.

5 Conclusions

The aim of this research was twofold. From the methodological side, to compare different measures of systemic risk, and different ways to take into account correlations among them. From the applied side, to determine if there are differences between the Islamic and the conventional banking sectors in terms of systemic risk especially in the presence of a financial crisis.

Methodologically, the systemic risk summary measures with the stock market return index and the one with crude oil index have similarities in their outcomes, for which MES and ΔCoVaR are mainly affected by market capitalization (the top ranks, namely the most systemic sectors; are dominated by the CBwin sector), while the SRISK measure is more related to leverage and capital buffering (top ranks are dominated by the CB sector). Our proposed measure based on partial correlations, exhibits a mixed effect of size and leverage for MES (the top ranks are dominated by the IB and CBwin sectors), a leverage effect for SRISK (the top ranks are dominated by the CB sector), and a size effect for ΔCoVaR (the top ranks are dominated by the CBwin sector).

From the applied viewpoint, we obtained several findings. First, the Islamic banking system may contribute to reducing the crisis effect at its beginning as long as it is well capitalized with a low leverage level, but it has a lower mitigation ability when the financial crisis spills over the real economy, in this context, it is noticed that it contributes to the systemic risk level.

Second, most individual countries and also the GCC overall systemic risk level are driven by the CBwin sector, especially during the crisis period. In addition, they are driven also by both the CBwin and IB sectors by 2009 as the crisis materialize within the real economy.

Third, the CBwin sector systemic risk level is close in magnitude to the IB one, and both are higher in magnitude than the CB sector, as the later has lower market capitalization than the previous two. This difference is emphasized by the SRISK measure that indicated higher risk with lower capital buffers for the CB sector.

However, at the aggregate country and gulf region levels, and knowing that the GMES estimation is weighted by the market capitalization of the specified sector, the lower scale of the CB sector compared to the other sectors affects this sector's weight, which may have shielded the risk of the CB sector at the individual countries and Gulf region level, especially considering that the CB sector average size is only 2.29% from the total gulf market capitalization, the CBwin sector average is 64.16% and the IB sector average is 33.54% through the study time line.

Nevertheless, given the low percentage of the CB sector within the system, the volatility of its MES is high compared to the MES volatility for the CBwin and IB sectors, that have higher market capitalization shares. In addition, the partial correlation approach reflects a diversification effect on the GMES measure as the CB sector volatility is reduced by the presence of CBwin and IB sectors.

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Appendix

Table 1: Descriptive Statistics of Banking Sectors' Returns and Return Indexes

Descriptive Statistics	AE_CB	AE_CBW	AE_IB	AE_ind	BH_CB	BH_CBW	BH_IB	BH_ind	KW_CB	KW_CBW	KW_IB	KW_ind	OM_CB	OM_CBW	OM_IB	OM_ind	QA_CBW	QA_IB	QA_ind	SA_CBW	SA_IB	SA_ind
pre-crisis																						
Mean	-0.000761	0.000336	0.001358	-0.000266	0.000005	0.000608	0.000251	-0.000371	0.001356	0.002900	0.000695	0.000502	-0.000384	0.000613	-0.000152	0.000992	0.000648	0.000798	0.000021	0.000195	-0.000899	-0.000060
Standard Error	0.000885	0.000608	0.000988	0.000907	0.000024	0.000424	0.000409	0.000439	0.000861	0.001120	0.000455	0.000599	0.000398	0.001338	0.000004	0.000405	0.000860	0.000824	0.000855	0.000878	0.001649	0.001079
Median	-0.000852	0.000078	0.000041	0.000721	0.000000	-0.000012	-0.000211	-0.000372	0.000153	0.000101	0.000088	0.000000	-0.000354	0.000459	-0.000111	0.000013	-0.000007	0.000328	0.000162	0.000303	0.000208	0.001965
Standard Deviation	0.020189	0.013860	0.022532	0.020681	0.000556	0.009679	0.009321	0.010010	0.019624	0.025535	0.010381	0.013656	0.009083	0.030512	0.000088	0.009234	0.019605	0.018786	0.019496	0.020017	0.037604	0.024614
Sample Variance	0.000408	0.000192	0.000508	0.000428	0.000000	0.000094	0.000087	0.000100	0.000385	0.000652	0.000108	0.000186	0.000083	0.000931	0.000000	0.000085	0.000384	0.000353	0.000380	0.000401	0.001414	0.000606
Kurtosis	3.431112	3.012193	4.832876	6.184525	24.402998	5.921662	5.238156	41.491437	4.811799	2.199176	2.141857	34.172358	5.759257	229.807199	0.322363	4.898307	0.912220	2.018732	50.484871	6.195480	42.536205	6.710309
Skewness	0.016086	0.079276	0.345742	-0.819090	-0.447504	0.630736	0.652609	3.686992	0.523186	0.622843	0.383903	-2.679695	-0.219876	0.951993	-1.516953	0.387589	0.221282	-0.088115	3.714204	-0.319478	-2.471780	-0.370477
Range	0.189871	0.123996	0.238585	0.200577	0.008185	0.093326	0.091408	0.165458	0.189557	0.200629	0.081229	0.226661	0.084103	0.953275	0.000233	0.095877	0.144637	0.169379	0.327444	0.209929	0.733535	0.280811
Minimum	-0.098498	-0.051784	-0.107685	-0.117106	-0.004752	-0.043355	-0.037965	-0.050472	-0.105198	-0.087940	-0.031798	-0.147698	-0.042703	-0.465841	-0.000336	-0.047693	-0.061119	-0.089084	-0.080631	-0.104576	-0.431120	-0.116816
Maximum	0.091373	0.072212	0.130900	0.083471	0.003433	0.049971	0.053443	0.114986	0.084359	0.112688	0.049431	0.078963	0.041401	0.487434	-0.000103	0.048184	0.083518	0.080294	0.246813	0.105353	0.302415	0.163995
Sum	-0.395731	0.174708	0.706158	-0.138381	0.002761	0.316018	0.130628	-0.192835	0.705320	1.507755	0.361267	0.261018	-0.199860	0.318855	-0.079263	0.515984	0.337203	0.415146	0.011118	0.101525	-0.467455	-0.031356
Count	520	520	520	520	520	520	520	520	520	520	520	520	520	520	520	520	520	520	520	520	520	520
crisis																						
Mean	0.000153	-0.000104	-0.001197	-0.001863	0.000026	-0.000354	-0.000206	-0.001066	0.000443	-0.000165	-0.000251	-0.000572	0.000293	-0.000097	-0.000165	-0.000049	0.000231	-0.000103	0.000244	-0.000900	-0.000683	-0.000960
Standard Error	0.000793	0.000469	0.000823	0.000994	0.000030	0.000526	0.000557	0.000637	0.000842	0.001168	0.000711	0.000708	0.000795	0.000819	0.000004	0.000735	0.000893	0.001136	0.000884	0.000918	0.000997	0.000921
Median	-0.000441	0.000064	-0.000257	0	0	-0.000008	-0.000029	0	0.000153	-0.000600	0.000292	0	0.000556	0.000558	-0.000123	0.000052	0.000204	-0.000044	0	-0.001293	-0.000230	0
Standard Deviation	0.018128	0.010734	0.018817	0.022742	0.000683	0.012035	0.012738	0.014558	0.019255	0.026717	0.016255	0.016186	0.018192	0.018734	0.000098	0.016814	0.020416	0.025976	0.020209	0.020988	0.022799	0.021070
Sample Variance	0.000329	0.000115	0.000354	0.000517	0.000000	0.000145	0.000162	0.000212	0.000371	0.000714	0.000264	0.000262	0.000331	0.000351	0.000000	0.000283	0.000417	0.000675	0.000408	0.000440	0.000520	0.000444
Kurtosis	2.092056	4.505593	5.021708	13.024972	39.525181	5.301721	9.947232	18.317770	6.121009	3.300288	3.439159	11.718398	7.028730	7.189173	0.283387	8.646507	4.626983	16.201375	11.379276	4.356256	3.781772	5.471144
Skewness	0.051066	0.332795	0.080445	-1.768289	2.543561	-0.149178	0.903795	-2.331535	0.276064	0.082497	-0.316598	-1.659572	-1.014392	-0.706872	-1.457930	-1.033939	-0.277277	0.290673	-1.199154	-0.305627	0.057443	-0.733572
Range	0.155133	0.104069	0.175019	0.282419	0.011046	0.122664	0.156312	0.187708	0.183246	0.227759	0.127534	0.181530	0.183360	0.193139	0.000311	0.167370	0.189962	0.387524	0.223531	0.182776	0.198114	0.194158
Minimum	-0.071398	-0.040173	-0.087776	-0.172614	-0.004710	-0.059701	-0.055614	-0.116017	-0.094483	-0.105445	-0.064683	-0.115716	-0.108007	-0.105763	-0.000405	-0.086974	-0.097503	-0.182584	-0.131729	-0.098010	-0.102652	-0.103285
Maximum	0.083735	0.063896	0.087242	0.109805	0.006336	0.062963	0.100698	0.071691	0.088763	0.122313	0.062851	0.065814	0.075353	0.087375	-0.000094	0.080396	0.092459	0.204940	0.091803	0.084767	0.095463	0.090874
Sum	0.080063	-0.054559	-0.626144	-0.974232	0.013519	-0.184964	-0.107868	-0.557580	0.231514	-0.086467	-0.131253	-0.299370	0.153236	-0.050927	-0.086391	-0.025608	0.120732	-0.054010	0.127763	-0.470771	-0.357287	-0.501829
Count	523	523	523	523	523	523	523	523	523	523	523	523	523	523	523	523	523	523	523	523	523	523
post-crisis																						
Mean	0.000376	0.000794	0.000887	0.000716	0.000038	0.000347	-0.000253	-0.000824	-0.000169	0.000201	0.000017	0.000124	0.000193	0.000384	-0.000311	0.000098	0.000741	0.000630	0.000531	0.000395	0.000312	0.000352
Standard Error	0.000400	0.000269	0.000311	0.000450	0.000028	0.000256	0.000439	0.000331	0.000412	0.000773	0.000347	0.000316	0.000285	0.000313	0.000218	0.000226	0.000358	0.000341	0.000312	0.000276	0.000312	0.000288
Median	-0.000148	0.000834	0.000651	0	0	0.000006	-0.000026	0	0.000074	-0.000092	-0.000110	0	-0.000030	0.000091	-0.000122	0.000138	0.000210	0.000421	0	-0.000064	0.000109	0.000417
Standard Deviation	0.015838	0.010639	0.012286	0.017804	0.001101	0.010114	0.017351	0.013086	0.016302	0.030578	0.013744	0.012488	0.011255	0.012387	0.008621	0.008943	0.014155	0.013489	0.012332	0.010928	0.012349	0.011413
Sample Variance	0.000251	0.000113	0.000151	0.000317	0.000001	0.000102	0.000301	0.000171	0.000266	0.000935	0.000189	0.000156	0.000127	0.000153	0.000074	0.000080	0.000200	0.000182	0.000152	0.000119	0.000153	0.000130
Kurtosis	6.442986	9.706968	11.086858	13.057831	30.628074	26.411695	116.639846	69.582013	5.604807	5.355592	6.379446	14.393201	5.883658	10.744628	42.640721	14.544636	7.820836	10.787712	15.096224	9.677342	8.363208	12.852093
Skewness	0.166423	0.107321	0.259598	0.345838	0.438010	-1.859483	0.739494	-3.937014	-0.157018	-0.359341	-0.121721	-0.561881	0.207905	-0.260191	-0.096234	-0.634544	0.102879	0.621550	0.173265	0.523570	0.248860	-0.394763
Range	0.194394	0.159161	0.180779	0.292902	0.018158	0.182500	0.581136	0.312707	0.178722	0.396463	0.150344	0.197174	0.135191	0.182701	0.220058	0.124358	0.165889	0.181812	0.198129	0.151263	0.166743	0.165847
Minimum	-0.079534	-0.070065	-0.073950	-0.106630	-0.009589	-0.137068	-0.277067	-0.234346	-0.097629	-0.253855	-0.071970	-0.105174	-0.069066	-0.092950	-0.114710	-0.064982	-0.082316	-0.090841	-0.085544	-0.070698	-0.075201	-0.075468
Maximum	0.114860	0.089096	0.106829	0.186272	0.008569	0.045432	0.304069	0.078362	0.081093	0.142608	0.078374	0.092000	0.066125	0.089751	0.105349	0.059376	0.083573	0.090970	0.112585	0.080565	0.091542	0.090379
Sum	0.588057	1.243264	1.388912	1.120088	0.059228	0.542409	-0.395837	-1.290296	-0.264502	0.314395	0.026727	0.194520	0.301721	0.600389	-0.487004	0.153540	1.160062	0.985978	0.831360	0.618356	0.488150	0.551021
Count	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565	1565

Table 2: Assets Distribution of the GCC Banking Sectors Per Country

Country	Bank Type	Ownership	Count	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
OM	CB	Public	5	0.1218	0.1298	0.1382	0.1468	0.0986	0.117	0.1167	0.1127	0.1486	0.1689
		Private	2	0.0137	0.0146	0.0141	0.0139	0.0139	0.0143	0.0132	0.0137	0.0162	0.0219
	CB.win	Public	5	0.6285	0.6063	0.5927	0.5833	0.6106	0.5722	0.5797	0.6146	0.6131	0.5551
		Private	2	0.2261	0.2403	0.2465	0.2561	0.277	0.2965	0.2903	0.2591	0.2221	0.2541
	IB	Public	1	0.0068	0.0061	0.0051	0	0	0	0	0	0	0
		Private	1	0.0032	0.0031	0.0035	0	0	0	0	0	0	0
	Banking Sector	Total Public	11	0.757	0.7421	0.736	0.7301	0.7092	0.6892	0.6965	0.7272	0.7617	0.724
		Total Private	5	0.243	0.2579	0.264	0.2699	0.2908	0.3108	0.3035	0.2728	0.2383	0.276
		Total Assets	16	97,271,221	84,158,952	75,535,737	69,027,144	58,695,117	51,749,367	48,445,794	45,005,903	31,288,219	22,990,976
BH	CB	Public	2	0.0069	0.0065	0.0064	0.0085	0.0074	0.0084	0.0077	0.0065	0.0035	0.007
		Private	6	0.1521	0.1592	0.1551	0.1621	0.1623	0.1803	0.2397	0.2722	0.2882	0.3178
	CB.win	Public	4	0.4448	0.444	0.4613	0.5296	0.4972	0.5202	0.5034	0.5402	0.5484	0.5206
		Private	2	0.0641	0.0752	0.0492	0.0069	0.0285	0.0025	0	0	0	0
	IB	Public	7	0.2468	0.229	0.2308	0.1918	0.1895	0.1886	0.1642	0.129	0.1239	0.1264
		Private	18	0.0852	0.0861	0.0972	0.1011	0.1151	0.1001	0.085	0.052	0.0359	0.0282
	Banking Sector	Total Public	13	0.6985	0.6795	0.6984	0.7299	0.6941	0.7172	0.6754	0.6758	0.6759	0.6541
		Total Private	26	0.3015	0.3205	0.3016	0.2701	0.3059	0.2828	0.3246	0.3242	0.3241	0.3459
		Total Assets	39	178,491,905	169,144,233	151,157,555	126,739,419	134,850,310	117,718,680	125,617,066	122,948,061	95,114,734	75,734,958
KW	CB	Public	1	0.0496	0.0506	0.052	0.064	0.062	0.0678	0.0709	0.0752	0.0907	0
		Private	0	0	0	0	0	0	0	0	0	0	0
	CB.win	Public	5	0.6044	0.6005	0.5881	0.6012	0.59	0.6315	0.6402	0.6603	0.6286	0.6977
		Private	0	0	0	0	0	0	0	0	0	0	0
	IB	Public	10	0.3451	0.3477	0.3588	0.3341	0.3473	0.2997	0.2876	0.2637	0.2807	0.3023
		Private	2	0.001	0.0012	0.0011	0.0008	0.0007	0.001	0.0013	0.0008	0	0
	Banking Sector	Total Public	16	0.999	0.9988	0.9989	0.9992	0.9993	0.999	0.9987	0.9992	1	1
		Total Private	2	0.001	0.0012	0.0011	0.0008	0.0007	0.001	0.0013	0.0008	0	0
		Total Assets	18	241,159,890	223,893,976	203,261,985	164,345,351	178,280,457	152,446,532	155,141,579	144,222,669	92,453,820	62,648,797
QA	CB	Public	0	0	0	0	0	0	0	0	0	0	0
		Private	2	0.0658	0.0667	0.0737	0.0629	0.0707	0.0589	0.0631	0.0435	0.0433	0.0432
	CB.win	Public	5	0.7239	0.7396	0.7139	0.7269	0.7172	0.7483	0.7951	0.8292	0.8606	0.8682
		Private	0	0	0	0	0	0	0	0	0	0	0
	IB	Public	4	0.2314	0.1905	0.1749	0.1121	0.1465	0.0856	0.0539	0.0337	0.0159	0.0102
		Private	1	0.0044	0.0033	0.0028	0.0044	0.0037	0.005	0	0	0	0
	Banking Sector	Total Public	9	0.9553	1.93	2.8887	3.839	4.8638	5.8339	6.8489	7.863	8.8765	9.8785
		Total Private	3	0.0702	1.07	2.0765	3.0672	4.0744	5.064	6.0631	7.0435	8.0433	9.0432
		Total Assets	12	288,484,210	256,675,999	214,122,728	139,776,935	180,516,442	116,976,862	97,501,681	68,046,844	42,543,931	29,633,161
SA	CB	Public	0	0	0	0	0	0	0	0	0	0	0
		Private	2	0.0196	0.0227	0.0165	0.0162	0.0165	0.0161	0.0153	0.0166	0.0158	0.0161
	CB.win	Public	8	0.7186	0.7183	0.7252	0.7656	0.7422	0.7788	0.7863	0.7979	0.794	0.7929
		Private	0	0	0	0	0	0	0	0	0	0	0
	IB	Public	4	0.225	0.22	0.2219	0.1827	0.2038	0.1688	0.1659	0.1489	0.1508	0.1499
		Private	1	0.0369	0.0389	0.0364	0.0356	0.0375	0.0363	0.0325	0.0366	0.0395	0.041
	Banking Sector	Total Public	12	0.9435	0.9383	0.9471	0.9482	0.946	0.9476	0.9522	0.9468	0.9448	0.9428
		Total Private	3	0.0565	0.0617	0.0529	0.0518	0.054	0.0524	0.0478	0.0532	0.0552	0.0572
		Total Assets	15	593,099,888	532,298,841	482,946,123	387,811,914	424,198,169	371,958,084	357,547,286	292,467,531	234,117,698	206,981,802
AE	CB	Public	4	0.1455	0.1383	0.1106	0.0741	0.0898	0.0682	0.0677	0.0714	0.0908	0.1311
		Private	6	0.0204	0.0207	0.0163	0.0091	0.0099	0.0085	0.011	0.0102	0.0115	0.015
	CB.win	Public	12	0.672	0.6614	0.6947	0.7308	0.7296	0.7479	0.7487	0.7621	0.7125	0.6718
		Private	0	0	0	0	0	0	0	0	0	0	0
	IB	Public	7	0.1492	0.1497	0.1506	0.1563	0.1422	0.1503	0.1507	0.1562	0.1852	0.1821
		Private	2	0.0128	0.0299	0.0278	0.0297	0.0285	0.025	0.0219	0	0	0
	Banking Sector	Total Public	23	0.9667	0.9495	0.9559	0.9612	0.9616	0.9664	0.9671	0.9898	0.9885	0.985
		Total Private	8	0.0333	0.0505	0.0441	0.0388	0.0384	0.0336	0.0329	0.0102	0.0115	0.015
		Total Assets	31	615,693,005	564,234,726	491,067,182	402,841,683	431,002,091	373,209,553	340,012,385	277,965,633	177,095,192	113,200,679

Table 3: Market Capitalization

	pre-crisis	*crisis*	*post-crisis*
AE_CB	1738686	1911293	1734313
AE_CBW	55208423	50925119	49805786
AE_IB	15555298	11407684	9753137
BH_CB	224252	267469	226714
BH_CBW	6644680	8683116	7467486
BH_IB	5772538	5153380	2695177
KW_CB	2366259	3815578	2800840
KW_CBW	12139935	15956478	10062579
KW_IB	19533126	22659197	18364591
OM_CB	1207104	1397523	1524171
OM_CBW	4155795	6745862	6397893
OM_IB	397405	397404	383108
QA_CBW	21529509	22041625	38137765
QA_IB	12844002	10772994	13351518
SA_CBW	96851843	73975213	59673371
SA_IB	68496296	45031798	37807771

Table 4: Quasi Leverage

	pre-crisis	*crisis*	*post-crisis*
AE_CB	2.31	3.21	5.17
AE_CBW	2.87	5.41	7.36
AE_IB	2.65	6.23	8.14
BH_CB	2.62	2.35	2.42
BH_CBW	6.58	7.90	9.18
BH_IB	3.47	4.86	11.95
KW_CB	4.17	3.60	4.44
KW_CBW	3.52	3.98	5.58
KW_IB	2.18	2.94	4.56
OM_CB	3.53	3.88	5.17
OM_CBW	3.22	4.01	5.55
OM_IB	1.01	1.01	1.06
QA_CBW	2.24	3.45	4.11
QA_IB	1.59	2.03	3.27
SA_CBW	2.64	4.44	6.06
SA_IB	1.43	1.95	3.01

Table 5: MES-Return Index

	pre-crisis	*crisis*	*post-crisis*
AE_CB	0.898	0.925	0.774
AE_CBw	1.368	1.309	1.328
AE_IB	2.601	2.162	1.424
BH_CB	0.004	0.004	0.006
BH_CBw	0.219	0.263	0.220
BH_IB	0.837	1.122	1.130
KW_CB	0.461	0.449	0.419
KW_CBw	1.526	3.010	3.420
KW_IB	0.837	1.122	1.130
OM_CB	0.885	2.065	1.407
OM_CBw	0.383	2.274	2.277
OM_IB	0.008	0.006	0.149
QA_CBw	1.536	1.979	1.495
QA_IB	1.700	2.150	1.377
SA_CBw	1.854	3.107	1.612
SA_IB	3.219	3.723	2.549

Table 6: MES-Partial Correlation

	pre-crisis	*crisis*	*post-crisis*
AE_CB	0.081	0.133	0.116
AE_CBw	0.192	0.165	0.170
AE_IB	0.076	-0.012	0.102
BH_CB	-0.184	-0.166	-0.182
BH_CBw	0.091	0.111	0.093
BH_IB	-0.011	0.420	0.333
KW_CB	-0.177	-0.129	-0.137
KW_CBw	0.140	0.190	0.355
KW_IB	0.081	0.103	0.103
OM_CB	0.190	0.270	0.212
OM_CBw	-0.046	0.678	0.730
OM_IB	0.013	0.004	-0.009
QA_CBw	-0.054	0.118	0.136
QA_IB	0.203	0.015	0.227
SA_CBw	0.024	0.195	0.135
SA_IB	0.865	0.748	0.436

Table 7: MES-Oil Index

	pre-crisis	*crisis*	*post-crisis*
AE_CB	0.206	0.195	0.170
AE_CBw	0.268	0.257	0.316
AE_IB	0.651	0.525	0.346
BH_CB	-0.001	-0.001	-0.001
BH_CBw	0.071	0.083	0.071
BH_IB	0.219	0.231	0.240
KW_CB	0.134	0.130	0.121
KW_CBw	0.580	0.565	0.663
KW_IB	0.288	0.377	0.337
OM_CB	0.091	0.189	0.124
OM_CBw	0.232	0.248	0.220
OM_IB	-0.008	-0.006	-0.056
QA_CBw	0.369	0.349	0.248
QA_IB	0.383	0.488	0.250
SA_CBw	0.288	0.532	0.317
SA_IB	0.275	0.192	0.564

Figure 1: Countries Comparison of MES

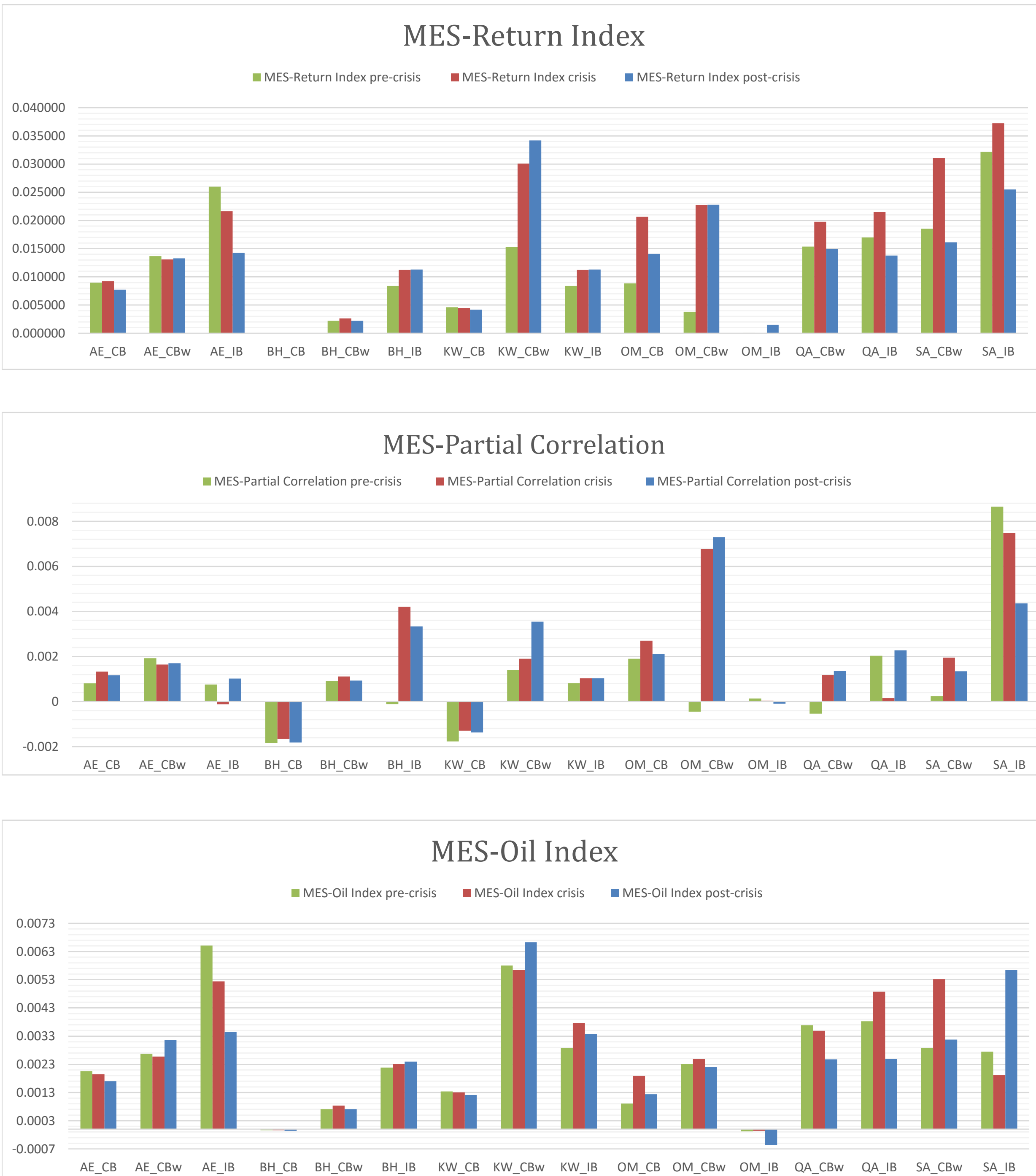


Table 8: SRISK-Return Index

	pre-crisis	*crisis*	*post-crisis*
AE_CB	-1182264	-1154628	-822752
AE_CBw	-32061502	-21857706	-13009710
AE_IB	-7161829	-3864856	-1759827
BH_CB	-177803	-217408	-183160
BH_CBw	-2895363	-3047329	-1852825
BH_IB	-3425861	-2376908	209111
KW_CB	-1407381	-2499602	-1651925
KW_CBw	-6102061	-5440674	-1564671
KW_IB	-3425861	-2376908	209111
OM_CB	-717726	-632432	-590781
OM_CBw	-2970937	-3006192	-1611437
OM_IB	-364865	-364963	-343187
QA_CBw	-13355596	-10481205	-18109431
QA_IB	-8246349	-6181937	-7253894
SA_CBw	-58101930	-26728430	-18715270
SA_IB	-40935488	-19768305	-16197828

Table 9: SRISK-Partial Correlation

	pre-crisis	*crisis*	*post-crisis*
AE_CB	-1395242	-1378757	-998080
AE_CBw	-41109483	-29740662	-21182159
AE_IB	-12126528	-6891319	-3619224
BH_CB	-184981	-225195	-190215
BH_CBw	-3031552	-3257886	-2002202
BH_IB	-4183122	-2920585	-93438
KW_CB	-1659053	-2854090	-1904645
KW_CBw	-8459675	-10501937	-5045384
KW_IB	-15860229	-17315503	-11364365
OM_CB	-831122	-919684	-834147
OM_CBw	-11825437	-4134223	-2839847
OM_IB	-364509	-365131	-351694
QA_CBw	-18102985	-15637098	-24641180
QA_IB	-10795230	-9022004	-9246876
SA_CBw	-76996210	-49393736	-30517307
SA_IB	-51974588	-33504901	-26114495

Table 10: SRISK-Oil Index

	pre-crisis	crisis	post-crisis
AE_CB	-1359500	-1359618	-982394
AE_CBw	-40381008	-29151314	-20206275
AE_IB	-10735163	-6032126	-3237214
BH_CB	-177986	-217638	-183430
BH_CBw	-3053992	-3298737	-2028379
BH_IB	-3962863	-3027573	-142795
KW_CB	-8467785	-10641076	-5416677
KW_CBw	-1365381	-2441896	-1551511
KW_IB	-15215612	-16420691	-10722131
OM_CB	-850295	-938832	-855628
OM_CBw	-2934529	-4583674	-3325390
OM_IB	-365894	-365770	-354353
QA_CBw	-16500317	-14833170	-24216696
QA_IB	-10455230	-8287985	-9275252
SA_CBw	-72564308	-45813337	-28837021
SA_IB	-57420471	-37675220	-25417642

Figure 2: Countries Comparison of SRISK

Table 11: ΔCoVaR-Return Index

	pre-crisis	*crisis*	*post-crisis*
AE_CB	0.395	0.499	0.359
AE_CBw	1.354	1.704	1.460
AE_IB	1.382	1.458	1.206
BH_CB	0.005	0.007	0.006
BH_CBw	0.136	0.171	0.160
BH_IB	0.257	0.478	0.415
KW_CB	0.243	0.259	0.229
KW_CBw	0.464	1.106	0.950
KW_IB	0.257	0.478	0.415
OM_CB	0.500	1.195	0.735
OM_CBw	0.171	0.897	0.576
OM_IB	0.057	0.063	0.036
QA_CBw	0.958	1.331	1.104
QA_IB	1.024	1.159	1.013
SA_CBw	1.643	2.146	1.132
SA_IB	1.536	2.007	1.045

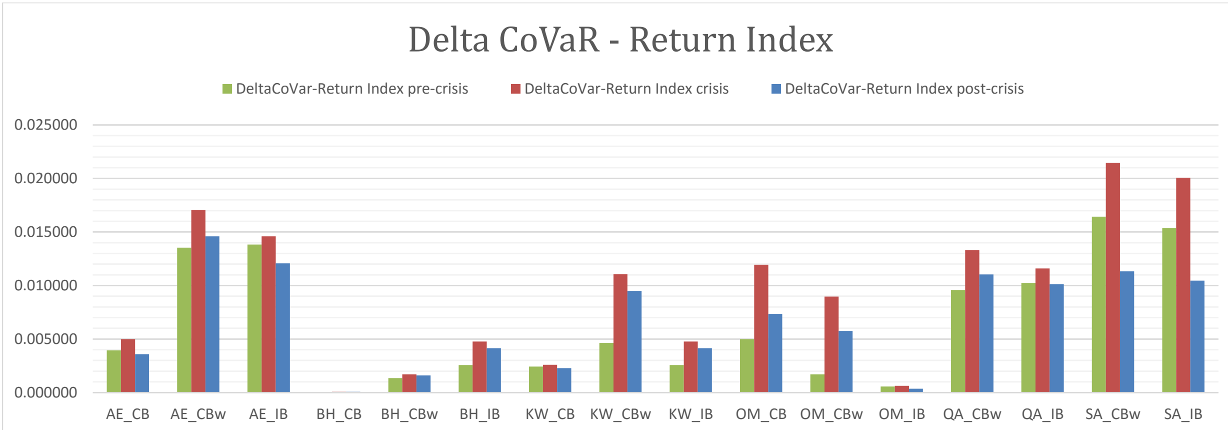
Table 12: ΔCoVaR-Partial Correlation

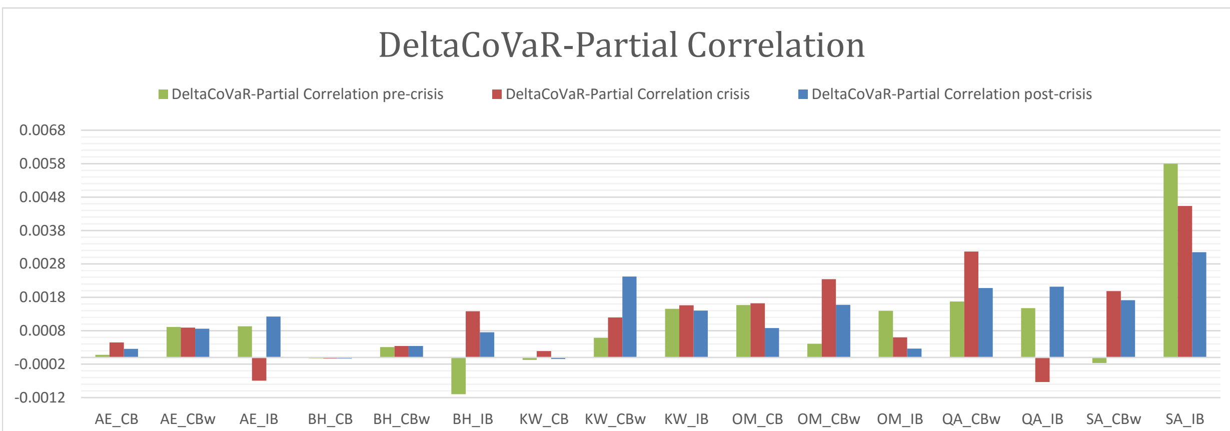
	pre-crisis	*crisis*	*post-crisis*
AE_CB	0.004	0.045	0.025
AE_CBw	0.091	0.089	0.086
AE_IB	0.093	-0.070	0.122
BH_CB	-0.003	-0.003	-0.003
BH_CBw	0.031	0.034	0.034
BH_IB	-0.110	0.138	0.075
KW_CB	-0.007	0.019	-0.004
KW_CBw	0.059	0.120	0.242
KW_IB	0.145	0.156	0.140
OM_CB	0.157	0.162	0.088
OM_CBw	0.041	0.234	0.158
OM_IB	0.140	0.060	0.027
QA_CBw	0.168	0.317	0.208
QA_IB	0.147	-0.073	0.211
SA_CBw	-0.017	0.198	0.171
SA_IB	0.580	0.453	0.315

Table 13: ΔCoVaR-Oil Index

	pre-crisis	*crisis*	*post-crisis*
AE_CB	0.150	0.191	0.190
AE_CBw	0.192	0.389	0.571
AE_IB	0.280	0.361	0.357
BH_CB	-0.014	-0.018	-0.018
BH_CBw	-0.057	-0.076	-0.071
BH_IB	0.125	0.159	0.158
KW_CB	0.143	0.182	0.181
KW_CBw	0.288	0.358	0.373
KW_IB	0.280	0.357	0.355
OM_CB	0.154	0.207	0.206
OM_CBw	0.270	0.344	0.342
OM_IB	0.049	0.063	0.057
QA_CBw	0.357	0.454	0.447
QA_IB	0.286	0.375	0.365
SA_CBw	0.164	0.485	0.549
SA_IB	0.062	0.078	0.677

Figure 3: Countries Comparison of ΔCoVaR





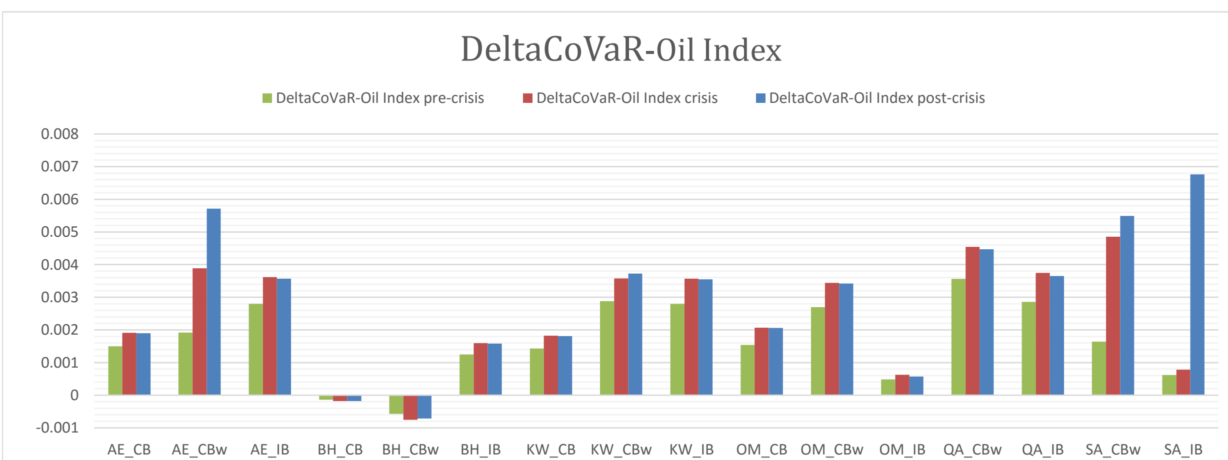
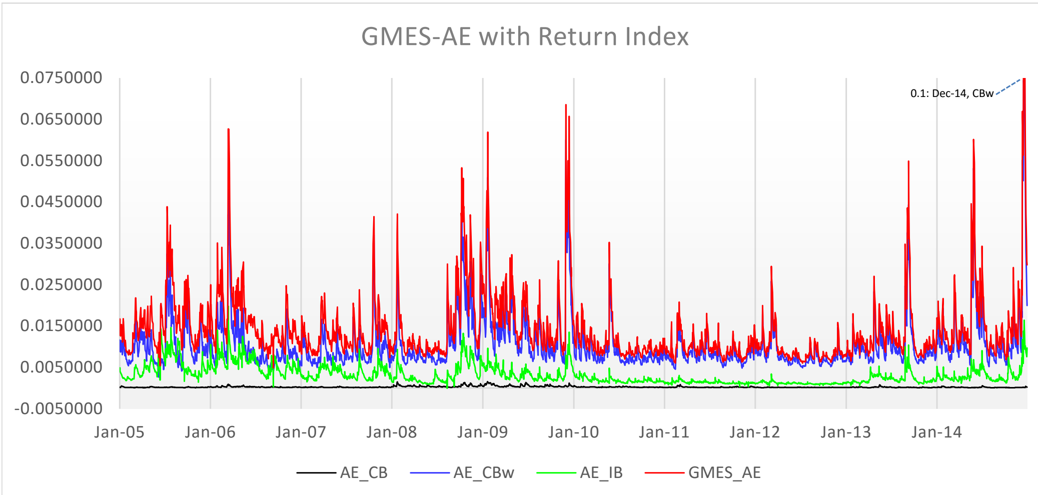
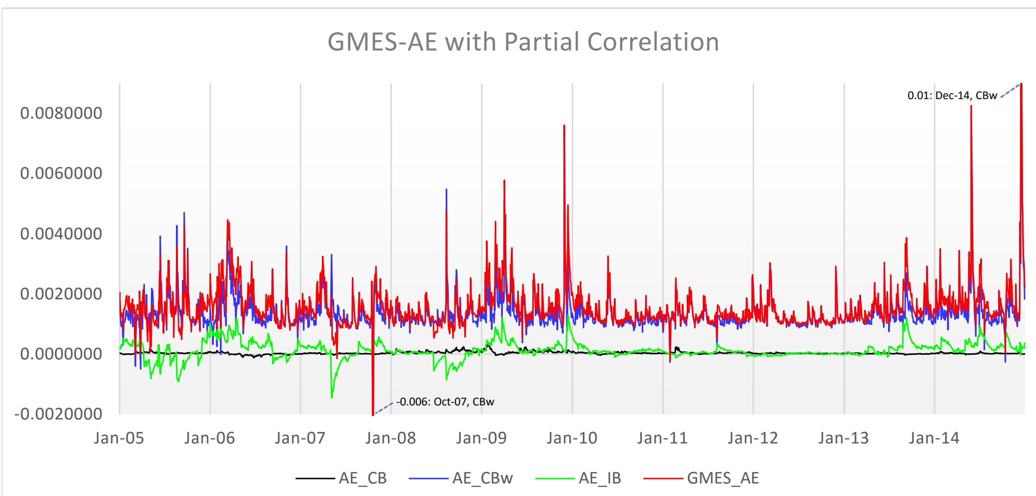


Figure 4: Country GMES for AE





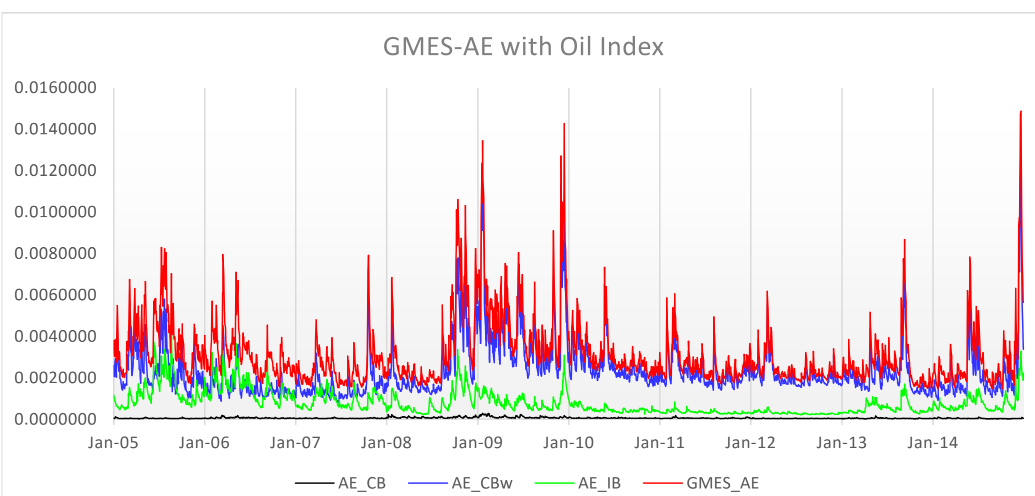
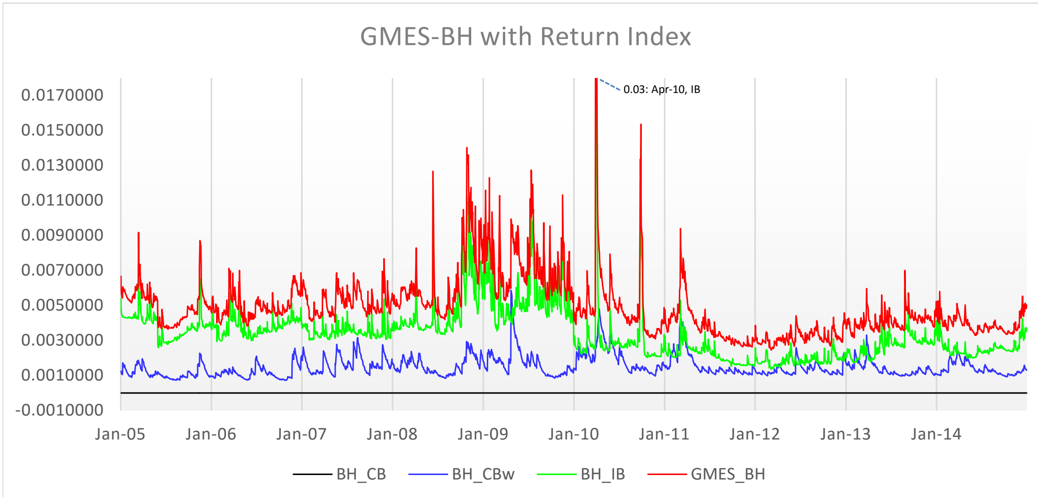
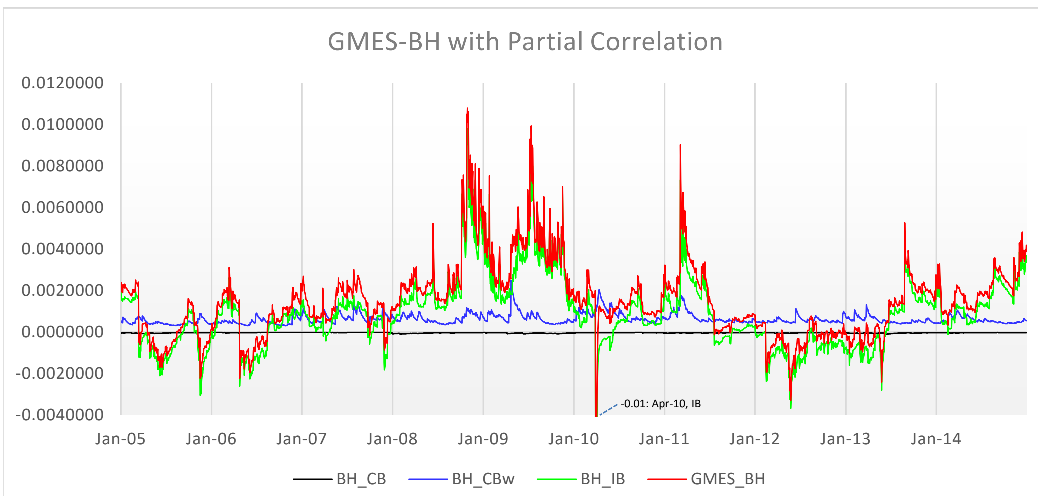


Figure 5: Country GMES for BH





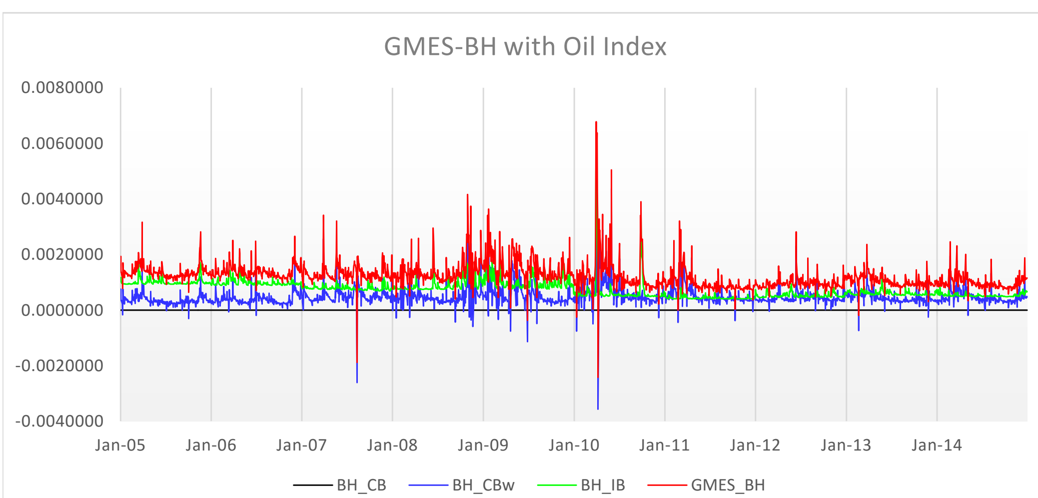
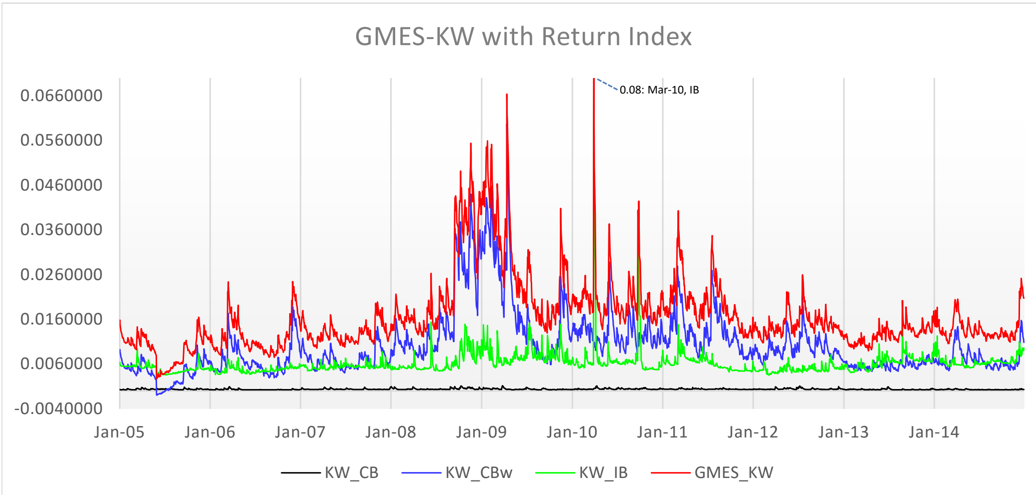
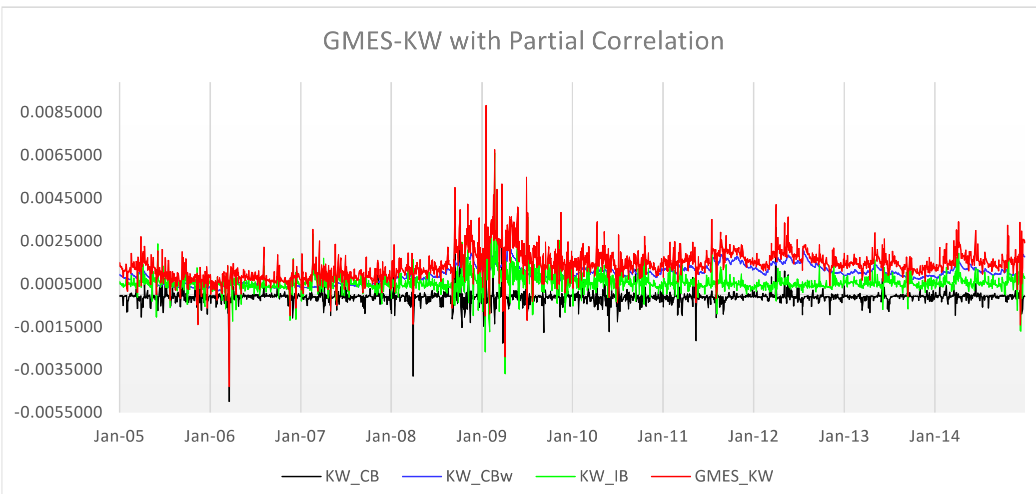


Figure 6: Country GMES for KW





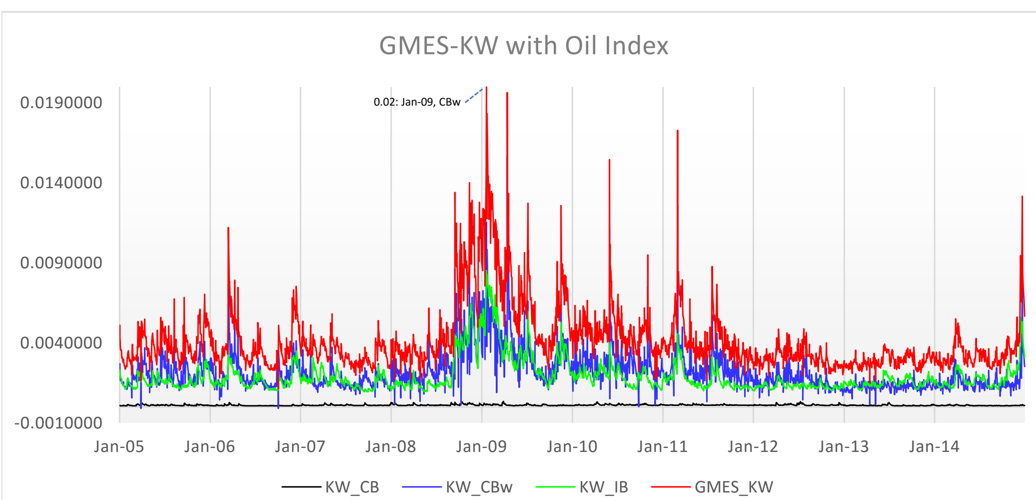
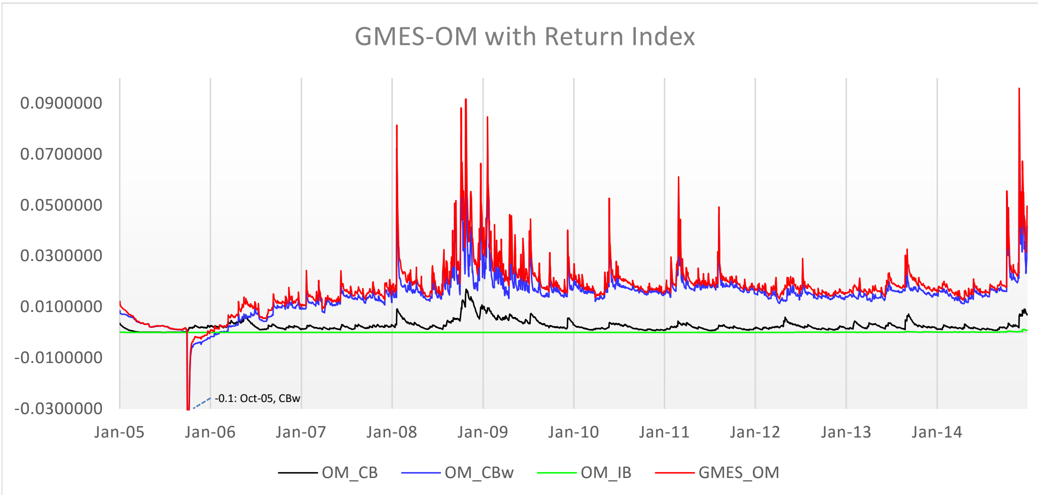
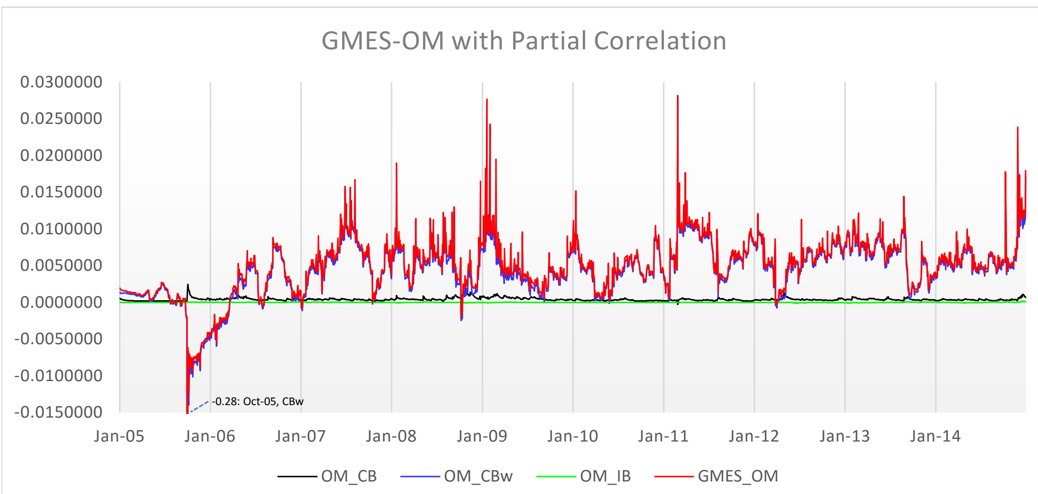


Figure 7: Country GMES for OM





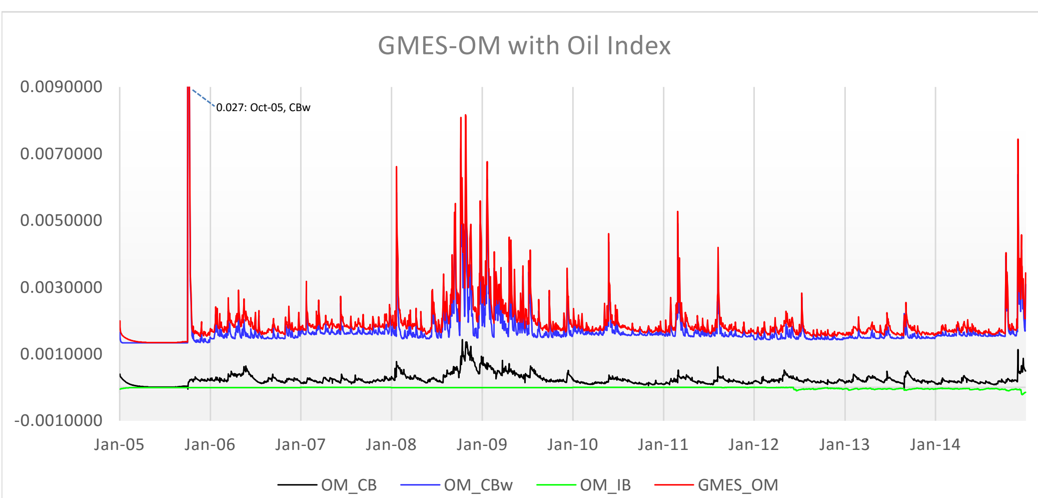
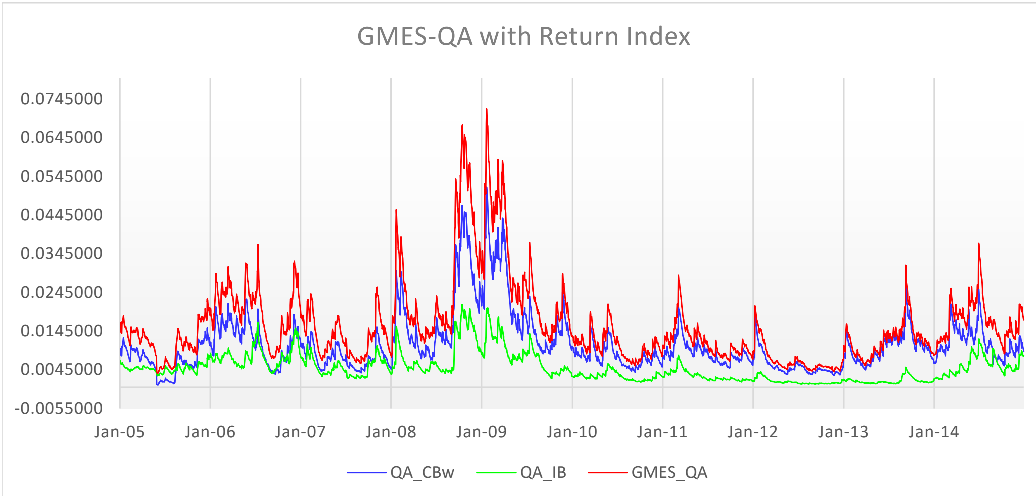
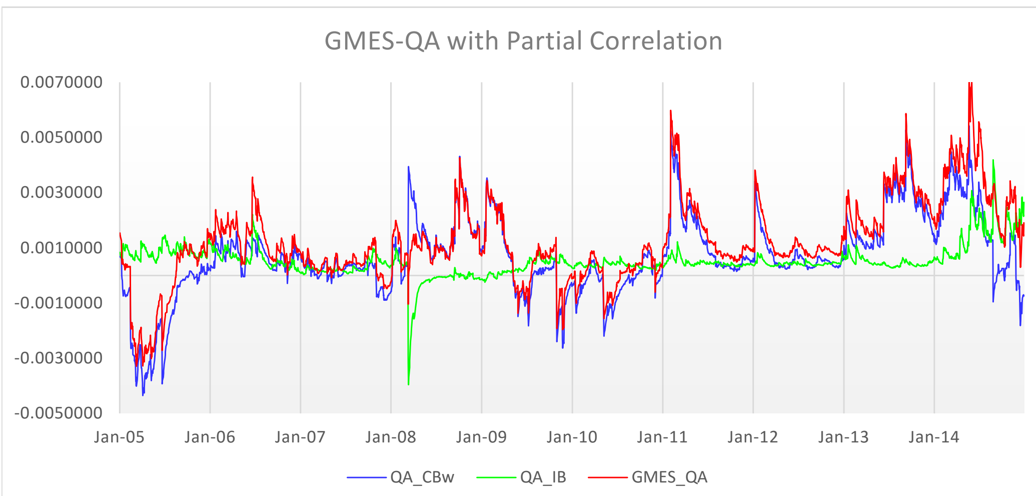


Figure 8: Country GMES for QA





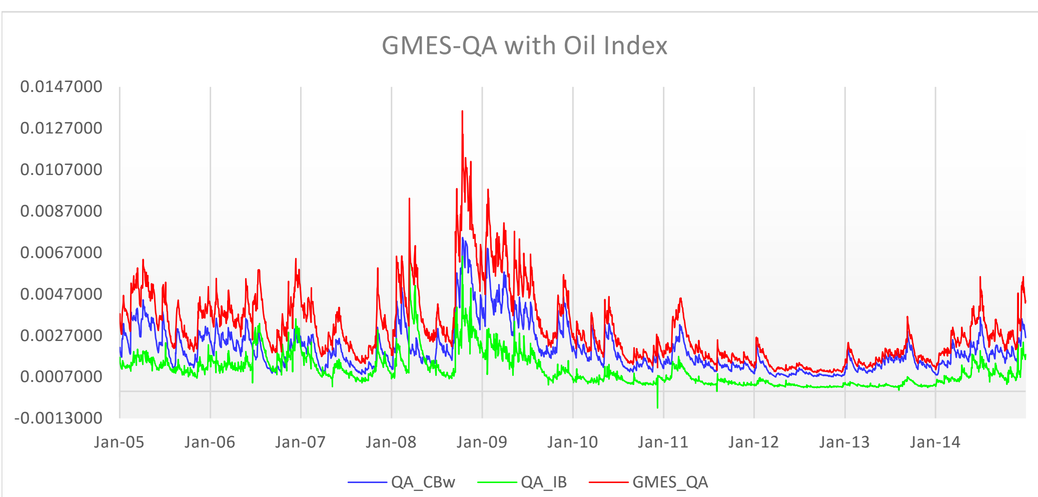
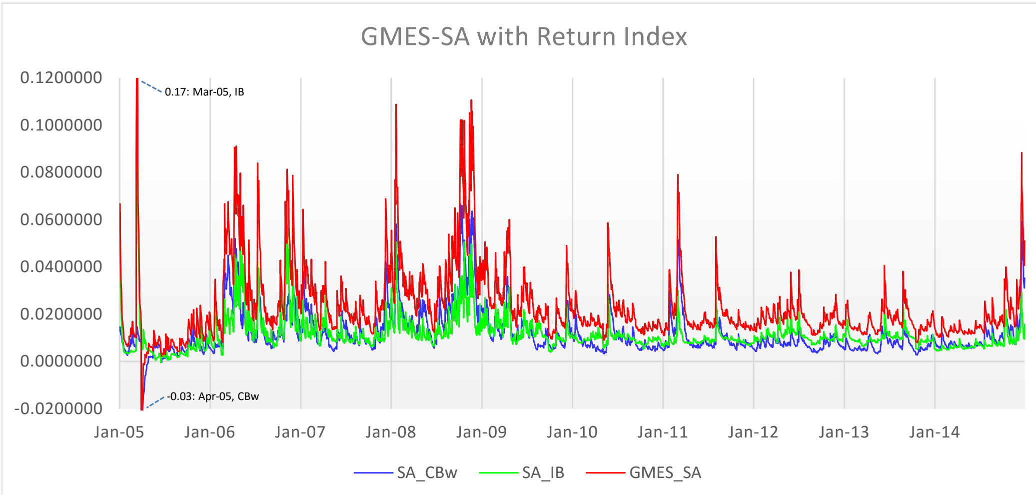
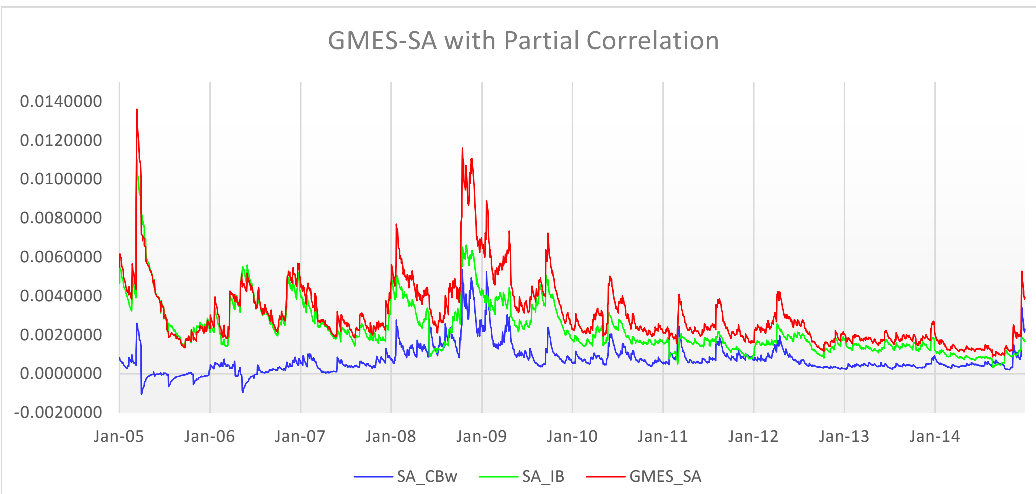


Figure 9: Country GMES for SA





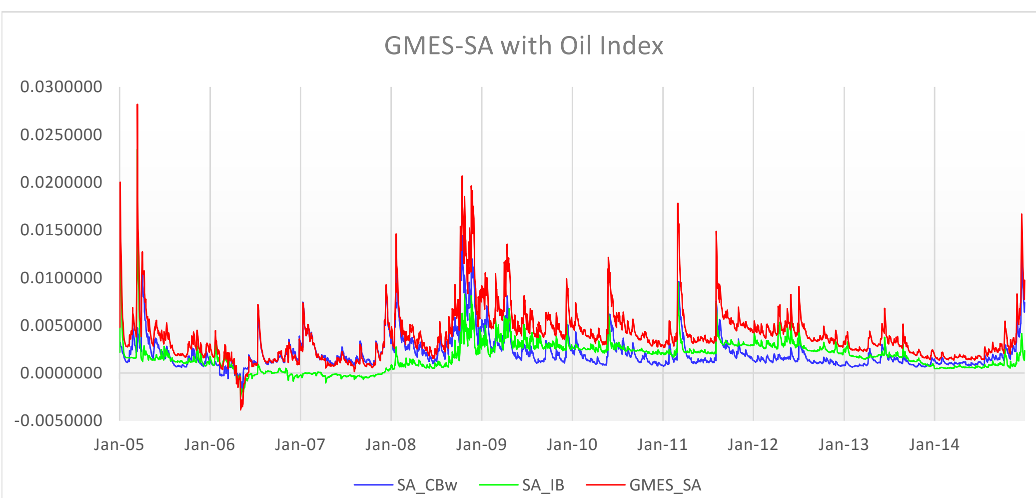


Table 14: Country GMES Correlation with Return Index

correlation		MES			GMES_AE	MES			GMES_BH	MES			GMES_KW	MES			GMES_OM	MES		GMES_QA	MES		GMES_SA
		AE_CB	*AE_CBw*	*AE_IB*		*BH_CB*	*BH_CBw*	*BH_IB*		*KW_CB*	*KW_CBw*	*KW_IB*		*OM_CB*	*OM_CBw*	*OM_IB*		*QA_CBw*	*QA_IB*		*SA_CBw*	*SA_IB*	
Pre-Crisis																							
MES	*AE_CB*	1																					
	AE_CBw	0.47	1																				
	AE_IB	0.44	0.46	1																			
GMES_AE		0.54	0.94	0.72	1																		
MES	*BH_CB*	-0.30	0.02	-0.11	-0.03	1																	
	BH_CBw	0.00	-0.04	-0.24	-0.11	0.05	1																
	BH_IB	0.04	0.09	-0.29	-0.04	0.15	0.38	1															
GMES_BH		0.03	0.05	-0.32	-0.08	0.13	0.70	0.92	1														
MES	*KW_CB*	0.07	0.37	0.11	0.33	0.34	0.16	0.15	0.18	1													
	KW_CBw	0.37	0.21	-0.05	0.15	-0.36	0.50	0.50	0.59	0.13	1												
	KW_IB	0.00	0.09	-0.31	-0.05	0.22	0.38	1.00	0.92	0.17	0.46	1											
GMES_KW		0.33	0.21	-0.11	0.13	-0.26	0.52	0.65	0.72	0.18	0.98	0.62	1										
MES	*OM_CB*	0.52	0.08	0.15	0.13	-0.59	0.00	0.09	0.06	-0.19	0.54	0.03	0.48	1									
	OM_CBw	-0.03	-0.24	0.00	-0.18	-0.12	0.01	0.10	0.08	-0.19	0.16	0.07	0.15	0.13	1								
	OM_IB	-0.04	-0.05	-0.26	-0.13	0.38	0.09	0.27	0.24	-0.06	0.04	0.30	0.09	-0.02	0.12	1							
GMES_OM		0.05	-0.21	0.02	-0.16	-0.21	0.01	0.11	0.09	-0.22	0.24	0.07	0.22	0.28	0.99	0.12	1						
MES	*QA_CBw*	0.50	0.18	0.11	0.19	-0.39	0.30	0.22	0.29	-0.03	0.68	0.18	0.64	0.67	0.09	-0.08	0.20	1					
	QA_IB	0.29	0.01	0.03	0.02	-0.53	0.44	0.09	0.25	-0.16	0.63	0.04	0.56	0.35	0.21	-0.13	0.26	0.64	1				
GMES_QA		0.47	0.13	0.09	0.14	-0.48	0.38	0.19	0.30	-0.08	0.72	0.14	0.67	0.62	0.14	-0.10	0.24	0.96	0.83	1			
MES	*SA_CBw*	0.47	0.21	0.15	0.23	-0.48	0.10	0.19	0.18	-0.05	0.55	0.13	0.51	0.56	0.15	-0.11	0.24	0.51	0.43	0.53	1		
	SA_IB	0.21	0.04	0.01	0.04	-0.20	0.20	0.38	0.37	0.04	0.37	0.34	0.40	0.34	0.20	0.04	0.25	0.34	0.27	0.35	0.51	1	
GMES_SA		0.37	0.13	0.08	0.14	-0.37	0.18	0.34	0.33	0.00	0.51	0.29	0.52	0.50	0.21	-0.03	0.28	0.48	0.39	0.49	0.83	0.91	1
Crisis																							
MES	*AE_CB*	1																					
	AE_CBw	0.56	1																				
	AE_IB	0.44	0.70	1																			
GMES_AE		0.58	0.98	0.83	1																		
MES	*BH_CB*	0.45	-0.03	-0.22	-0.07	1																	
	BH_CBw	0.13	0.25	0.36	0.30	-0.04	1																
	BH_IB	0.51	0.53	0.46	0.55	0.12	0.34	1															
GMES_BH		0.47	0.53	0.50	0.56	0.09	0.60	0.96	1														
MES	*KW_CB*	0.41	0.46	0.39	0.47	0.08	0.10	0.43	0.40	1													
	KW_CBw	0.56	0.64	0.53	0.65	0.13	0.18	0.69	0.64	0.49	1												
	KW_IB	0.40	0.52	0.50	0.55	-0.06	0.40	0.97	0.95	0.39	0.60	1											
GMES_KW		0.56	0.66	0.56	0.68	0.11	0.23	0.78	0.74	0.51	0.99	0.71	1										
MES	*OM_CB*	0.66	0.65	0.61	0.69	0.21	0.36	0.80	0.79	0.45	0.80	0.74	0.84	1									
	OM_CBw	0.67	0.69	0.50	0.69	0.21	0.14	0.64	0.59	0.43	0.63	0.58	0.66	0.75	1								
	OM_IB	-0.25	-0.48	-0.51	-0.51	0.21	-0.15	-0.54	-0.51	-0.28	-0.71	-0.52	-0.71	-0.62	-0.50	1							
GMES_OM		0.70	0.71	0.56	0.72	0.22	0.21	0.72	0.67	0.46	0.71	0.65	0.74	0.85	0.99	-0.55	1						
MES	*QA_CBw*	0.70	0.64	0.58	0.67	0.30	0.23	0.71	0.68	0.40	0.83	0.62	0.85	0.89	0.71	-0.62	0.79	1					
	QA_IB	0.62	0.64	0.63	0.69	0.10	0.26	0.67	0.65	0.37	0.81	0.62	0.82	0.85	0.62	-0.58	0.71	0.91	1				
GMES_QA		0.69	0.65	0.61	0.69	0.24	0.25	0.71	0.68	0.40	0.84	0.63	0.85	0.90	0.69	-0.62	0.78	0.99	0.96	1			
MES	*SA_CBw*	0.63	0.58	0.50	0.60	0.19	0.17	0.56	0.53	0.43	0.72	0.49	0.72	0.76	0.63	-0.48	0.70	0.75	0.75	0.77	1		
	SA_IB	0.58	0.55	0.51	0.58	0.20	0.21	0.50	0.49	0.51	0.65	0.43	0.65	0.70	0.61	-0.41	0.66	0.69	0.67	0.70	0.83	1	
GMES_SA		0.64	0.59	0.53	0.62	0.20	0.19	0.56	0.54	0.48	0.72	0.49	0.72	0.77	0.65	-0.47	0.71	0.76	0.75	0.77	0.98	0.93	1
Post-Crisis																							
MES	*AE_CB*	1																					
	AE_CBw	0.31	1																				
	AE_IB	0.42	0.79	1																			
GMES_AE		0.36	0.99	0.85	1																		
MES	*BH_CB*	-0.08	-0.10	-0.16	-0.11	1																	
	BH_CBw	0.20	0.03	0.02	0.03	-0.07	1																
	BH_IB	0.43	0.18	0.31	0.22	-0.07	0.17	1															
GMES_BH		0.45	0.17	0.28	0.21	-0.09	0.47	0.95	1														
MES	*KW_CB*	0.12	-0.10	-0.10	-0.10	0.02	0.23	0.05	0.12	1													
	KW_CBw	0.60	0.24	0.27	0.27	-0.23	0.36	0.32	0.40	0.28	1												
	KW_IB	0.16	0.09	0.18	0.11	-0.06	0.16	0.89	0.85	0.05	0.12	1											
GMES_KW		0.58	0.25	0.30	0.27	-0.22	0.38	0.64	0.69	0.28	0.92	0.51	1										
MES	*OM_CB*	0.55	0.47	0.57	0.51	0.00	0.22	0.41	0.43	0.10	0.52	0.18	0.52	1									
	OM_CBw	0.37	0.42	0.44	0.44	-0.18	0.14	0.20	0.22	0.05	0.39	0.13	0.39	0.55	1								
	OM_IB	-0.22	0.47	0.48	0.48	-0.09	-0.19	-0.07	-0.12	-0.22	-0.25	0.05	-0.20	0.23	0.29	1							
GMES_OM		0.43	0.48	0.51	0.50	-0.16	0.16	0.26	0.28	0.06	0.45	0.15	0.45	0.70	0.98	0.31	1						
MES	*QA_CBw*	0.60	0.42	0.52	0.46	-0.12	0.19	0.42	0.44	0.08	0.62	0.19	0.61	0.62	0.36	0.00	0.45	1					
	QA_IB	0.56	0.42	0.55	0.46	-0.34	0.23	0.42	0.45	0.03	0.56	0.19	0.56	0.62	0.41	0.08	0.49	0.83	1				
GMES_QA		0.61	0.44	0.55	0.48	-0.20	0.21	0.44	0.46	0.06	0.62	0.20	0.62	0.65	0.39	0.03	0.48	0.98	0.92	1			
MES	*SA_CBw*	0.37	0.47	0.48	0.49	-0.11	0.27	0.17	0.24	0.15	0.50	0.12	0.48	0.54	0.56	0.29	0.61	0.37	0.43	0.40	1		
	SA_IB	0.36	0.34	0.32	0.35	0.07	0.17	0.22	0.25	0.23	0.47	0.09	0.45	0.56	0.45	0.06	0.52	0.38	0.33	0.38	0.65	1	
GMES_SA		0.40	0.46	0.46	0.48	-0.05	0.26	0.21	0.27	0.19	0.54	0.12	0.51	0.60	0.57	0.22	0.63	0.41	0.43	0.43	0.95	0.85	1

Figure 10: Global Gulf Risk Measure

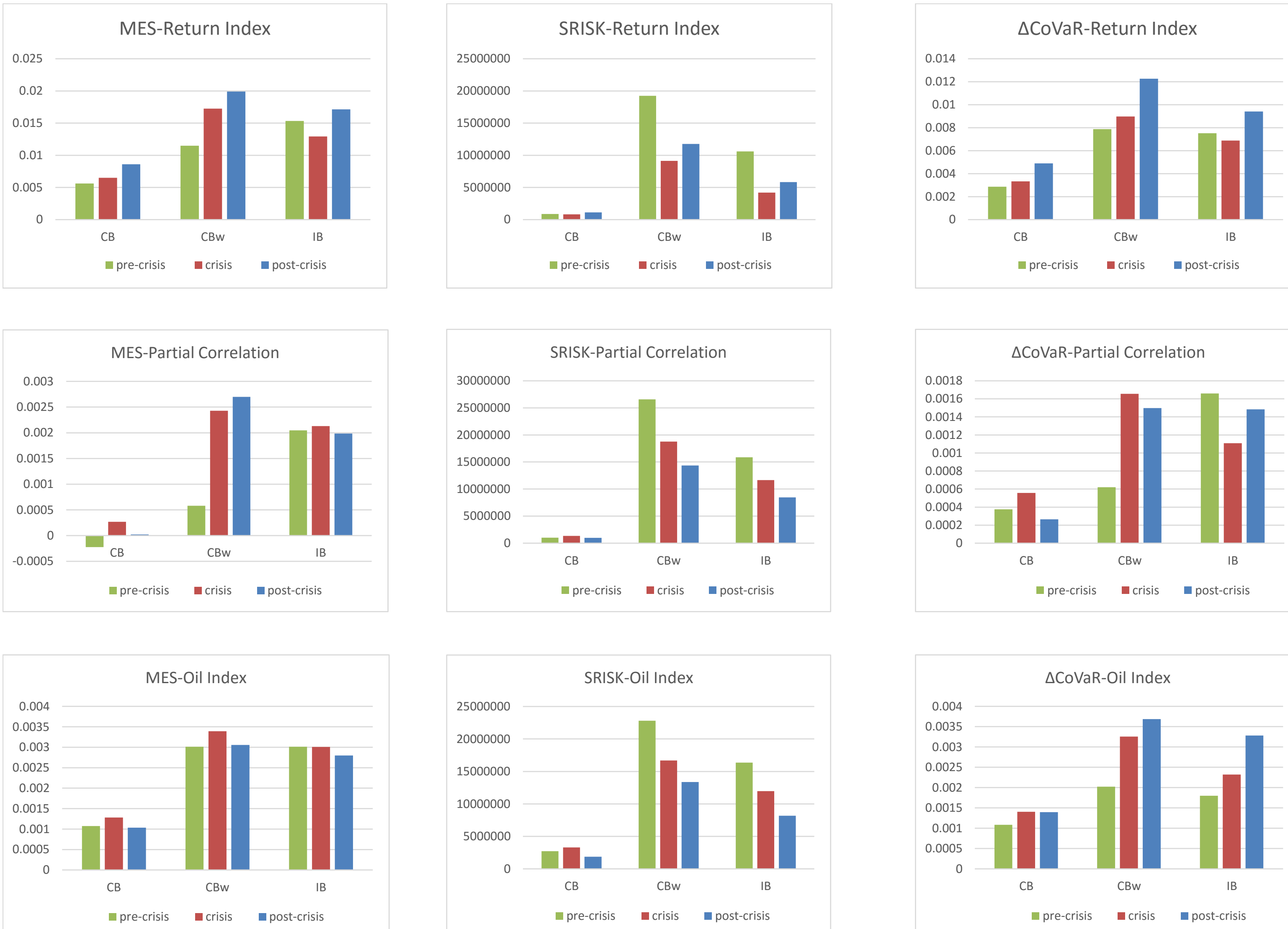
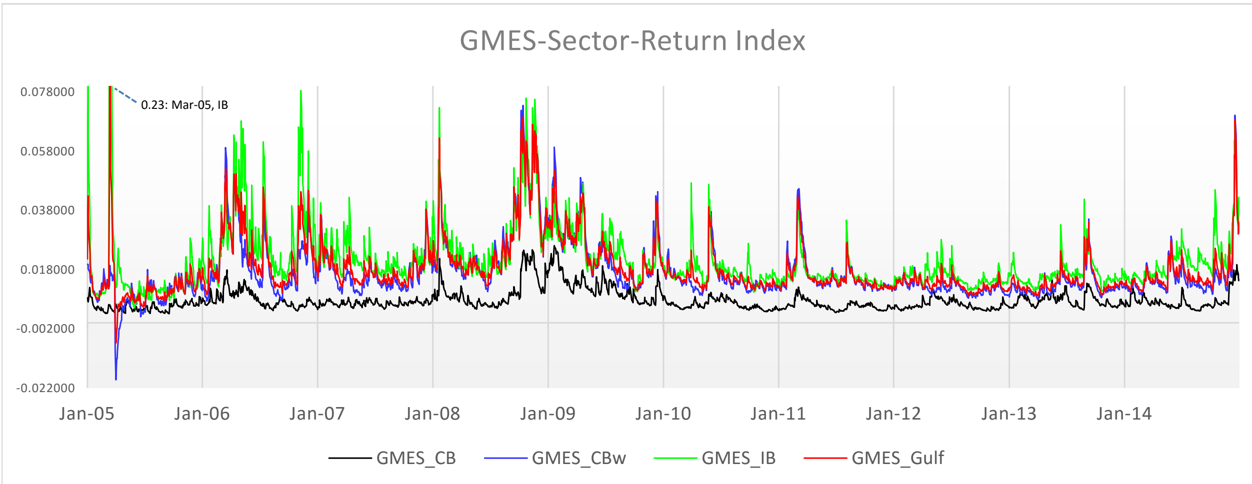
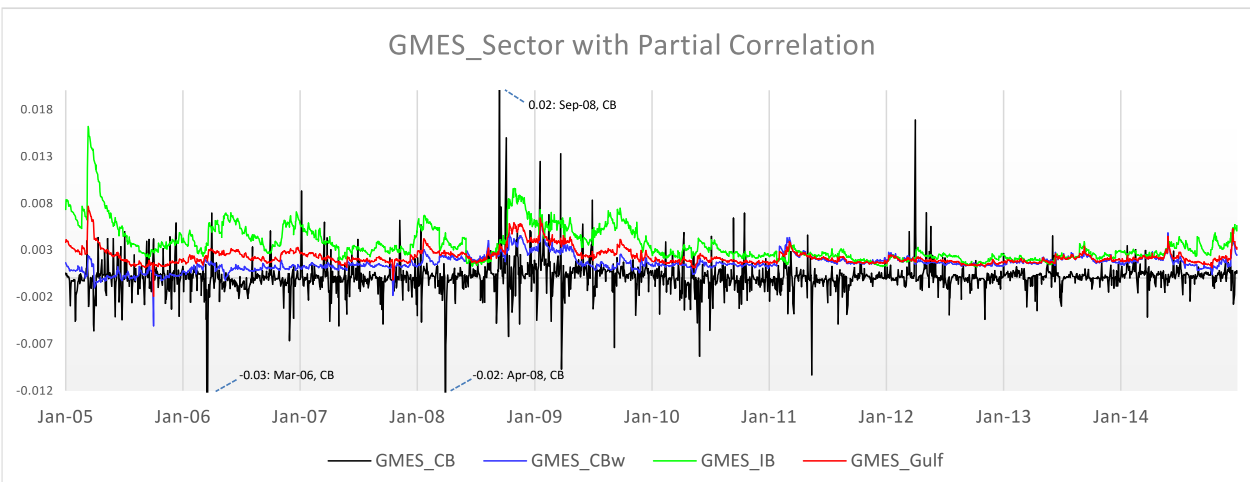


Figure 11: Gulf Region Risk level using GMES Per Sector





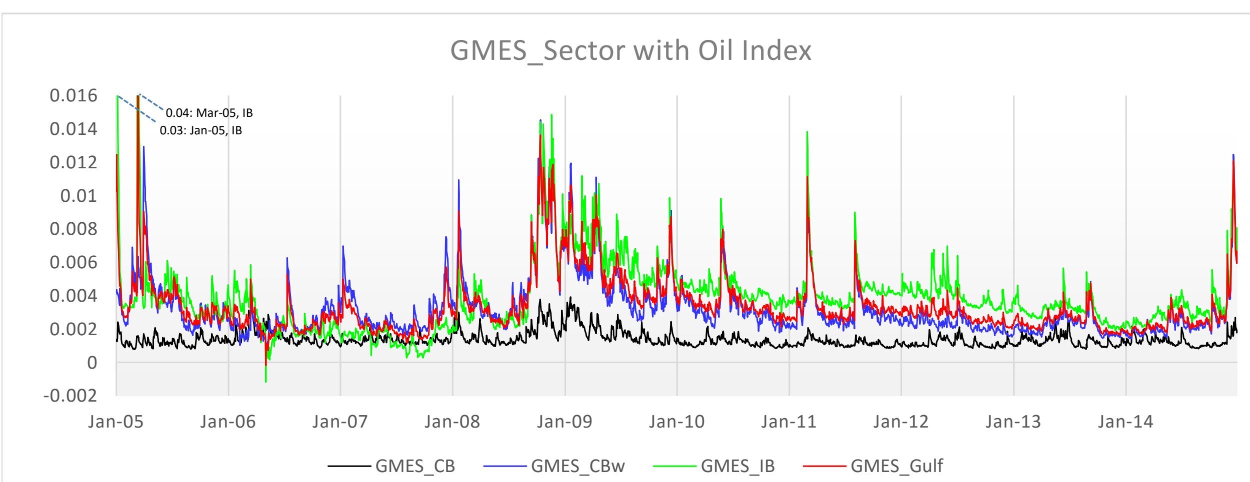


Table 15: Gulf Region GMES Correlation Using Return-Index Approach

Correlation	*GMES_CB*	*GMES_CBw*	*GMES_IB*	*GMES_Gulf*
pre-crisis				
GMES_CB	1			
GMES_CBw	0.64	1		
GMES_IB	0.32	0.49	1	
GMES_Gulf	0.53	0.83	0.9	1
crisis				
GMES_CB	1			
GMES_CBw	0.86	1		
GMES_IB	0.83	0.89	1	
GMES_Gulf	0.88	0.99	0.95	1
post-crisis				
GMES_CB	1			
GMES_CBw	0.72	1		
GMES_IB	0.67	0.8	1	
GMES_Gulf	0.74	0.98	0.9	1