Studying downside risk in the oil and gas market using logistic regression

by

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(1) Overview

The oil and gas industry is characterized by highly volatile price, and recent years have confirmed this as crude oil price fell below $40 per bbl in the fall of 2008 after hitting $140 just 6 months earlier, Currently, prices are above $100 per bbl. A commonly used method to control downside risk is Value-at-Risk (VaR) which provides an estimate of the worst-case scenario for the next holding period at a certain significance level. Although the method is widely used, it has been shown that it is none-coherent as it cannot guarantee a diversification bonus. While previous studies on VaR have mainly focused on the effect of volatility when assessing VaR's none-coherency, we argue that correlation is equally important. This is of particular interest in the oil and gas industry, where oil, gas and their refined products are typically highly correlated, and as a consequence, using VaR to control downside risk may result in ignoring diversification benefits.

(2) Methods

We study the oil and gas industry using a portfolio of 10 products for almost 10 years from October 2002 to June 2012, giving us 2 455 observations per product. To investigate the impact of correlation and volatility on VaR's vulnerability to violate coherency, we compare the standard deviation and Pearson correlation with VaR's violation ratio, calculated as the number of violations over the number of observations. All time series are calculated using a rolling window of 250, 500 and 1 000 observations, and we use a logistic regression to study the relative impact of volatility and correlation.

(3) Results

We show that a high level of correlation and volatility both increase VaR's likelihood of producing a none-coherent estimate. For our sample period, volatility and correlation show opposite trends, as correlation is steadily increasing, while volatility is decreasing except during the financial crisis. These variations provide us with significant results in the logistic regression. The empirical results from the oil and gas industry is confirmed using a Monte Carlo simulation, and we confirm previous studies on VaR's none coherency and the effect of volatility and sample size.

(4) Conclusions

Using VaR as a downside risk estimate in the oil and gas industry is in particular vulnerable to produce none-coherent estimates due to high levels of volatility and correlation. Using logistic regression, our findings indicate that in periods of high volatility, as seen during the financial crisis, VaR's violation ratio increases, and this effect is further amplified by high correlation levels. A none-coherent estimate does not provide the diversification bonus expected in portfolio theory, and as a consequence VaR is overestimating risk for an oil and gas portfolio.

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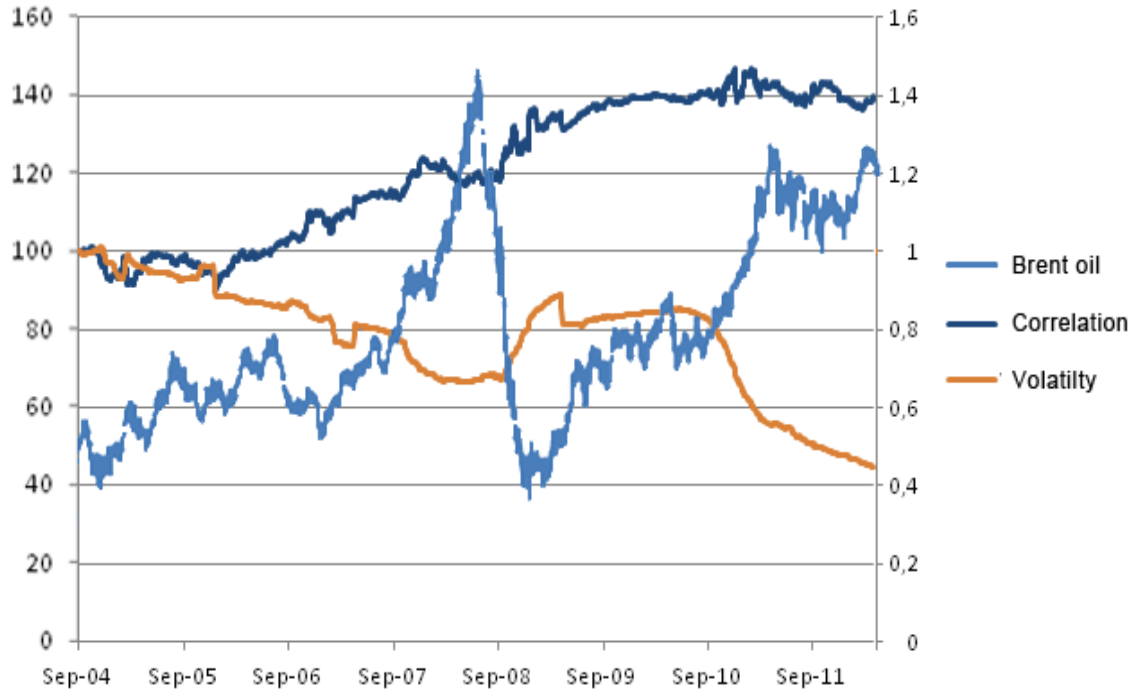

Figure 1 - Brent oil price USD/bbl on left axis for the period October 2002 - June 2012. Indexed correlation and volatility for oil and gas portfolio calculated using a rolling window of 500 observations on right axis.

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