Energy Risk Modeling

Jean Monnet Module: Energy Markets In The Framework Of EU Integration

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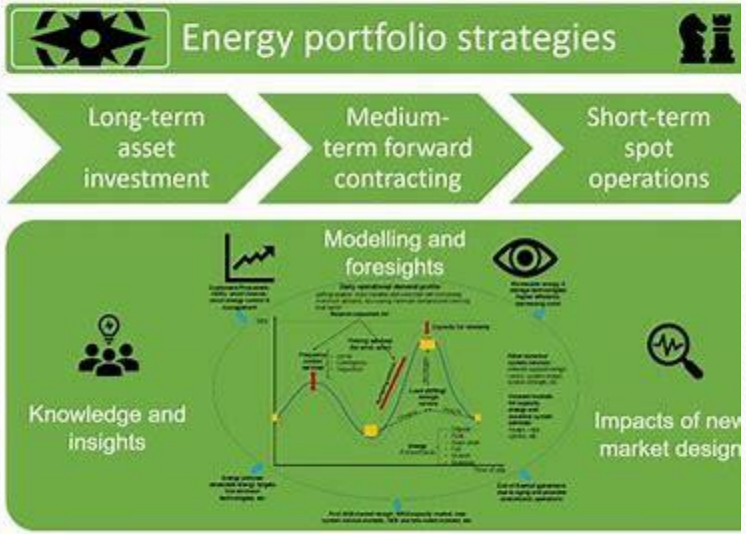


VAR model

VaR is defined as the maximum expected loss in the value of an asset or a portfolio of assets over a target horizon, subject to a specified confidence level

$$Pr(r_{t+1} \leq Var_{t+1}^{\alpha} | \omega_t) = a$$

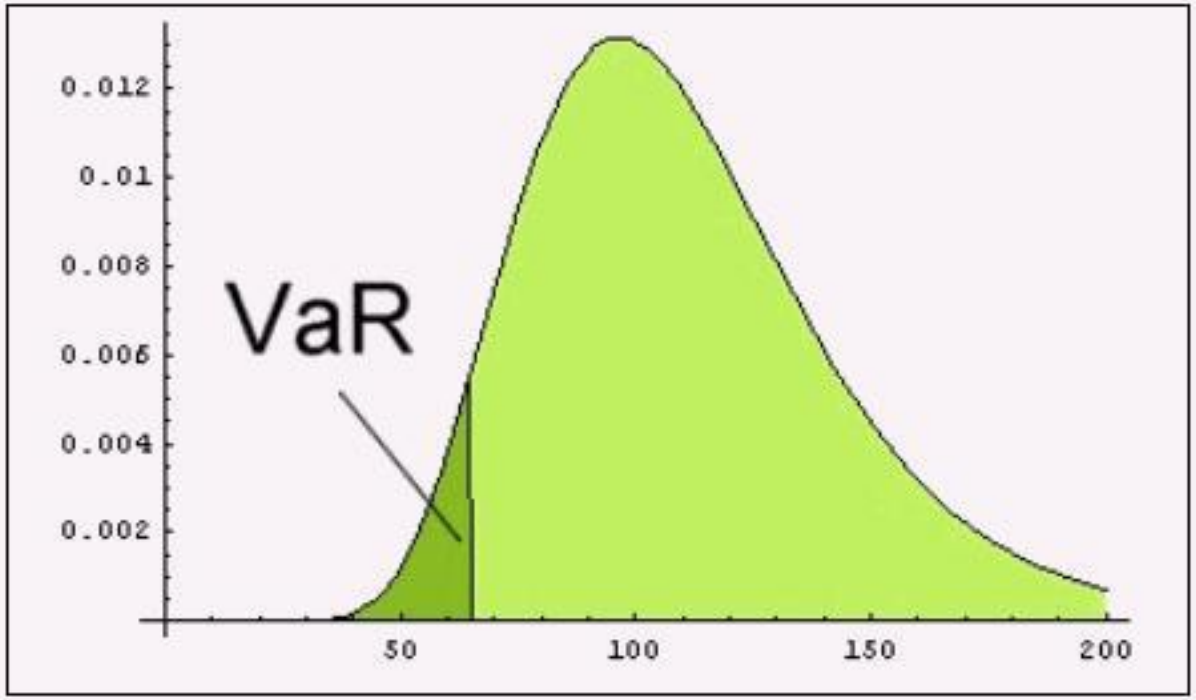
Where:

r_{t+1}- return of the asset or portfolio of assets over a time horizon

α-confidence level

ω_t - information at time *t*

VAR



VaR in energy markets

There are three general approaches to compute VaR in energy markets:

1- to assume the return distributions for the market risks.

2- to use the variances and co-variances across the market risks, and

3 -to run hypothetical portfolios through historical data or by using Monte Carlo simulations

VAR and Risk management in Energy

- Identify the assets and contractual commitments that make up your portfolio.
- Determine the probability distribution of returns for each asset or commitment.
- Calculate the VaR for each asset or commitment.
- Aggregate the VaR values to determine the overall VaR for your portfolio.
- Monitor your portfolio’s VaR on a regular basis.

Expected Shortfall (ES)

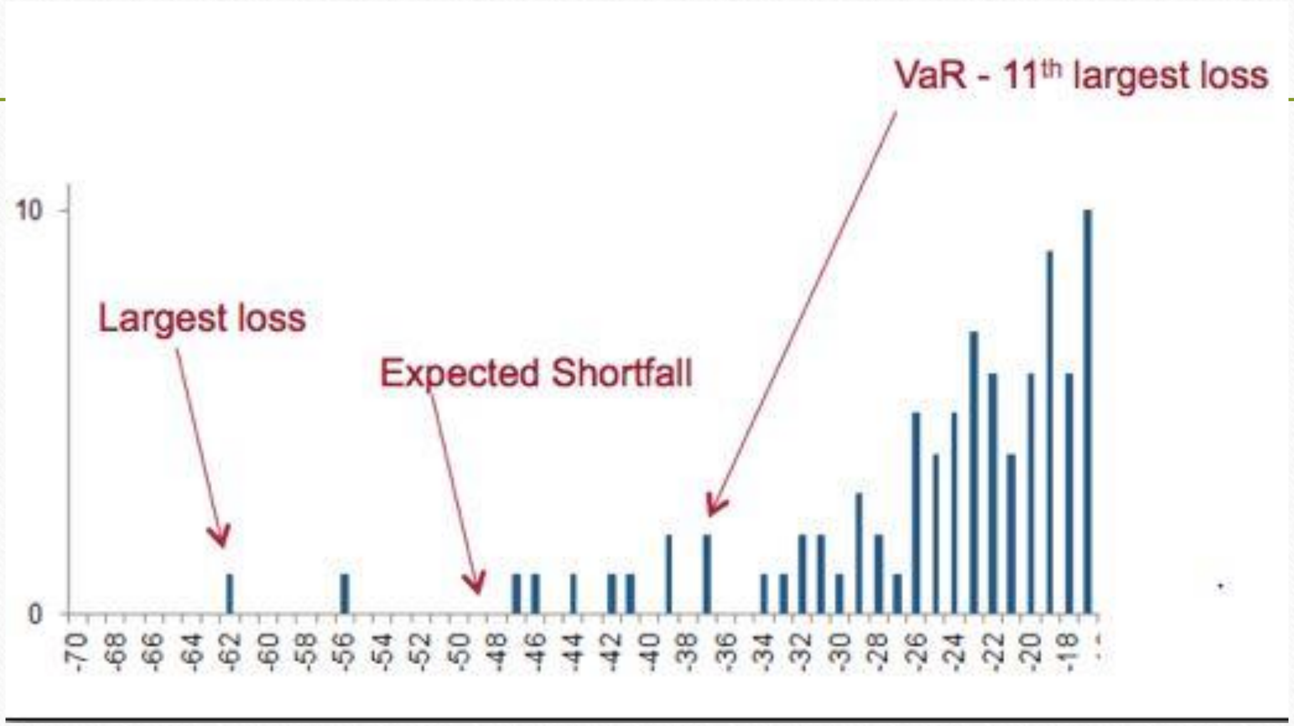
ES is used in finance to measure *market risk* . It is also used in other fields such as energy risk modeling, where it can be used to measure the risk of energy portfolios.

<u>Expected shortfall is the expected loss conditional that the loss is worse than the VaR level</u>.

To calculate Expected Shortfall (ES), you need to:

1. Calculate the daily (weekly etc.) returns of a portfolio over a certain period (1 year, 5 years, etc.).
2. Rank the returns for smallest to largest.
3. Calculate the mean of the x% (eg 5%) worst returns.

ES vs VAR



VaR - 11th largest loss
Largest loss
Expected Shortfall
10
0
-70 -68 -66 -64 -62 -60 -58 -56 -54 -52 -50 -48 -46 -44 -42 -40 -38 -36 -34 -32 -30 -28 -26 -24 -22 -20 -18

Garch Model

- Generalized AutoRegressive Conditional Heteroskedasticity (GARCH) is a statistical model used where the standant error volatility is not constant (heteroscedasticity)
- GARCH models assume that the variance of the error term follows an autoregressive moving average process
- In Energy Markets is widely used to predict prices volatility

Garch model

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \epsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2$$

GARCH models

There are different types of GARCH models that can capture different features of the data, such as asymmetry, long memory, or seasonality.

- Some examples are:
- - EGARCH: Exponential GARCH, which allows for asymmetric effects of positive and negative shocks on volatility.
- - IGARCH: Integrated GARCH, which imposes a unit root in the autoregressive component, implying that shocks have a permanent effect on volatility.
- - TGARCH: Threshold GARCH, which allows for different responses of volatility to positive and negative shocks depending on a threshold value.
- - GARCH-M: GARCH-in-mean, which incorporates the conditional variance into the mean equation, implying that volatility affects expected returns.
- - MGARCH: Multivariate GARCH, which models the conditional covariance matrix of multiple time series.

How does EU manage energy (power) risk

Regulation (EU) 2019/941 of the European Parliament and of the Council of 5 June 2019 on risk-preparedness requires EU countries to submit risk preparedness plans.

The regulation is part of the Clean Energy for All Europeans package which aims to put energy efficiency first, achieve global leadership in renewable energies and provide a fair deal for consumers.

Requirements

It establishes measures aimed at:

- safeguarding the security of electricity supply,
- to ensure the proper functioning of the internal market for electricity,
- an adequate level of interconnection between Member States,
- an adequate level of generation capacity, and balance between supply and demand.

Thank you for your attention!