EVALUATION OF THE VOLATILITY OF PRICES AND VOLUMES OF AN ENERGY PORTFOLIO

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Overview

In the liberalized energy market, consumers are free to choose their electricity supplier. This mechanism has significance especially for industrial consumers as they have options to choose between many different energy suppliers, whose offers barely differ due to the homogenous nature of electricity. As a result, the price becomes the differentiating factor forcing energy suppliers to calculate their prices exactly in order to secure their profitability considering the emerging risks associated with different contractual models on the one hand and on the other hand to persist in the competition. The focus of this research is on the risk that volatile prices (price risk) and volatile volumes (volume risk) pose to consumers and/or suppliers in the electricity market. A methodology to calculate the emerging risks due to price and volume volatilities of an energy portfolio is presented and evaluated. Based on the presented methodology the emerging risk can be quantified and considered during the budgeting process. Therefore, the hourly spot market price (day-ahead auction) volatility and the risk through volume volatility, which is split into risk through structural and volume deviations, are derived. Based on the derived volatilities a new so-called "risk-optimized" hedging approach is outlined.

Methods

Due to the temporal offset between the budgeting and the physical realization, an energy portfolio is affected by risks. The risks can be divided into price risks and volume risks.

Price risks are based on the uncertainty of the future structure and the absolute level of spot market prices. The budgeting of an energy portfolio is further based on hourly price forward curves (HPFC), which map the expected hourly spot market prices in the future. Thereby, the average price corresponds with the future price at the power derivatives market. In order to minimize the risk due to volatile prices, financial derivatives contracts are usually considered as hedge by the suppliers (or customers in case they assume the risk by themselves). Depending on the supply strategy, the position can be hedged during the budgeting of the portfolio or at a later time. If the position is left open, the resulting risk can be measured by the concept of value-at-risk (VaR). To do so, the daily price volatility of the market price has to be estimated. By utilizing statistical back testing methods (*Christofferson-Test, Kupiec-Test*) it can be shown, that the exponentially weighted moving average (EWMA) of the market prices daily returns over its trading period, maps the daily price volatility of the position in the considered timeframe adequately. However, due to the standardisation of the products at the power derivatives market, it is not possible to hedge the entire purchasing volumes, leading to the so-called spot-price-risk for the residual between the expected volumes and the standardised hedge (see Figure 1 (left)). As the characteristic of the spot market and the power derivatives market are distinctly different from each other, the VaR-method cannot be used to assess the spot-price-risk. Products at the power derivatives market are traded over longer periods with (different) daily prices, whereas spot market products are "one-time-realisations", which are, in contrary to the different products at the power derivatives market, only very limited comparable to each other. Instead of the VaR-method, the hourly spot market price volatility differentiated by hours (00:00 to 23:00), month (January to December) and type of the day (working day or holiday) is used to quantify the spot-price-risk analytically. In this work, the hourly spot market price volatility is derived by use of the standard deviation of historical spot prices, historic correlation factors and a suitable clustering method. For a given confidence level and period, the spot-price-risk can be assessed ex ante by the hourly spot market price volatility.

Volume risks are based on the uncertainty of the structure and the level deviations between the expected and actual purchase volumes. This risk can be split into a risk through structural deviations (temporally shifted purchase volume) and volume deviations (absolutely demand variation), by the use of a modelled time series. The modelled times series shows the structure of the actual purchased volume and the absolute level of the planned purchase volume during the budgeting process (see Figure 1 (right)). However, on basis of the characteristics and individuality of volume deviations of different customers, it is not possible to calculate the risk ex ante. Therefore, the ex post calculated (observed) volume risks should be considered as possible scenarios for future portfolios.

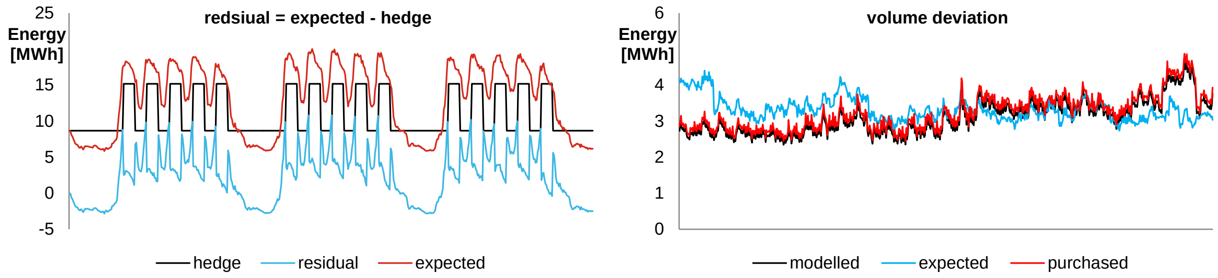

Figure 1: Schematically distribution between hedge and residual (left) and introduction of the modelled time series to deviate volume risks (right)

Results

The risk of an energy portfolio can be divided into a spot-price-risk, a volume risk due to structural volume deviations and a volume risk due to absolute volume deviations. These risk components usually cannot be directly influenced by the supplier. Depending on the market participants supply strategy, hedgeable open positions add a risk to the energy portfolio. The presented methodology is used to assess the risk of three different energy portfolios (2011 to 2013) of about 20 customers with power consumption between 10 and 1200 GWh per year. The results for the years 2012 and 2013 are shown in Figure 2, whereby the top/bottom of the blue bar shows the max./min. change in value of the residual of one customer and the red line indicates the average value within the portfolio. The analyses show that absolute volume deviations have the greatest impact on the risk of an energy portfolio as well as the risk of a single customer. The spot-price-risk and the risk due to structural volume deviations are almost at the same level for the considered portfolios but strongly differ for each of the single customers within the portfolio. Overall, huge portfolio effects are observed, leading to an overall risk of up to 4 €/MWh (for 99% confidence interval), which is slightly higher than the risk only caused be absolute volume deviations. It is important to note, that the overall length of the blue bar plots does not quantify the risk of the energy portfolio but the different realisations of the customers. The risk is assessed by the use of the standard deviation of the observed change in value of all customers within the portfolio by a 99% confidence level. The mentioned risk (chance) is both-sided.

The ex-ante calculated spot-price-risk is lower than the observed spot-price-risk for the considered portfolios. The difference is due to the calculation methodology, which cannot consider random distributed outliers of the hourly spot market price volatility without over- or underestimating the risk of single hours in general. Therefore, the analytical calculated spot-price-risk based on the presented methodology is quantitatively not reliable and should be corrected by general factors afterwards but can be qualitatively used to optimize the hedge for instance.

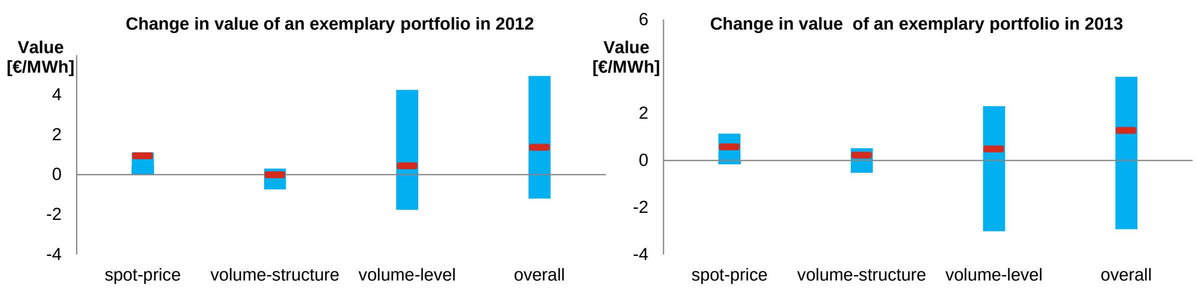

Figure 2: Observed changes in the value of the residual of two exemplary portfolios

Conclusions and Outlook

Based on the presented methodology, it is possible to assess the risk of an energy portfolio, differentiated by price, volume structure and absolute volume deviations. The observed financial risk of the considered energy portfolio is up to 4 €/MWh and thereby clearly over customary risk premiums. The observed risk is both sided hence can lead to a higher or lower price than expected. The calculated hourly spot market price volatility can be qualitatively used to optimize the hedging strategy. As it is unavoidable to have open positions independent of the chosen hedge, the main idea of a risk-optimised-hedge is to shift greater open positions into hours with relatively low price volatility and smaller open positions into hours with relatively high price volatility.