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Malaysian equities: A sector analysis of risk and normality

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MALAYSIAN EQUITIES: A SECTOR ANALYSIS OF RISK AND NORMALITY

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Abstract- This study uses Value at Risk (VaR) and Conditional Value at Risk (CVaR) metrics to measure the relative riskiness of sectors for Malaysian equities. VaR is a widely used volatility measure, but only measures risk below a specified threshold, whereas CVaR looks at risk beyond that threshold. The study finds that the relative risk of sectors changes with changingeconomic circumstances as measured by VaR, but remains significantly the same as measured by CVaR. Parametric (normally distributed) measures of VaR are compared to nonparametric measures, and it is found, consistently across all sectors, that parametric measures are not suitable measures of volatility for Malaysian equities due to a large spread in tail risk.

Index Terms- Value at Risk, Conditional Value at Risk, Malaysian Sectors, Parametric, Nonparametric.

I. INTRODUCTION

Malaysia's economy is a vital part of the ASEAN region, having the third largest economy (by GDP) in that region, and the second largest stock exchange by market cap. It is ranked as the second most competitive nation in the ASEAN region, and is also globally very competitive, ranked 20th in the world by the World Economic Forum [22].On certain components of the competiveness ranking scale, Malaysia scores highly among the top countries in the world, ranked number4 on financial market development, and 7 on goods market efficiency.

Given the importance of Malaysia's economy and stock exchange, both globally and more particularly to the ASEAN region (as outlinedin section II below) this study provides a focus on that nation. In particular, the relative riskiness of sectors of the stock exchange are examined. Sector analysis of equities is not only important to investors in determining portfolio mix, but as equity prices reflect all available market and economic information, high volatility in equity prices within a particular sector can Be an indicator of potential economic problems within that sector. Two key metrics will be used. Firstly, the study will use Value at Risk (VaR) which measures risk at a selected threshold over a specified time period. The second metric used is Conditional Value at Risk (CVaR) which captures that extreme risk beyond the VaR threshold. As part of the VaR and CVaR analysis, the study will examine whether parametric metrics (which assume the market is normally distributed), or nonparametric metrics (which make no assumptions about normality) are appropriate in the Malaysian equity market. This will not only provide important information about metric selection, but also about the distribution of the overall market and its sectors. The study incorporates ten years from 2005 to 2015. As part of the study, we will separately examine the Global Financial Crisis (GFC) years. By using CVaR as well as isolating the GFC period, the study is able to focus on that extreme risk in the tail of the distribution during the most extreme circumstances, which is when investors and sectors are most vulnerable. The research questions are thus threefold. Firstly, what is the relative risk of sectors, using both VaR and CVaR metrics? Secondly, does this relative risk between sectors change as economic circumstances change? And thirdly, how normally distributed is the market and each of its sectors? The study commences by providing some background on Malaysian sectors, followed by a discussion on the literature, then an outline of the data and methodology used, then a discussion on the analysis and results, with conclusions thereafter.

II. BACKGROUND ON MALAYSIA'S SECTORS

Malaysia has a total GDP exceeding RM 800 billion (USD $220 billion). The major exports of Malaysia are electrical and electronic products (33%) petroleum (12%) and palm oil (8%) [11]. Table 1 provides a breakdown of GDP by economic sector.

Table 1(a). GDP by sector

	RM bil	%
Agriculture, forestry & fishing	58	7.1%
Mining	66.9	8.2%
Manufacturing	200.1	24.6%
Construction	32.2	4.0%
Services	457.1	56.1%
	814.3	100.00%

Table 1(b). Breakdown of Services Sector GDP.

	RM bil	%
Electricity gas and water	20.9	2.6%
Transport storage & communcations	65.1	8.0%
Wholesale, retail, accom, restaurant	140.4	17.2%
Finance, insurance, real estate & business serv.	122.4	15.0%
Government services	65.8	8.1%
Other services	42.5	5.2%
	457.1	56.13%

Source: [11]

The financial sector in Malaysia remained strong

compared to many other global countries during the GFC. This has been attributed to negligible exposure to sub-prime assets, a well capitalized banking sector, and strong reforms of the financial sector following the Asian Financial Crisis. Nonetheless, the global economic conditions during the GFC led to a decline in economic growthin Malaysia (with negative growth in the first two quarters in 2009) and a fall in equity prices. The impact was lessened through two government fiscal rescue packages and through monetary easing measures introduced by the Bank Negara Malaysia.[14, 15].

III. SECTORAL STUDIES IN THE ITERATURE

Here we provides a selection of literature which highlights why it is important to divide a market analysis into different sectors and economic periods, as we do in this study. Prior studies in other markets show that risk is not consistent across sectors and that relative sector risk changes across time periods. Some prior studies have shown that certain sectors in can yield abnormal returns.A study on global equitiesfound the resource sector to yield significant abnormal returns under the capital asset pricing model (CAPM)[12] whereas the industrial sector and the information technology (I.T.) sector yield abnormal returns under the Fama and French 3-factor model [13]. In Europe it was found, using VaR and CVaR metrics, that the relative risk of sectors changes with changing economic circumstances   and that those sectors that were most/least risky prior to the GFC are not the same as those sectors that were most/least risky during the GFC [7]. In Indonesia, Agriculture and Mining were found to be highly volatile compared to other industries, when using VaR and CVaR metrics. In the Indonesian study, Consumer Staples was found to be more stable with consumers generally continuing to purchase essential goods throughout different economic cycles. Somewhat surprisingly in the Indonesian study, the Consumer Discretionary sector was also found to be very stable in the GFC. Consumer Discretionary can generally be very volatile in risky times, due to customers delaying essential purchases, however, given that Indonesia did not experience the same level of downturn as many countries during the GFC and had very rapid recovery thereafter, there was no need for consumers to make major changes to buying patterns [6]. A further important finding of this study was that, in contrast to findings in other global markets, the Indonesian market was found to normally distributed, even during the GFC (due to its relative stability over that time), with a parametric VaR model (which assume normal distribution) yielding VaR results which were not significantly different to a nonparametric VaR model. In Australia it was also found that relative industry risk changes as economic circumstances change. Those sectors that were the most risky in upturn times were different to those sectors that were the most risky in downturn times. It

was also found that optimal sector portfolio mix changes when using VaR as an optimizer as compared to CVaR[5].

IV. DATA AND METHODOLOGY

A. Data
The study uses sector indices from Datastream. These indices are designed to represent approximately 97% of the available Bursa Malaysia market cap and comprises 8 sector indices. This includes Oil & Gas, Basic Materials, Industrials, Consumer Goods, Consumer Services, Utilities, Telecom and Financials.

B. Method
Risk is measured in this study using VaR and CVaR. VaR, which measures potential losses over a specific time period within a given confidence level, is a well understood and widely used metric for measuring market risk.   The VaRconcept gained significant traction as a benchmark risk metric on its incorporation into the Basel Accord as a required measurement for determining bank capital adequacy for market risk. Although widely used, VaR has been criticized for having undesirable mathematical properties such as lack of sub-additivity [9, 10]. A major problem with VaR its focus on risks below a specified threshold (level of confidence), which completely ignores the tail risks beyond VaR [20]. Conditional Value at Risk (CVaR) measures extreme returns (those beyond VaR). Pflug[17] showed CVaR to be a coherent risk measure with several desirable properties, includingsub-additivity. CVaR has been used in several portfolio optimization studies by several studies, including Rockafeller et. al[18, 19, 21],Andersson et.al [8], and Alexander et. al [1,2]. It has also been used as an alternative method to VaR for measuring market and credit risk in an Australia[3, 4]. Our methodology involves calculation of VaR and CVaR. VaR can be calculated using parametric or nonparametric historical simulation methods. Parametric methodology was introduced and popularized by Riskmetrics [16].Under this approach, the standard deviation (σ) of daily returns is obtained, which is then multiplied by a factor according to normal tables for the desired level of confidence, e.g. at a 95% confidence level, $VaR_x = 1.645\sigma_x$ (where σ is the standard deviation). Of course the key problem with this approach is that it assumes that returns are normally distributed, which may not be the case, especially during times of high volatility. Therefore an alternative is the historical distribution approach. This approach makes no assumption about the distribution, but is based on actual historical returns (returns are ordered from best to worst, with 95% VaR being the actual 95 percentile return. Therefore our analysis will commence with a comparison of parametric and nonparametric returns to determine the best approach, followed by a ranking analysis of the sectors for the total period and for the GFC period. CVaRis

calculated as the average of those returns beyond VaR, i.e. the average of those 5% of returns which exceed the historical VaR (for historical nonparametric CVaR), or the average of actual returns beyond the normally distributed VaR measure (for parametric VaR).

V. ANALYSIS AND RESULTS

A. ASSESSMENT OF NORMALITY

As mentioned in the prior section, parametric measures will result in a VaR of 1.645σ, based on a 95% confidence level. In other words, 95% of observations wiil not exceed 1.645σ, based on a standard normal distribution. If more than 95% of actual observations have a return of less than 1.645σ, then parametric methods will overestimate VaR short, and vice versa. In this study, CVaR is based on the average of the 5% observations beyond the 95% VaR. To see where CVaR falls on a standard normal distribution, this study undertook a Monte Carlo analysis. Ten sets of random numbers of were generated with 20,000 observations each based on a normal distribution (σ of 1 and mean of zero). Therefore a total of 200,000 numbers were generated. As expected, the average VaR of these sets was 1.645σ at 95%. The average of the worst 5% (CVaR) was 2.067σwhich is 98.1% of observations based on a standard normal distribution. Therefore, we would expect, that if our distribution is normal, then 95% of observations would be lower than or equal to 1.645σ (VaR), and 98.1% of observations would be lower than or equal to 2.067σ (VaR). In Figure 1, the analysis compares the actual historical distribution of our obsevations, to those of a normal distribution, with discussion of these results taking place after the figure. (parametric VaR and CVaR). In each case, the dotted VaR line is shown as 1.645 and the dotted CVaR line at 2.067, which are the normally distributed thresholds for VaR and CVaR. The bold solid lines show the actual historical VaR (bottom line) and CVaR (top line) for each of the years (2005 – 2015) in our analysis. The thin solid lines are trend lines. Some interesting results emerge. The top graph on the prior page shows that the average VaRto σover the period is 1.457, which (using F tests for significant differences in volatility at the 95% level) is significantly less than the 1.645σ normally distributed level. Is this finding consistent over time and across industries? VaR only exceeds 1.645 in one of the years (2011). Even during the GFC years,VaR stayed below the 1.645 level. So it is fairly consistently lower than parametric VaR, but what is also clear, is that the graph moves up and down, i.e. the distance between historical and parametric is not consistent. For every industry, VaR is below 1.645, ranging from 1.44 for Oil and Gas to 1.56 for Consumer Services. But again, the distance between historical and parametric is constantly fluctuating.
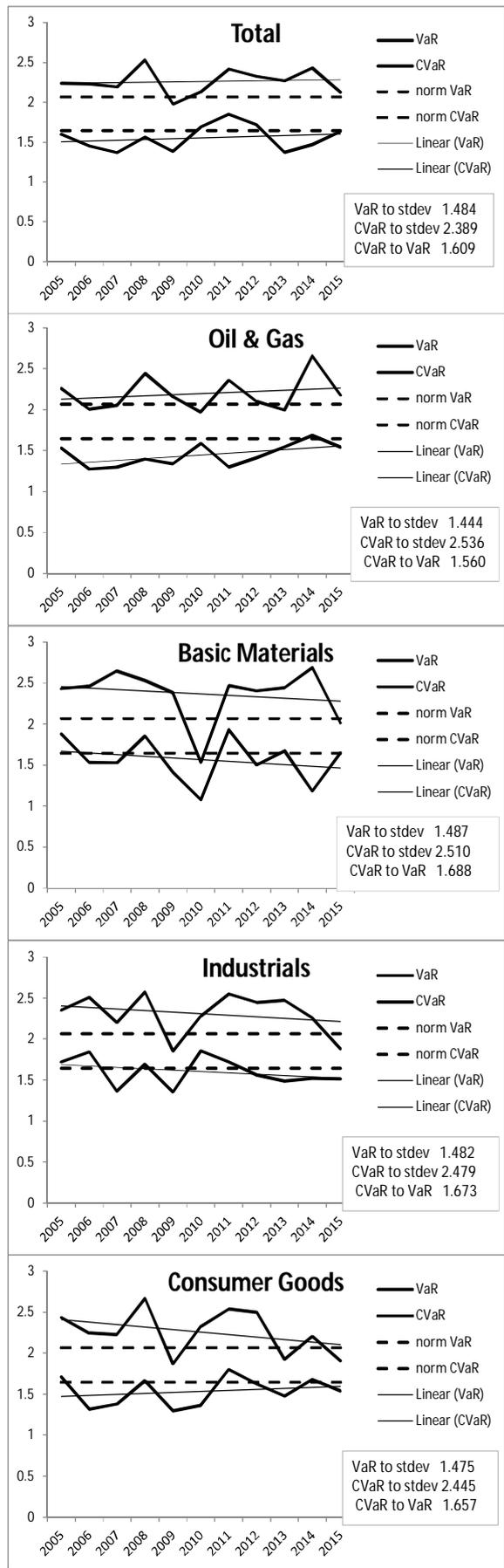

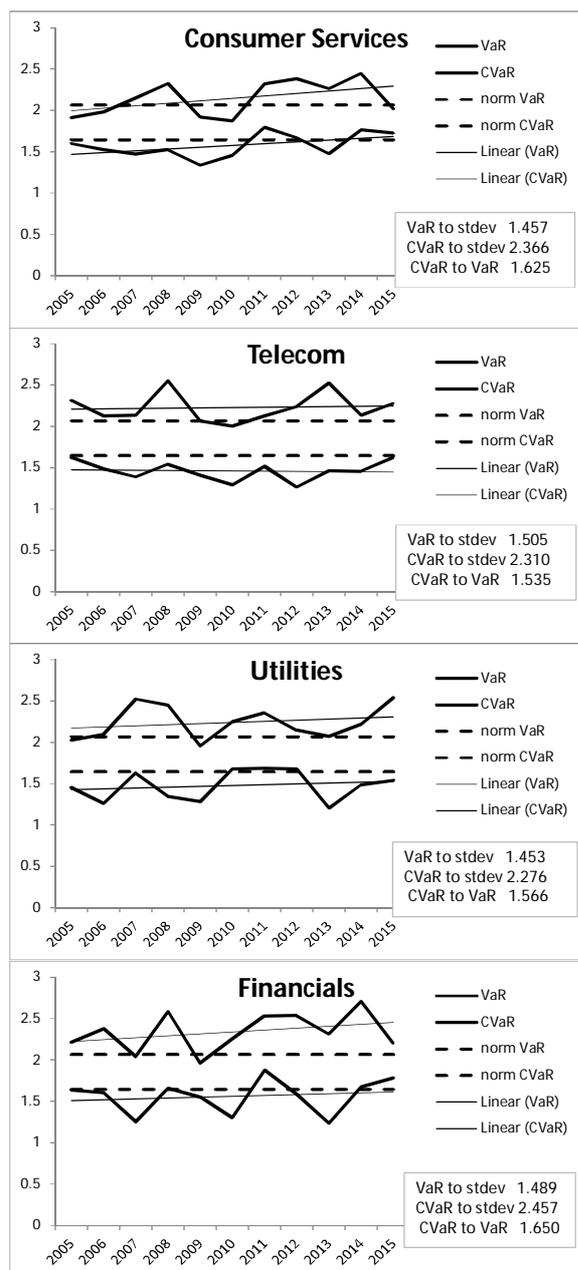**Figure 1. Historical distribution compared to normal distribution.**

Figure 1 (continued).Historical distribution compared to normal distribution.

The dotted lines show a normal distribution In regards to CVaR, the opposite occurs. CVaR to σ is 2.389, compared to 2.067 for a normal distribution. What this means is that there are some large negative observations at the tail end of the distribution. This is the case for all the individual sectors, ranging from 2.25 for Oil and Gas to 2.51 for Basic Materials. We can conclude that parametric VaR, overall, would overestimate the true VaR and not be an appropriate estimate of VaR in Malaysia. Parametric CVaR, on the other hand would underestimate CVaR. The spread between parametric VaR and CVaR (2.067/1.645) is 1.26, whereas as the spread for Malaysian equities is a much higher 1.62. As parametric VaR and CVaR are not appropriate measures, we will continue our sector analysis with only historical VaR in Table 2.

A. Sector Analysis

Table 2 showsVaR and CVaR for each sector. The first section of the table shows the total period from 2005-2015. The second section shows non-GFC years (excludes years 2007-2009) and the third section shows GFC years 2007-2009. A ranking of 1 is least risky, and a raking of 8 is most risky.

The final section of the table shows how rankings change from the non-GFC to the GFC period, with a negative figure representing a deterioration in rankings. Over the entire period, Financials are the least risky as measured by both VaR and CVaR. Basic Materials is the most risky followed by Oil and Gas and Consumer Services. What is interesting is how this changes over the GFC as compared to non-GFC periods. Both CVaR and VaR increase substantially, but the rankings change. Financials and Telecoms become relatively more risky for VaR, whereas Oil and Gas become relatively less risky. For CVaR, Consumer Goods and Telecoms become relatively more risky for CVaR and Utilities less risky. A Spearman rank correlation test was applied to measure whether there was significant difference in rankings between these two time periods. The VaR rankings are significantly different. Those industries that were the most (least) risky in the non-GFC period are not the same industries that were most (least) risky in the GFC period. From a CVaR perspective, there is no significant difference between the periods.

Those industries that have extreme tail risk remain (significantly) the same industries across both the time periods studied. It is beyond the scope of this paper to investigate the underlying characteristics of each industry to see why certain sectors are more or less risky than others or why the risk of certain industries changes from one period to the next. That could be the subject of a whole separate study. However there are some broad observations that could be made, in particular in regards to the resources (Oil and Gas and Basic Materials) and Financial sectors. It is not surprising to see the resources sectors reflecting the highest risk, as these sectors are influenced by world commodity prices which can be highly volatile. The volatility of these sectors is a common theme in other sector studies mentioned in Section 3

Financials have shown the lowest risk over the entire period. Although there was a downward shift in GFC from number 1 to number 4 ranking in VaR, the industry remained number 1 from a CVaR perspective. This is in stark contrast to what happened globally, with the financial sector (particularly in Europe and the United States) having massive increases in risk and bank failures escalating substantially. The sustained low risk of banks is testament to the reforms of the banking industry in Malaysia following the Asian Financial Crisis and consistent with the observations in Section II that Malaysian had banks had negligible exposure to sub-prime assets and remained well capitalized over the GFC.

Table 2. Sector VaR and CVaR values and rankings

Total Period

	σ	VaR	CVaR	Ranking σ	Ranking VaR	Ranking CVaR
Oil and Gas	0.0109	0.0158	0.0246	7	6	7
Basic Materials	0.0110	0.0163	0.0275	8	8	8
Industrials	0.0086	0.0128	0.0214	2	2	4
Consumer Goods	0.0090	0.0133	0.0220	3	3	5
Consumer Services	0.0104	0.0161	0.0238	6	7	6
Telecom	0.0090	0.0136	0.0209	4	5	2
Utilities	0.0093	0.0136	0.0213	5	4	3
Financials	0.0084	0.0125	0.0206	1	1	1
Total	0.0094	0.0139	0.0224			

Non-GFC Period

	σ	VaR	CVaR	Ranking σ	Ranking VaR	Ranking CVaR
Oil and Gas	0.0091	0.0135	0.0202	7	7	7
Basic Materials	0.0095	0.0148	0.0217	8	8	8
Industrials	0.0065	0.0108	0.0153	4	4	4
Consumer Goods	0.0064	0.0101	0.0146	2	3	3
Consumer Services	0.0081	0.0133	0.0175	5	6	5
Telecom	0.0065	0.0096	0.0144	3	2	2
Utilities	0.0082	0.0123	0.0182	6	5	6
Financials	0.0060	0.0095	0.0143	1	1	1
Total	0.0071	0.0116	0.0162			

GFC

	σ	VaR	CVaR	Ranking σ	Ranking VaR	Ranking CVaR
Oil and Gas	0.0134	0.0180	0.0343	6	3	7
Basic Materials	0.0136	0.0222	0.0360	7	8	8
Industrials	0.0118	0.0178	0.0301	2	2	3
Consumer Goods	0.0126	0.0187	0.0322	4	5	5
Consumer Services	0.0141	0.0204	0.0336	8	7	6
Telecom	0.0129	0.0187	0.0320	5	6	4
Utilities	0.0112	0.0159	0.0298	1	1	2
Financials	0.0120	0.0181	0.0290	3	4	1
Total	0.0127	0.0189	0.0315			

Ranking Changes

	σ	VaR	CVaR
Oil and Gas	1	4	0
Basic Materials	1	0	0
Industrials	2	2	1
Consumer Goods	-2	-2	-2
Consumer Services	-3	-1	-1
Telecom	-2	-4	-2
Utilities	5	4	4
Financials	-2	-3	0

CONCLUSIONS

The research set out to examine three questions. Firstly, to determine the relative risk of sectors, using both VaR and CVaR metrics. The study showed Financials to be of the lowest risk with Oil and Gas, Basic Materials and Consumer Goods the highest. Secondly, whether relative risk between sectors change as economic circumstances change. The study showed that there was significant difference in rankings between the GFC and non-GFC for VaR but

not CVaR.Thirdly, whether the Malaysian market and each of its sectors are normally distributed. It was found that normally distributed (parametric) measures would not be appropriate, as they would overstate VaR and understate CVaR.

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