Methodological description and interpretation of the volatility index for electricity markets

There are two ways of measuring the volatility of commodity markets. The first option is to try to measure the so-called implied volatility, giving estimation for the future volatility by analysing the forward an option contracts for a given commodity. In contrast to this approach, the retrospective (statistical) volatility index looks backwards as it captures the amplitude of price movements for a given period of time in the past.

In order to calculate the volatility of electricity markets on regional and European levels we need to achieve a common methodology and different markets' data need to be comparable. As forward and option trading is premature on many European power markets (either the number of contracts, the liquidity of the market or contracts on the full length of the power curve are missing), we decided to choose the retrospective approach of volatility calculation.

A common way to calculate such a volatility index from daily average prices of commodities is to take the logarithmical differences of the daily average prices of two consecutive trading days, and then to compute the relative standard deviation for a given period of time (e.g.: 30 days) from these figures. The value obtained is usually multiplied by the square root of the number of trading days in a year (annualisation). It is a common practice that volatility values are expressed in percentages hence the reason why the annualised value is multiplied by 100.

If X_i denotes the logarithmical difference of the daily average prices of two consecutive trading days, k denotes the number of trading days observed and X_k denotes the averages of X_i-s over a period of k trading days:

$$X_i = \log_{10} P_{dayT} - \log_{10} P_{DayT-1} \qquad\qquad \overline{X}_k = \frac{\sum_{i=1}^{k} X_i}{k}$$

We can obtain the annualised volatility as follows (taking N as the number of trading days for a whole year):

$$VOL_{(T-k+1,T)} = 100 * \sqrt{N} * \sqrt[2]{\frac{\sum_{i=1}^{k}(X_i - \overline{X})^2}{k}}$$

If we want to measure a volatility based on daily average prices with a monthly time span, k should be set to either 21 or 30 regarding the nature of the market (i.e.: whether there is a seven day trading week or five). The corresponding values for N in the two different cases are 365 and approximately 252.

In the case of electricity markets it is better to eliminate weekend prices from volatility calculations, while lower trading volumes and as a consequence higher daily price variations bring a bias into the volatility values. For this reason an average monthly 21 trading day time period and average yearly 252 trading day time period is taken for the volatility computations.

The interpretation of such a volatility definition is of course strongly related to the absolute value of this VOL formula (its lowest value is 0, meaning absolute stability in prices over the observed time, while the theoretical maximal value is infinite). In order to calculate the volatility of the electricity markets two different options can be proposed:

The *first option* is to make a simple monthly volatility calculation (k=21) for each national/regional electricity market and then an aggregation of the volatility values of these markets in order to obtain a European volatility figure.

The *second option* is to provide a comparison of the volatilities of a shorter and a longer period (the ratio of volatility values of k=21 and k=252 cases). This provides information on the short term behaviour of the volatility compared to a longer term one, and can be interpreted as the current market situation (short term – monthly) is either less volatile or more volatile than usual (long term – annual).

The first option can be interpreted as **absolute** volatility, while the second one as **relative** volatility.

Construction of regional and European level volatility indices from the regional sub-indices

The retrospective indices described on the previous page can be computed for all national or regional markets. Regional power area volatility indices and the European level volatility index should be compiled from the data of individual markets. This involves an aggregation phase that relies on daily traded volume data of the individual markets.

For the construction of an index measuring the price volatility of electricity markets the daily average of day-ahead wholesale base-load prices and daily traded volume of day-ahead power data were chosen as a computation basis. These data are generally available on all power trading platforms and as standard products they are comparable on different markets, making possible a cross-country or cross-regional aggregation.

For the electricity markets the sum of the daily market volume data are used as an aggregation factor. In order to compute the regional and the European level volatility of electricity markets firstly the weighting factors are computed for each market on each trading day, then the daily logarithmical differences are aggregated by using these weights. As a next step the standard deviation is calculated from these values and finally the obtained results are multiplied by the usual annualisation factor and by 100. This process is described using the following formulae:

For country/regional market i, trading day T and for time span of k trading days the weighting coefficient is the following:

$$Wci = \sum_{T-k+1}^{T} Dci$$

where Dci stands for the daily traded volume of day-ahead contracts on a given market on a given trading day.

The daily logarithmical differences (Xi values for each market – see on the first page) are aggregated as weighted arithmetical averages:

$$X_{REGi} = \frac{\sum Wci * Xi}{\sum Wci} \qquad\qquad X_{EUi} = \frac{\sum Wci * Xi}{\sum Wci}$$

Then the regional and the European level aggregated daily logarithmical differences serve as input data for standard deviation calculation and for the regional and the European level volatility index (X_{REG} X_{EU} and $VOL_{T-k+1,T}$ values – see on the first page).

The *absolute volatility index* would be calculated with k being set equal to 21, which shows the annualised volatility computed over a monthly time span.

The *relative volatility index* can be defined as a ratio of a short term and longer term volatility (for the short term k can be set to 21 while for the longer term period k is set to 252):

$$RVI_{REGi} = \frac{VOL_{(T-20,T)}}{VOL_{(T-251,T)}} \qquad\qquad RVI_{EU} = \frac{VOL_{(T-20,T)}}{VOL_{(T-251,T)}}$$

In the Quarterly Reports on European Electricity Markets, **Relative Volatility Indices (RVIs)** are presented in order to provide our users information on the relation of short term volatility compared to a longer term one.

If the value of an RVI is greater than 100 it means that recently the given power market is more volatile than the longer term volatility should imply. If the RVI value is less than 100, the short term volatility is less than the longer term one, hence the given market is less volatile than it is 'under normal conditions'.