MEASURING MARKET RISKS FOR INDUSTRIES IN VIETNAM: THE VaR AND CVaR APPROACHES

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ABSTRACT

This study is conducted to estimate the market risk for all industries in Vietnam. Data covers the period from 2009 to May 2017. This research period is then divided into two distinct periods, including the post GFC (2009-2011) and the normal period (2012-2017) to identify the behavior of the market risk for Vietnam's industries. The two widely used approaches, being the VaR and CVaR, are utilized in this study. Empirical findings from this study indicate that *Pharmaceutical* and *Energy* are the least risky industries whereas *Oil and Gas* and *Securities* are the riskiest industries among all industries in Vietnam. In addition, this study provides evidence to confirm that all four targeted industries by the Vietnamese Government to the year 2020 including *Services; Food; Energy;* and *Telecommunication* are generally considered low risk industries in comparison with the other industries in the economy. Findings from this study support the calls for the Government to take a more proactive approach to other non-targeted industries for a more balanced development of the national economy.

Keywords: Market risk; Value at Risk; Conditional Value at Risk; Vietnam.

JEL classification: C10; G10; E32

1. Introduction

In the process of integration into the global economy, the development of the Vietnam's financial market is unavoidable. The financial market is expected to offer many attractive channels of capital mobilization as well as a wide variety of investment for various types of investors worldwide. Simultaneously, the financial market will provide great incentives for relevant State management agencies to have constantly improved the legal framework in order to promote the sustainable development of the market and to strengthen the trust of investors. Based on the Resolution of the 11th Congress of the Communist Party of Vietnam on Orientation and Solutions for Development of Major Economic Industries to 2020, the Vietnamese Government has devoted great importance to investment into four key industries, including services, energy, telecommunications, and food. However, this focus should not be viewed from the sense that other industries will be ignored along the way of the national economic growth and development.

In order to make an optimal investment decision, investors need to consider the risk level of one particular stock/industry compared to the others in the same industry as well as the risk at industry level in the market. In other words, each investor needs to determine the risk level of the industries to diversify their positions in order to minimize the risk given their expected return. Estimating a risk for various industries has played an important and necessary tool for investors to improve investment efficiency and to achieve optimal outcomes.

Some attempts have been found in empirical studies in the context of measuring risk in Vietnam. However, these studies have focused on the Vietnamese banking system. Our intensive literature review presents that no attempt has been found to estimate a market risk for industries using a combination of VaR and CVaR in the context of Vietnam. As such, this paper is conducted to provide empirical evidence in relation to the market risk of various industries in Vietnam, and its ranking for the last 10 years since the stock market in Vietnam had formally been in operation.

This paper is structured as follows. Following this Introduction, a brief discussion on the key approaches, being the VaR and CVaR approaches, are discussed in Section 2, followed by a summary of relevant empirical studies worldwide. Section 3 presents

data and empirical findings are presented in Section 4, followed by concluding remarks and policy implications in Section 5.

2. Literature review

2.1 Value at Risk (VaR) and Conditional Value at Risk (CVaR)

Many methods have been utilized for assessing and estimating the level of market risk for an industry. Among these methods, the Value at Risk (VaR) approach is one of the fundamental and key approaches for this purpose. On the ground of the assumptions that market movements are as usual and there are no portfolio transaction costs, an index with a given probability and intervals, VaR, is considered as a threshold where the likelihood of a loss over the market adjusted value of that index over the given time period exceeds the value at the given probability level. It is generally agreed that the greatest attraction of VaR is that it represents risk in the form of a single number. VaR is defined as the maximum amount a portfolio can lose at a certain level of confidence, typically at 95 per cent level of confidence.

Although widely known and used, VaR has also exhibited many disadvantages. Arztner et al. (1997; 1999) considered that VaR contained inconvenient mathematical attributes, such as lack of surplus and convexity. In addition, these authors also argued that VaR is based on the assumption of a standard distribution which is in proportion to the standard deviation. Mckay & Keefer (1996) and Mauser & Rosen (1999) argued that VaR is calculated on the basis of a combination of two portfolios which might outperform the overall risk of individual portfolio. They also considered that the tricky thing with VaR is that it is difficult to optimize when the level of market risk is computed from various scenarios. This view is based on the argument that the function of a positional portfolio may exhibit multiple local extrema, which makes it uncertain when determining the set of optimal positions and the overall VaR value.

Conditional Value at Risk (CVaR) is considered to be a more effective measure and estimate of the level of the market risk in comparison with VaR. CVaR can be used to measure marginal value which is beyond the capacity of VaR approach. Allen & Powell (2006) considered CVaR as a VaR equivalent method for measuring market and credit risks. On the same line with this view, Pflug (2000) demonstrated that CVaR is a rigorous risk measure which incorporates many desirable attributes such as convexity

and monotone, two of the most interesting properties, which the VaR approach fails to do so. Furthermore, VaR does not represent the probable loss range except for the first threshold value given associated with the specific measure. In contrast, CVaR determines the number of losses that may be encountered in the tail distribution. Rockafellar & Uryasev (2002) studied CVaR for portfolio optimization problems and provided evidences that CVaR was more effective than VaR.

In practice, the Basel regulation requires the amount of capital required in the banking system to be calculated. In the regulation, the Value at Risk (VaR) approach is mentioned as a recommended tool for calculating the amount of capital required under the regulation. As previously discussed, VaR measures the potential loss over a given period of time for given level of confidence (reliability). Doing so can help commercial banks to prevent bad cases of bankruptcy so that the amount of capital reserves is enough for the bank to use in case of abnormal occurrence. In addition, estimating accurately a level of appropriate reserves which is not in excess of the required level, can help banks to enhance their financial performance. Other VaR applications for credit risk include, to name a few, the diagonal model (Bollerslev et al., 1988), the multivariate GARCH model (Engle & Kroner 1995), the CreditMetrics model (Gupton et al., 1997), the CreditPortfolioView model (Wilson, 1998) and the iTransition model (Allen & Powell, 2009).

According to Allen et al. (2012), there are three main methods for VaR measurement: (i) Parametric, (ii) Historical, and (iii) Monte Carlo Simulation. While the parametric approach assumes the rates of return and risk to follow a particular distribution (e.g. a normal distribution), the historical methods use no assumption and the actual observations of return are utilized. In addition, the Monte Carlo Simulation generates random numbers (and return) which is based on a predetermined indicator.

In a simple language, VaR determines the maximum loss value in a given period of time associated with a given level of confidence. However, VaR does not present any other possible losses other than the specified VaR. Samanta et al. (2005) criticized the VaR risk measurement because it did not measure the losses in tail. CVaR will overcome this problem. CVaR can measure the distribution losses in the tail because the key purpose of using CVaR is to measure the earnings exceed VaR. For example, if VaR is

measured at 95 per cent, $CVaR_\alpha$ is an average of the worst 5 per cent of the returns (α = 0.05). CVaR is usually calculated as a percentage. For example, 0.01 CVaR daily at a 95 per cent confidence level means that the loss should not exceed an average of 1 per cent in the worst 5 per cent of cases. CVaR used in optimization problems (Alexander et al., 2003; Bird et al., 2013), risk management and optimization (Sarykalin et al., 2008). Boubakera & Sghaierb (2013) studied CVaR simulates the dependence between financial assets, the adequacy of bank capital (Allen et al., 2016), and risk during crisis (Allen et al., 2012; Toquea & Terrazab, 2014).

2.2 Empirical Study

Various papers have attempted to estimate the market risk level using VaR and CVaR methods concurrently. Powell et al. (2017) categorized the S&P Goldman Sachs Commodity Index into groups and used the modified CVAR method to assess the level of risk in particular periods classified by GDP growth. Findings from this empirical study indicated that there were differences in the level of risk of different commodities in different periods considered. Adesi (2016) used VaR and CVaR methods to study about the options price. The results showed that when the measurement method changed, estimates from CVaR were less sensitive than those of VaR. Valecký (2012) used mixture normal VaR to estimate the market risk of four European market portfolios (Vienna Stock Exchange Austrian Traded Index - ATX, Deutsche Boerse AG German Stock Index - DAX, Financial Times Stock Exchange 100 Index - FTSE 100 and Prague Stock Exchange Index - PX). The results showed that with higher reliability, the VaR figure estimated by the Markov-Switching normal distribution gives better results than other distributions.

Allen et at. (2012) studied the relationship between market and credit risk of European industries using VaR, CVaR and KMV/Merton methods. Findings from their study indicated that Telecommunication and Information Technology is one of the highest risk industries in pre-GFC period. However, during the GFC period, Financial and Consumer Discretionary industries become those of the highest risk industries. Kourouma et al. (2011) studied Value at Risk and Expected Shortfall of Standard & Poor 500 (S&P500), Cotation Assistée en Continu - French stock market index (CAC 40), Wheat and Crude oil indexes during 2008 GFC. The results show that unconditional

VaR is not as effective as the conditional models. In their study, the conditional EVT model predicting property loss presents a more accurate and reliable outcome. Allen & Powell (2007) studied the market risk of industries in Australia using VaR and CVaR and measured the credit risk by the KMV/Merton model. The results showed that Technology industry is at high risk. Meanwhile, both models showed a significant association between industry rankings over 7 years. Harmantzis et al. (2006) compared the performance of Value at Risk and Expected Shortfall by studying daily returns of popular indices and currencies from 1990 to 2003. Results from this study indicated that with 95 per cent level of confidence, the impact of window size on performance was not determined, while the reliability was more pronounced the 99 per cent level of confidence. Moreover, non-fat tailed models could predict risk less accurately than fat tailed ones. Allen & Powell (2006) argued that CVaR is actually considered as a VaR equivalent method for measuring market and credit risks. Rockafellar & Uryasev (2002) utilised CVaR for portfolio optimization problems and also provided evidence to confirm their view that CVaR is more effective than VaR, we can reduce CVaR efficiently by linear programming and non-smooth optimization techniques.

3. Data and Methodology

This study is conducted to estimate the level of market risk for various industries in Vietnam. These industries include *Banking*, *Education*, *Energy*, *Food*, *Oil and gas*, *Pharmaceutical*, *Real estate*, *Securities*, *Services*, and *Telecommunications*. As stated above, four key industries (i.e. Services, Energy, Telecommunications, and Food) will receive particular attention in this analysis because they are targeted industries by the Vietnamese Government in the national economic strategies to the year 2020. Data utilized in this study for of each industry covers the period of 9 years, from 2009 (the first year when relevant data becomes available) to June 2017 (when this study was conducted). Data is collected from a financial website at http://cophieu68.vn.

Among various methods to calculate VaR as previously presented, a parametric approach used by RiskMetrics (J.P. Morgan & Reuters, 1996) is utilised in this paper. In the parametric approach, it is hypothesized that the rates of return and risk follow the standard distribution. In this method, the following steps are used to estimate VaR. *First,* the current value V_0 of the portfolio is calculated. *Second,* the expected rate of return *m*

and the deviation of the squared yield of the portfolio σ is estimated. *Third,* VaR is determined by the following expression:

$$VaR = V_0 * (\mu_p - \alpha * \sigma_p)$$

For simplicity, VaR is calculated in term of percentage rather than in absolute value. It is also noted that the parametric CVaR is calculated by the average returns beyond the parametric VaR. This practice follows the approach adopted in various studies such as Allen et al. (2012) and Powell et al. (2017).

It is generally agreed that the global financial crisis hit the world, including Vietnam in October 2008. This study wishes to examine the level of market risk of industries in Vietnam prior to and during the GFC. However, it is impossible to do so as data is not available. GFC is generally considered to cover the period from 2007 to 2009 (Powell et al., 2017). As such, in this study, the change of the market risk level of various industries in Vietnam are considered in two distinct periods: (i) the recovery period which includes the 2009-2011 (post-GFC) period; and (ii) the normal phrase including 2012-2017 period. This choice is relatively arbitrage. However, it is expected to shed lights to policies and investment decisions in relation to any consideration of the level of market risk for Vietnam's industries.

4. The results

Daily VaR and CVaR (both at 95 per cent confidence level) of all industries for the full researched period, from 2009 to 2017 are presented in Table 1 below[1]. At the overall level, the general trend of the market risk for all industries in Vietnam declines from 2009 to 2013, then increases in 2014 and returns to decline in subsequent years. However, the common observation from the findings of this study is that the level of market risk for all industries in Vietnam has decreased since 2009 to date. In details, for the period from 2009 to 2017, the level of risk for *Energy* declined. At 95 per cent confidence level, in 2009, the largest loss for *Energy* is 4.31 per cent (of the investment) whereas this loss has been substantially reduced to 0.96 per cent in 2017. In comparison with all other industries in Vietnam, the level of market risk for *Securities* fluctuates over the period. For this industry, with 95 per cent confidence, the largest loss was 5.92

[1] Visualized graphs referring to Table 1 are shown in Appendix 1.

per cent in 2009. This level then gradually decreased in the following years. This industry was then hit with an increase of the market risk of 4.11 per cent in 2012 which was down to 2.64 per cent in 2013, to 4.13 per cent in 2014, then gradually decreased to 1.86 per cent in 2017. For all industries, the level of market risk over the period has consistently changed under both VaR and CVaR approaches.

Table 1. Daily VaR and CVaR at 95 per cent confidence level: 2009 - 2017

Year	Banking	Education	Energy	Food	Oil and gas	Pharma	Real Estate	Securities	Services	Telecom
Value at Risk at 95 per cent level of confidence (*Per cent)*										
2017	1.59	1.52	0.96	0.94	2.03	1.32	1.29	1.86	2.78	1.82
2016	1.98	4.05	1.26	2.13	3.40	2.14	1.97	2.03	1.98	1.51
2015	2.85	2.73	1.49	2.00	3.19	1.74	1.75	2.71	1.92	1.96
2014	1.95	1.96	2.22	1.90	3.38	1.95	2.61	4.13	2.24	2.93
2013	2.19	1.71	2.69	2.31	2.64	2.06	2.47	2.70	2.09	2.10
2012	2.77	2.62	2.66	2.52	3.30	2.30	3.01	4.11	2.44	2.26
2011	2.88	2.25	2.30	1.86	3.25	1.64	2.80	3.73	3.36	2.45
2010	2.54	3.58	2.88	2.67	3.37	1.76	2.87	4.04	4.16	2.91
2009	4.69	4.01	4.31	4.08	4.45	3.27	4.37	5.92	4.85	4.26
Avg.	**2.35**	**2.61**	**2.31**	**2.27**	**3.18**	**2.04**	**2.36**	**3.14**	**2.87**	**2.47**
Conditional Value at Risk at 95 per cent level of confidence (*Per cent)*										
2017	2.37	2.15	1.40	1.07	2.46	1.77	1.93	3.06	4.03	3.21
2016	2.90	5.88	1.67	3.03	4.50	2.81	2.74	2.82	2.68	2.38
2015	3.67	3.44	1.95	2.73	5.12	2.40	2.37	3.97	2.78	3.00
2014	3.00	2.64	3.14	3.07	4.99	3.23	3.69	5.91	3.37	4.19
2013	3.18	2.18	3.67	3.36	3.47	3.04	3.22	3.72	2.56	2.91
2012	3.77	3.77	3.65	3.18	4.39	3.00	3.78	4.78	3.03	3.10
2011	3.24	2.94	3.04	2.49	4.19	2.38	3.48	4.40	4.19	3.27
2010	3.42	4.54	3.69	3.45	4.27	2.42	3.6	4.86	5.19	3.57
2009	5.37	4.86	4.77	4.56	4.97	4.02	4.94	6.41	5.97	4.74
Avg.	**3.31**	**3.58**	**3.00**	**2.99**	**4.49**	**2.90**	**3.16**	**4.24**	**3.75**	**3.37**

Source: Authors' analysis

When the entire research period of 2009-2017 is considered, as presented in Table 2 below, the VaR varies within the range of almost 1.88 per cent to 4.56 per cent whereas a relatively higher range of 2.58 per cent to 5.22 per cent is found under the CVaR approach.

Table 2. VaR and CVaR at 95 per cent confidence level: 2009-2017 Average

Period	Banking	Education	Energy	Food	Oil and gas	Pharma	Real Estate	Securities	Services	Telecom
Value at Risk at 95 per cent level of confidence (*Per cent)*										
Normal	2.22	2.43	1.88	1.97	2.99	1.92	2.18	2.92	2.24	2.10
Post-GFC	3.37	3.28	3.16	2.87	3.69	2.22	3.35	4.56	4.12	3.21
Conditional Value at Risk at 95 per cent level of confidence (*Per cent)*										
Normal	3.15	3.34	2.58	2.74	4.15	2.71	2.96	4.05	3.07	3.13
Post-GFC	4.01	4.12	3.83	3.50	4.48	2.94	4.01	5.22	5.11	3.86

*Note: "**Normal**" and "**Post-GFC**" periods represent the 2012-2017 and 2009-2011 periods, respectively.*

Source: Authors' analysis

Table 3. Ranking – Ten industries in Vietnam: 2009 - 2017

Period	Banking	Education	Energy	Food	Oil and gas	Pharma	Real Estate	Securities	Services	Telecom
Based on Value at Risk at 95 per cent level of confidence										
Normal	5	3	10	8	1	9	6	2	4	7
Post-GFC	4	6	8	9	3	10	5	1	2	7
Based on Conditional Value at Risk at 95 per cent level of confidence										
Normal	4	3	10	8	1	9	7	2	6	5
Post-GFC	5	4	8	9	3	10	6	1	2	7

*Note: 1 represents the highest risk level while 10 represents the lowest ones. "**Normal**" and "**Post-GFC**" periods represent the 2012-2017 and 2009-2011 periods, respectively.*

Source: Authors' analysis

As indicated in Table 3, estimates of the level of market risk for various industries suggest that while *Pharmaceutical* and *Energy* are the least risky industries, *Oil and Gas* and *Securities* are the riskiest ones among all industries in Vietnam for the 2012-2017 period (the normal period). However, the post-GFC period reveals some differences. During the post-GFC, the *Securities* and *Services* are those industries with highest risk, whereas the least risky industries are *Food* and *Pharma*. These findings are consistent when either VaR or CVaR is considered.

We now shift our attention to the four targeted industries in Vietnam including *Services; Food; Energy;* and *Telecommunication.* Among these four industries in term of the market risk level, *Service* ranks the riskiest industry whereas *Food* is the lowest (or safest) ones among all four targeted industries, as presented in Table 4 below. The level of market for these four industries is highest in 2009, after some fluctuation in 2012, gradually decreases to 2017. Spread of the market risk level for all industries

indicates that these four targeted industries are unstable in relative riskiness ranking over the research period.

Table 4. Ranking – Four targeted industries

Year	Services	Energy	Telecom	Food
Value at Risk at 95 per cent level of confidence				
2017	1	3	2	4
2016	2	4	3	1
2015	3	4	2	1
2014	2	3	1	4
2013	4	1	3	2
2012	3	1	4	2
2011	1	3	2	4
2010	1	3	2	4
2009	1	2	3	4
Average	**1**	**3**	**2**	**4**
Spread	3	3	3	3
Conditional Value at Risk at 95 per cent level of confidence (*Per cent)*				
2017	1	3	2	4
2016	2	4	3	1
2015	2	4	1	3
2014	2	3	1	4
2013	4	1	3	2
2012	4	1	3	2
2011	1	3	2	4
2010	1	2	3	4
2009	1	2	3	4
Average	**1**	**3**	**2**	**4**
Spread	3	3	2	3

Note: *1 represents the highest risk level while 4 represents the lowest level of the market risk among the 4 targeted industries. Spread is calculated as the difference between the highest and lowest ranking for an industry within the full research period.*

Source: Authors' analysis

Next, Table 5 presents some evidences to confirm that the level of market risk for all four targeted industries has substantially decreased from the post GFC period (2009-2011) to the normal period (2012 to 2017). Particularly, the VaR results suggest that the level of market risk reduces 31% (*Food*) - 46% (*Services*) from the former to the latter period. For CVaR figures, the reduction range is 19% (*Telecom*) – 40% (*Services*).

Table 5. Period VaR and CVaR results – Four key industries

Period	Services	Energy	Telecom	Food
Value at Risk at 95 per cent level of confidence (*Per cent)*				
Normal	2.24	1.88	2.10	1.97
Post-GFC	4.12	3.16	3.21	2.87
% Changed	**-46**	**-41**	**-35**	**-31**
Conditional Value at Risk at 95 per cent level of confidence (*Per cent)*				
Normal	3.07	2.58	3.13	2.74
Post-GFC	5.11	3.83	3.86	3.50
% Changed	**-40**	**-33**	**-19**	**-22**

Note: *"**Normal**" and "**Post-GFC**" represent the 2012-2017 and 2009-2011 period, respectively.*

Source: Authors' analysis

Finally, Table 6 presents a summary of ranking for four targeted industries over the two periods. On balance, *Services* is generally ranked the riskiest industry whereas *Energy* and *Food* are relatively safe in terms of the relative market risk among the four industries under both VaR and CVaR approaches.

Table 6. Period Ranking – Four key industries

Period	Services	Energy	Telecom	Food
Based on Value at Risk at 95 per cent level of confidence				
Normal	1	4	2	3
Post-GFC	1	3	2	4
Based on Conditional Value at Risk at 95 per cent level of confidence				
Normal	2	4	1	3
Post-GFC	1	3	2	4

Note: *1 represents the highest risk level while 4 represents the lowest ones. "**Normal**" and "**Post-GFC**" periods represent the 2012-2017 and 2009-2011 periods, respectively.*

Source: Authors' analysis

5. Concluding remarks

This study presents empirical evidence in relation to the market risk level of all industries in Vietnam for the most recent period, from 2009 to June 2017. On the ground of the VaR and CVaR approaches, findings from this study indicate that the level of market risk across all industries have substantially reduced from 2009 (the first year after the GFC) to the most recent year of 2017. During this research period, *Pharmaceutical* and *Energy* are generally considered the safest (lowest market risk) industry in Vietnam. In addition, the Vietnamese Government have selected the so-called 4 targeted industries including *Services; Food; Energy;* and *Telecommunication*

among all ten industries in Vietnam. Empirical findings from this study indicate that all these industries targeted by the Government are relatively safer in comparison with other industries. The findings support the call for the Government to take a courage to divert the attention on other riskier industry in order to achieve a more balanced outcome for the economy. The findings from this study provide additional evidence for investors to make an investment decision in Vietnam to reasonably expect a return for their investment. This study also presents important evidence to confirm the view that Vietnam's industries have substantially improved the economic performance over the entire research period, moving from a relatively higher level of the market risk (the post GFC period of 2009-2011) to a lower risk environment for the normal period (2012-2017).

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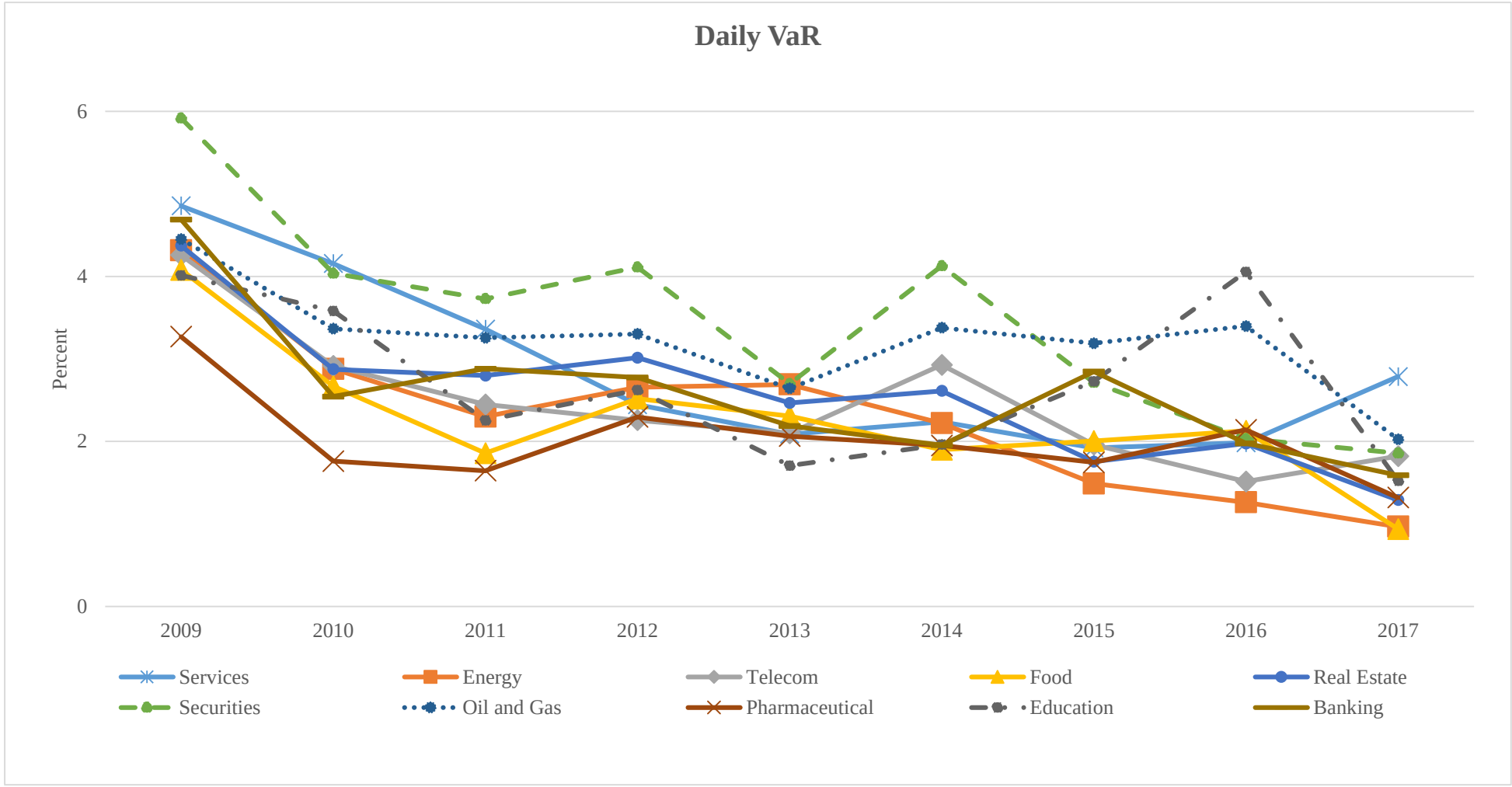
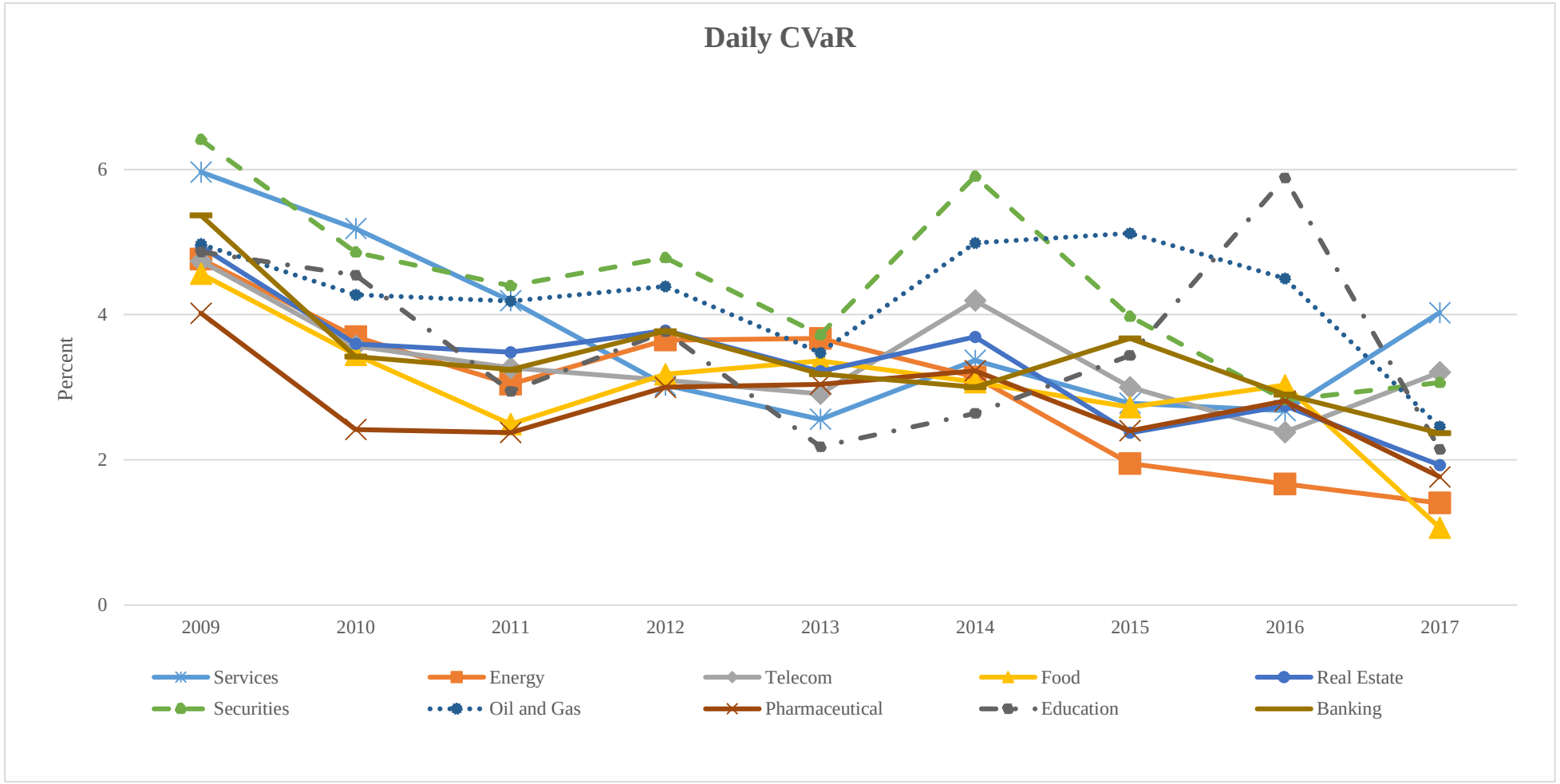
Appendix 1. Daily VaR and CVaR at 95 per cent level of confidence – Ten industries



Source: *Authors' analysis*



Source: *Authors' analysis*