EVALUATING VALUE-AT-RISK ESTIMATES FOR AN ENERGY PORTFOLIO

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Overview

The oil and gas industry experience high price volatility (Pindyck, 2001) and consequently it is important to manage price risk. Several papers (e.g. Hamilton (2009) and Kilian (2009)) try to explain how changes in supply and demand, as well as political issues altering future expectations, impact market equilibrium and creates sudden shifts in oil and gas prices. The paper considers prices between 01.2000 and 06.2015. During this period, the oil price has seen two periods of long-lasting growth and increasing price levels, and two shorter periods of significant price reductions. The first period was related to the financial crisis and a strong reduction in demand, while the second period occurs now, after a strong increase in supply combined with low demand growth.

Methods

Value at Risk (VaR) is a widely used measurement in order to control the underlying risk in the portfolio (Jorion, 2006). It defines the worst case scenario within a certain confidence level over a specified time horizon. To estimate VaR, we assess four methods: (1) historical simulation, (2) a standard normal distribution, (3) a student's t distribution and (4) an exponential weighted moving average (EWMA) volatility adjusted quantile regression (QReg).

To assess time varying changes to risk, VaR is calculated using a rolling window, estimating VaR using 250 days of observations (equivalent to 1 year of historical data). Moreover, both 95% and 99% VaR is calculated, to assess the tail-end of the distributions.

To validate the methods, the unconditional Kupiec-test (Kupiec, 1995) and the conditional Christoffersen test (Christoffersen, 1998) is utilized. The Kupiec-test assesses whether VaR is violated according to the chosen percentile, while Christoffersen-test requires a random distribution of VaR-violations. Finally, the economic accuracy is calculated using a loss-function, comparing the actual loss with the estimated VaR when the loss exceeds VaR. This loss function should be minimized in order to provide an economically efficient VaR.

Results

The results confirms typicall distributional facts for the log-returns of commodity prices, as a normal VaR is adequate for the 95% VaR, but fails for 99% VaR, and the student's t VaR provides a better estimate for the 99% VaR compared to the 95% VaR. Further, historical simulation provides adequate results for both VaR-levels. However, QReg provides the best results, according to both the Kupiec and Christoffersen test. In addition it provides the most economically efficient estimates according to the loss function.

Conclusions

In this paper, several VaR-estimation methods are considered. The industry standard, historical simulation, is compared to more theoretical approaches, and although VaR-estimates are accurate on average, the methods struggle to adjust and experience clustering of VaR-violations. Moreover, there are differences in economic accuracy between methods and commodities. This suggests that a portfolio of oil and gas products should use VaR carefully. The use of a volatility adjusted quantile regression (QReg) to estimate VaR seems to improve the accuracy of VaR, as both the Kupiec and Christoffersen test favors this method. In addition, according to the loss function the QReg minimizes losses when the actual loss exceeds VaR.

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