Spotting the difference

Power assets in the Nordic electricity market are priced using a discount rate higher than the risk-free rate. To be consistent, forward prices must then be lower than the expected spot-price **By Sam Syvertsen**

The Nordic electricity market has liquidity in a full range of derivative forward products, ranging in time from the next day to products 10 to 20 years ahead. With an accurate spot price forecast, it is easy to evaluate a forward price for the next day. If the forward price is higher than expected, the trader should sell, and if it is lower, he should buy.

Looking further into the future, however, reveals subtle developments that confound this simple rule. Here we outline how to use a long-term analysis of expected spot price properly.

Buying an asset

When investments are made in new electricity generation, a cashflow analysis is usually undertaken. This basically involves taking expected cashflow in year t and discounting it with a risk-adjusted interest rate.

To simplify matters, we will not analyse what the risk-adjusted rate should be, but will merely accept that in practice electricity companies use a risk-adjusted discount rate for evaluating investment in generation assets. The size of the adjustment may vary from company to company, but a range of 1%–3% on top of the loan rate would reasonably reflect today's practice.

For example, take an imaginary company, Power Inc (PI), which owns 1 megawatt – or 8,760 megawatt hours (MWh) – of power delivered in 2020 and has no costs (see table 1).

We assume an investor with a loan rate of 5%. We further assume that the investment needs a risk premium of 2% based on the investor's risk assessment and that he or she expects spot electricity to cost on average 250 pence/MWh in 2020. A straightforward cashflow analysis then gives a value for the company of £5,659 ($8,267).

Hedging the profit

Let us then assume that the forward price for 2020 is equal to the expected spot price, and to secure the deal our buyer sells 1 MW of power in the forward market for 250 pence/MWh. The buyer will then be certain to get £21,900 in 2020.

To finance the purchase, our buyer takes a loan at the assumed rate of 5%. This accumulates to 5,659 x $(1.05)^{20}$ = 15,016 in 2020. After repaying the loan, our buyer has a profit of £6,884

The interesting thing about this profit is that at no time has any risk been taken, except credit risk on the buyer and the bank. Getting money without taking risk is what economists call "a free lunch". It is well known that free lunches do not exist in markets with equilibrium. Hence, something is wrong if we assume that the market above is in equilibrium.

What is wrong is the assumption that the expected spot price equals forward price. In equilibrium the forward price will instead be:

(15,016 / 21,900) x 250p/MWh = 68.6% of 250p/MWh = 171.41p/MWh

If this is the correct price, there is no free lunch.

If we put the results into a formula it can be shown that in equilibrium

Forward price year t = expected spot price year t x ((1 + loan cost)/(1 + discount factor)) t

In our example this gives:

250p/MWh x $((1.05)/(1.07))^{20}$ = 250p/MWh x 0.981^{20} = 171.41p/MWh

This means that if our estimate of the expected spot price is correct, the appropriate forward price for 2020 during 2000 should be 68.6% of the expected spot price.

Table 2 shows the risk adjustment and percentages for different years, risk adjustment being the difference between the discount factor and the loan rate. A loan rate of 5% is assumed for all alternatives as different loan rates have rather small impact on the results.

Reading from the table, we can see that in our example, with 2% difference and a time horizon to 2020, the equilibrium forward price should be 68.6% of the expected spot price. Table 2 may of course also be used the other way. If the forward price of a contract is known, the implicit expected spot price may be calculated.

Is this really true?

At first, this result may seem counterintuitive, and people are often incredulous when these arguments are presented. The important assumption is that investments in power assets are discounted at higher-than-risk-free rate.

To put it in standard textbook terms, it is assumed the power asset has a beta higher than zero. The beta we are looking at cannot be directly

Table 1: A simple example – Power Inc

Assumptions	
Power Inc (PI) assets: 1 MW of power in 2020	
Loan rate:	5%
Risk premium:	2%
Expectation	
Spot price for 2020:	250 pence/MWh
Income of PI (8,760 hours):	£21,900
Value of PI	5,659 = Income/$(1.07)^{20}$

Source: authors

Part of Markedskraft's Norwegian analysis team (from left): Rune Valle, managing director; Tor Reier Lilleholt, senior analyst; Sam Syvertsen, deputy managing director; and Eylert Ellefsen, head of analysis

compared to an investment in a power station, as we assume there is zero operating cost.

For thermal power plants especially, there will be a complex relationship between the input cost – of, for example, natural gas or coal – and the output – electricity. This makes it difficult to calculate the risk adjustment for a pure electricity beta on the basis of the rate used for investment in thermal generating plants.

Investing in a hydro plant, however, involving large initial capital outlay, small operating costs and no input costs, should approximate the investment outlined quite closely. The risk-adjusted rate used for evaluating hydro plants could therefore be applied fairly directly to the forward-versus-spot price evaluation.

It follows from this that with a well-developed forward market, the value of production should be evaluated at the forward price and discounted by the risk-free rate when one is doing investment analysis. This is logical, as a full hedge converts the power project into a financial project. We should remember, however, that physical assets usually have option values that are important when calculating total value.

An interesting observation is that someone who sells a forward contract expects a negative return. If in our previous example the equilibrium forward price really was 171.41p/MWh, someone selling this forward would expect to pick up a loss of: 250p/MWh – 171.41p/MWh = 78.59p/MWh in 2020.

Why should someone enter into such a deal? The reason is of course that the investor in this period enjoys being in a net negative beta position. In a perfect world, this means that if the investor incorporated this short position with a long position in a stock index, a portfolio with a beta value of zero could be achieved.

If this net position gives an expected profit higher than the risk-free rate, it is a good investment. It is by such processes that the equilibrium outlined in our example can be attained.

Currently, there are very few financial portfolios in this market, and I suspect that the aforementioned equilibrium is still absent. If so, excellent business opportunities are likely to await the first participants.

Markedskraft, with offices in Norway, Sweden and Denmark, provides portfolio management and brokerage services, and supplies spot price prognosis for the full range of products in the market, updating the short-term prognosis several times a day and the long-term prognosis once or twice a year. ■

Sam Syvertsen has been deputy managing director of Markedskraft since 1994
e-mail: sam.syvertsen@markedskraft.com

Table 2: Calculating expected spot price from forward price at different risk-adjustment percentages

Risk adjustment (%)	Year 2005	2010	2015	2020
0.5	97.7%	95.4%	93.1%	90.9%
1.0	95.4%	91.0%	86.7%	82.7%
1.5	93.2%	86.8%	80.8%	75.3%
2.0	91.0%	82.8%	75.3%	68.6%
2.5	88.9%	79.0%	70.3%	62.5%
3.0	86.9%	75.4%	65.5%	56.9%

Source: authors