VALUE-AT-RISK MODELS FOR KSA INSURANCE MARKETS: CONVENTIONAL AND TAKAFUL

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ABSTRACT

The purpose of this paper is to select the best VaR specification for the Insurance listed companies in an emerging economy, KSA. The author debated of the decoupling hypothesis of the Islamic insurance stocks (Takaful insurance companies) from the conventional insurance stocks (Mutual insurance companies). The author estimated the value at risk for the KSA insurance industry. The author also reconsidered the efficiency of a family of asymmetric ARCH models to assess the potential financial risk for daily stock returns. The researcher specifically accounted for the stylized facts of right-fat tails and skewed distribution of returns via the skewed Student distribution. The author also applied the Kupiec's (1995) and Engle and Manganelli (2004) tests to check the performance of each model. The study found that the APARCH model with Skewed distribution records the best forecasting ability for both Takaful and Conventional insurance companies. The decoupling hypothesis of Takaful insurance companies from Mutual insurance companies has been rejected. The study provides some valuable insights on risk management for the Insurance industry in KSA. Policy makers have to take into consideration fat tails and asymmetric return distribution in assessing risk for both Takaful and Mutual insurance companies. The results have practical implications for the Insurance and Financial industry in KSA and in emerging stock markets.

Keywords: Risk Management, Value-at-Risk, Long Memory, APARCH Type-Models, Insurance industry.

JEL Classification: C53, G21, G28

INTRODUCTION

Due to the implementation of the Vision 2030 initiatives, a faster growth in the non-oil private sector is expected, which include promoting the role of the private sector in creating more jobs, increasing its contribution to GDP, supporting small and medium enterprises (SMEs). In author view, the insurance industry can be a pillar in the fulfilment of this vision, since its contribution to the non-oil output is only 2.1% in 2016 compared to other sectors[1]. According to the Saudi Arabian Monetary Authority, the retention ratio of the Saudi insurance industry, which indicates the percentage of Gross Written Premium (GWP) retained by the insurance companies, reached 84%, in 2016. This indicates the low percentage of reinsurance contracts due to the tiny integration between the domestic and global insurance markets: The 2017 Financial Stability Report indicates that "*most of the market risk is being assumed by the insurance companies*". Accordingly, since all insurance companies in KSA are publicly listed, they have to manage the market risk. This is in light with a number of financial crises such that the debt defaults of many

Latin American countries in the early 1980s, the Asian in 1997-98, the 1998 Russian financial crisis and the latest subprime mortgage crisis in 2008 and 2009. Following these dramatic events in financial markets, Basle I, II and III agreements are the main references to regulate financial markets. The effective risk management in the particular KSA insurance industry is extremely crucial to quantify their risk levels.

Although its large criticism following the recent financial crisis, Rossignolo et al. (2012) and Degiannakis et al. (2013) show that VaR remains the most privileged measurement of risk. For emerging and frontier economies, McMillan and Speight (2007); Huang and Tseng (2009); Halbleib and Pohlmeier (2012); Allen et al. (2013); Hammoudeh et al. (2013) and others found that VaR models with heavy tail distributions provide the best performance in estimating risk. Hence, VaR computation has to account for the stylized facts of asymmetry and fait tails in stock market volatility. In the case of the GCC countries, this includes Maghyereh and Al-Zoubi (2006) and Aloui and Ben Hamida (2014).

Researcher's interest in the insurance sector is due to two reasons. First, the insurance industry can increase the contribution of the non-oil GDP sector in accordance with the 2030 vision. Second, the author attempts to offer a tool to manage risk for these companies. This is also in light of a recent literature on Islamic markets which debates the validity of the decoupling hypothesis of the Islamic financial products from the conventional assets. This hypothesis relies on the assumption that Islamic investments have their own characteristics and are different from the conventional ones, Masih et al. (2018). These characteristics are in terms of potential safety in times of financial crisis. While some studies support this hypothesis (Rizvi and Arshad, 2014; Kenourgios et al., 2016; Yilmaz et al., 2015), others are rejecting it (Hammoudeh et al., 2014; Ajmi et al., 2014; Naifar, 2016; Ben Nasr et al., 2016 ; Aloui et al., 2016; Shahzad et al., 2017).

EMPIRICAL FRAMEWORK AND METHODOLOGY

This paper checks the forecasting ability of four specifications belonging to the family of ARCH model in estimating VaR of insurance stocks in KSA. The study focused on the ex-ante future distribution of the insurance industry in KSA. To this aim, the study examined the behaviour of VaR models to model the large negative returns for long trading positions. This research analysis doesn't deal with short trading positions since it is forbidden in TADAWUL (Saudi Stock Exchange). For a portfolio of financial assets, VaR measures and quantifies the potential loss on with a given probability (99% or 95%) over a specific period. Alexander (2008) provides a deep explanation of Value-at-Risk**.**

The researcher computed daily stock returns $r_{i,t}$ as $100\left[ln\left(P_{i,t}\right) - ln\left(P_{i,t-1}\right)\right]$ where $P_{i,t}$ is the price of stock *i* at day *t*. For the specification of VaR models, the study supposes that $r_{i,t}$ an AR (*n*) of the form $\Phi(L)\left(r_{i,t} - \mu\right) = \varepsilon_{i,t}$ where $\Phi(L)$ is an autoregressive lag polynomial of order *n*, since daily returns exhibit negative serial correlations. For the conditional variance specification, the author considered three variants of the Ding et al. (1993) univariate Asymmetric Power ARCH (APARCH) model, namely APARCH with Normal distribution (APARCH-N), APARCH with Student distribution (APARCH-ST) and APARCH ith skewed Student distribution (APARCH-SKST). The author also applied the RiskMetics (RM) specification that relies on the Normal distribution. In line with Giot and Laurent (2003), McMillan and Speight (2007), McMillan and Kambouroudis (2009), Diamandis et al. (2011), Hasanov et al. (2018) and others, the in- sample performance of the four models were checked at 1% and 5% tails.

To this end, the researcher follows Kupiec (1995) and examined the failure rate f_i for the returns $r_{i,t}$, ie the percentage of losses that exceeds the VaR estimate in a backtesting process. $\hat{f}_i \equiv N/T$, where T is the sample size and N is the number of violations. The author then tested if f is statistically equal to the VaR confidence level α. Under the null hypothesis, H_0:$\hat{f}_i = \alpha$, the likelihood ratio test, also called the unconditional coverage test, has the following form:

$$LR_{un} = 2ln\left(\left(1-\frac{N}{\tilde{T}}\right)^{\tilde{T}-N} \quad \left(\frac{N}{\tilde{T}}\right)^{N}\right) - 2ln\left((1-p)^{\tilde{T}-N} \quad p^{N}\right) \qquad (1)$$

This test follows asymptotically a $\chi_2(1)$ distribution.

According to Xekalaki and Degiannakis (2010) and Christoffersen (1998, 2012), the Kupiec (1995) test either overestimates or underestimates the percentage of violations. For this reason, the Dynamic Quantile test statistic (DQ) of Engle and Manganelli (2004) was applied that overcomes this limitation. In addition to examining if the rate of violations is equal to the specified level of VaR, it also tests the absence of serial correlation in these exceptions. The DQ test is based on the demeaned process of violations Hit. This sequence takes the following values:

$$Hit_i(\alpha) = \begin{cases} 1-\alpha & if \;\; r_i < ex-ante\, Var(\alpha) \\ \alpha & otherwise \end{cases} \qquad (2)$$

The conditional efficiency test of Engle and Manganelli (2004) checks the absence of correlation of Hit with its previous values and with the forecasted VaR and its past values. Specifically, they use the following regression model:

$$Hit_t(\alpha) = \delta_0 + \sum_{i=1}^{i'} \delta_i Hit_{t-1}(\alpha) + \sum_{j=1}^{j'} \gamma_j VaR_{t-j+1|t-j}^{(1-p)} + \varepsilon_t, \;\; \varepsilon_t \sim N(0,1) \qquad (3)$$

and examined the hypothesis of joint nullity of all coefficients:

$$H_0: \;\; \delta_0 = \delta_1 = \cdots = \delta_{i'} = \gamma_1 = \cdots = \gamma_{j'} = 0 \qquad (4)$$

If this hypothesis is verified, this corresponds to the conditional efficiency of the test.

DATA

In 2017, the KSA insurance sector is comprised of 35 companies. All those companies are listed in the Saudi Stock Market and issue insurance policies in insurance activities including general insurance, vehicle insurance, health insurance and protection and savings insurance. Daily stock prices series from Data Stream were collected. The study excluded four companies with lack of data, a company that only operates in the reinsurance activity and a company that was suspended by SAMA. The final sample was comprised of 29 companies, 4 in the Takaful segment and the remainder 25 in the conventional insurance. The study was conducted on daily returns and used the data that extends from 2005 to the end of the first semester of 2017. The time-period covered any effects of the 2007-2009 subprime crises. In this study, the estimation process is based on the full sample.

ESTIMATIONS AND RESULTS

Table 1 provides descriptive statistics for the data. The common feature is that only 6 insurance companies (20.7%) are recording arithmetic positive returns, two of which are offering Islamic products. This was one of the reasons of restructuring the insurance industry by the SAMA authority. The estimated standard deviations show that the Takaful insurance companies are less risky than the conventional ones, which corresponds to the nature of Islamic products that prohibit risky activities. The author notices that all the 29 stock returns series are skewed and leptokurtic. Researcher's assumption is that the APARCH model will take into consideration these stylized facts.

Table1
DESCRIPTIVE STATISTICS OF KSA INSURANCE LISTED COMPANIES

	1st Observation	n	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	P
Takaful insurance companies								
Jazira Takaful	19/07/2013	1030	0.092	2.91	0.21	6.81	630.90	0.000
AlRajhi Takaful	13/07/2009	2079	0.005	2.56	-0.04	6.87	1300.41	0.000
SABB Takaful	18/06/2007	2619	-0.004	3.42	0.00	5.53	699.22	0.000
Solidarity	08/06/2010	1843	-0.030	2.75	-0.26	6.89	1181.90	0.000
Mutual insurance companies								
CHUBB	29/07/2009	2067	-0.026	2.98	0.04	6.17	864.64	0.000
METLIFE AIG ANB	11/03/2014	863	-0.082	2.60	-0.62	11.42	2602.26	0.000
Al Alamiya	08/12/2009	1973	0.010	3.23	0.01	5.68	589.27	0.000
Sagr Insurance	08/02/2008	2450	-0.008	3.05	-0.08	6.33	1134.74	0.000
Al-Ahlia	04/10/2007	2541	-0.071	3.48	0.02	4.99	419.36	0.000
Alinma Tokio M	22/06/2012	1310	-0.081	2.73	0.02	6.66	733.18	0.000
Allianz SF	23/07/2007	2594	-0.021	3.50	0.00	5.20	522.05	0.000
Amana Insurance	11/06/2010	1840	-0.040	3.85	0.06	5.07	328.98	0.000
AICC	04/02/2008	2454	-0.074	3.14	-0.01	5.67	728.60	0.000
Arabian Shield	26/06/2007	2613	-0.011	3.21	-0.13	5.73	818.51	0.000
AXA Cooperative	27/07/2009	2069	0.001	3.02	0.00	6.11	831.42	0.000
Buruj	15/02/2010	1924	0.014	3.25	-0.05	6.11	773.91	0.000
Gulf General	08/02/2010	1929	-0.030	3.01	-0.08	6.30	878.00	0.000
Gulf Union	11/09/2007	2558	-0.074	3.03	-0.24	5.78	847.86	0.000
Malath Insuranc	07/05/2007	2649	-0.060	3.16	-0.22	6.07	1062.11	0.000
SAICO	03/09/2007	2564	-0.043	3.34	0.02	5.19	513.42	0.000
Salama	18/06/2007	2619	-0.029	3.38	-0.11	5.11	492.40	0.000
Saudi Rein	22/05/2008	2376	-0.048	2.37	-0.20	8.12	2609.08	0.000
Tawuniya	03/10/2005	3064	0.023	2.68	-0.17	7.55	2653.93	0.000
MEDGULF	08/05/2007	2648	-0.013	2.99	-0.22	6.33	1245.99	0.000
Trade Union	08/02/2008	2450	-0.034	2.85	-0.28	6.62	1372.16	0.000
U C A	19/06/2008	2356	-0.006	2.89	-0.09	6.46	1178.37	0.000
WAFA Insurance	23/08/2007	2571	-0.068	3.86	-0.04	4.37	201.53	0.000
Walaa	17/07/2007	2598	-0.011	3.21	-0.04	5.59	728.48	0.000
Wataniya	04/06/2010	1845	0.000	2.92	0.22	6.44	922.80	0.000

Note: The table provides the listed insurance companies in KSA, the starting date for each stock, descriptive statistics: number of observations n, arithmetic mean, standard deviation, skewness, kurtosis, Jarque-Bera normality test and the corresponding p-values. The last date for all stocks in the sample is 30/06/2017.

After computing the four competing VaR models, RM, APARCH-N, APARCH-ST and APARCH-SKST (The full results are available upon request), the author examined their performance. The researcher performed a back testing procedure. He computed the one-day-

ahead VaR for the four models at the 1% and 5% significance levels and then calculated the percentage of violations for the return series $r_{i,t}$. For long positions, the author is interested in the failure rate where stock returns are less than the one-day-ahead VaR.

Table 2 reports the p-values of the Kupiec (1995) unconditional test at the 1% and 5% significance levels. With $\alpha = 1\%$, VaR models with Gaussian distribution: APARCH-N and RM, generated biased estimates and had a poor performance in forecasting large negative returns. The APARCH-ST and APARCH-SKST provided better estimates but the APARCH-SKT had the best performance. In the less extreme case of $\alpha = 5\%$, the performance of the Normal VaR models has significantly improved. The RM specification recorded the best forecasting ability, with one exception for Tawuniya stock returns. The author notices that these conclusions are valid for both Takaful and Mutual insurance companies.

Table 2
KUPIEC TEST RESULTS (IN-SAMPLE) FOR THE LONG TRADING POSITION

	α = 1%				α = 5%			
	RM	APARCH-N	APARCH-ST	APARCH-SKT	RM	APARCH-N	APARCH-ST	APARCH-SKT
Takaful insurance companies								
Jazira Takaful	0.00	0.05	0.40	0.40	0.53	0.72	0.29	0.24
AlRajhi Takaful	0.00	0.00	0.69	0.86	0.61	0.08	0.17	0.08
SABB Takaful	0.00	0.00	0.72	0.56	0.65	0.01	0.72	0.65
Solidarity	0.00	0.00	0.42	0.27	0.82	0.12	0.61	0.47
Mutual insurance companies								
CHUBB	0.00	0.00	0.28	0.55	0.89	0.17	0.29	0.18
METLIFE AIG ANB	0.00	0.00	0.44	0.90	0.46	0.73	0.14	0.14
Al Alamiya	0.00	0.00	0.69	0.95	0.97	0.15	0.78	0.86
Sagr Insurance	0.00	0.00	0.25	0.35	0.96	0.20	0.96	0.61
Al-Ahlia	0.00	0.00	0.78	0.91	0.93	0.93	1.00	0.59
Alinma Tokio M	0.00	0.02	0.61	0.61	0.29	0.75	0.85	0.95
Allianz SF	0.00	0.00	0.69	0.33	0.54	0.74	0.95	0.41
Amana Insurance	0.00	0.04	0.74	0.93	0.52	0.01	0.39	0.67
AICC	0.00	0.00	0.16	0.60	0.39	0.95	0.63	0.30
Arabian Shield	0.00	0.00	0.86	0.86	0.24	0.04	0.88	0.76
AXA Cooperative	0.00	0.03	0.12	0.12	0.72	0.28	0.72	0.72
Buruj	0.00	0.00	0.77	0.77	0.69	0.04	0.69	0.69
Gulf General	0.00	0.00	0.20	0.31	0.24	0.95	0.44	0.44
Gulf Union	0.00	0.00	0.64	0.51	0.15	0.99	0.06	0.05
Malath Insuranc	0.00	0.00	0.37	0.62	0.62	0.50	0.69	0.45
SAICO	0.00	0.00	0.04	0.17	0.67	0.73	0.57	0.73
Salama	0.00	0.00	0.52	0.81	0.47	0.65	0.59	0.37
Saudi Rein	0.00	0.00	0.87	0.87	0.91	0.16	0.22	0.22
Tawuniya	0.00	0.00	0.91	0.44	0.04	0.00	0.49	0.82
MEDGULF	0.00	0.00	0.49	0.49	0.82	0.09	0.40	0.40
Trade Union	0.00	0.00	0.76	0.92	0.34	0.61	0.55	0.61
U C A	0.00	0.00	0.15	0.23	0.84	0.13	0.06	0.05
WAFA Insurance	0.00	0.00	0.33	0.58	0.05	0.02	0.76	0.50
Walaa	0.00	0.00	0.69	0.69	0.85	0.65	0.79	0.65
Wataniya	0.00	0.00	0.11	0.40	0.32	0.02	0.61	0.41

Note: The table reports the Kupiec (1995) test results. The null hypothesis tests, for the long trading position, if the percentage of violations is equal to α. The models are RiskMetrics (RM), Normal APARCH (APARCH-N), Student APARCH (APARCH-ST) and skewed Student APARCH (APARCH-SKT).

Table 3 provides the Dynamic Quantile test statistic (DQ) of Engle and Manganelli (2004). The study observed in-sample performance of the four competing models, at the 1% and 5% significance levels. At the 1% significance level, both RM and APARCH-N VaR models had a poor performance in modelling large negative returns, as with the less restrictive test of Kupiec (1995). The APARCH-ST and APARCH-SKT provided the best performance and the APARCH-SKT is still recording the best performance. These results are in line with the Kupiec (1995) test results. At the 5% significance level, all four models provided a bad performance. These conclusions are also valid for both Takaful and Mutual insurance companies.

Table 3
ENGLE AND MANGANELLI TEST RESULTS (IN-SAMPLE) FOR THE LONG TRADING POSITION

	α = 1%				α = 5%			
	RM	APARCH-N	APARCH-ST	SKST-APARCH	RM	APARCH-N	APARCH- ST	SKST-APARCH
Takaful insurance companies								
Jazira Takaful	0.00	0.00	0.96	0.92	0.18	0.13	0.62	0.64
AlRajhi Takaful	0.00	0.00	0.56	0.65	0.05	0.00	0.06	0.04
SABB Takaful	0.01	0.47	0.94	0.40	0.00	0.01	0.14	0.14
Solidarity	0.00	0.00	0.69	0.71	0.02	0.00	0.01	0.00
Mutual insurance companies								
CHUBB	0.00	0.00	0.92	0.98	0.08	0.00	0.00	0.00
METLIFE AIG ANB	0.01	0.01	0.37	0.16	0.00	0.00	0.05	0.05
Al Alamiya	0.01	0.07	0.98	0.98	0.00	0.00	0.01	0.01
Sagr Insurance	0.00	0.00	0.88	0.93	0.00	0.00	0.54	0.28
Al-Ahlia	0.00	0.00	0.72	0.79	0.00	0.00	0.01	0.03
Alinma Tokio M	0.04	0.30	0.15	0.15	0.53	0.53	0.25	0.29
Allianz SF	0.00	0.00	0.94	0.83	0.00	0.00	0.22	0.50
Amana Insurance	0.00	0.36	0.99	0.99	0.00	0.00	0.67	0.47
AICC	0.00	0.00	0.81	0.97	0.00	0.00	0.00	0.00
Arabian Shield	0.00	0.00	0.06	0.06	0.02	0.00	0.00	0.00
AXA Cooperative	0.00	0.02	0.72	0.72	0.00	0.00	0.08	0.08
Buruj	0.01	0.01	0.55	0.55	0.02	0.00	0.02	0.02
Gulf General	0.00	0.00	0.86	0.93	0.00	0.00	0.00	0.00
Gulf Union	0.00	0.00	0.80	0.79	0.00	0.00	0.00	0.00
Malath Insuranc	0.00	0.00	0.49	0.67	0.00	0.00	0.02	0.01
SAICO	0.00	0.00	0.02	0.22	0.00	0.00	0.01	0.01
Salama	0.00	0.00	0.96	0.97	0.00	0.00	0.00	0.00
Saudi Rein	0.00	0.00	0.72	0.72	0.54	0.29	0.64	0.64
Tawuniya	0.00	0.01	0.82	0.73	0.04	0.00	0.29	0.34
MEDGULF	0.00	0.01	0.95	0.95	0.01	0.00	0.32	0.32
Trade Union	0.00	0.00	0.04	0.04	0.00	0.00	0.00	0.00
U C A	0.00	0.00	0.15	0.26	0.00	0.00	0.00	0.00
WAFA Insurance	0.00	0.00	0.44	0.64	0.00	0.00	0.82	0.81
Walaa	0.00	0.00	0.95	0.95	0.06	0.00	0.08	0.19
Wataniya	0.00	0.00	0.70	0.97	0.00	0.00	0.00	0.00

Note: The table reports the Engle and Manganelli (2004) test results. The models are RiskMetrics (RM), Normal APARCH (APARCH-N), Student APARCH (APARCH-ST) and skewed Student APARCH (APARCH-SKT).

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CONCLUSION

This study has two main goals: First, tested the performance of four competing models namely APARCH with Normal distribution (APARCH-N), APARCH with Student distribution (APARCH-ST) and APARCH with skewed Student distribution (APARCH-SKST), in estimating VaR of insurance stocks in KSA. Second, checked the decoupling hypothesis of Takaful insurance stocks from the mutual insurance companies. This study focuses on the insurance industry because it can substantially increase the non-oil GDP sector, as its actual contribution is only 2.1% compared to the banking sector. This is in line with the KSA 2030 vision, which aims at diversifying sources of income for the Saudi economy and decreasing its dependence on oil products. The author is interested in this particular industry because the percentage of Gross Written Premium (GWP) retained by the insurance companies (84%, in 2016) is too big compared to the reinsurance contracts. Therefore, the insurance companies are assuming most of the market risk, and they have to manage this risk.

In sum, author's results are in line with outstanding literature dealing with the stylized facts of asymmetry and fat tails for stock market volatility in emerging markets. This study is providing two contributions. First, at extreme cases, VaR models with skewed distribution of the conditional variance showed a better performance than normal distribution. Second, the author found that VaR models for Takaful insurance companies had the same patterns as Mutual insurance companies, which is in contradiction with the decoupling hypothesis of Takaful insurance stocks from the mutual insurance companies. The researcher thinks that this is because both segments are under the same authority (SAMA). The author recommends that policy makers and risk managers in the KSA Insurance industry have to take into consideration the asymmetric behaviour of stock returns as well as fat tails in measuring risk.

ENDNOTE

1. According to the Saudi Arabian Monetary Authority, "*The banking sector has assets of 126% over the non-oil GDP sector".* Financial Stability Report 2017. http://www.sama.gov.sa/

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