Potential Credit Exposure

APRA Methodology vs Simulation

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1 Overview

In an earlier document 'Benchmark Pricing of Electricity Derivatives via Numerical Simulation', we have shown that it is possible to produce 'benchmark prices' using a simulation engine calibrated to forward market data. The prices were calculated as the expected return on an instrument given a number of simulated future spot price 'paths' (i.e. simulated prices for each half hour of the forecast period). As the expected price is essentially the mean of a distribution of prices, we have calculated not just the benchmark price of the instrument, but also the distribution of prices around this mean price.

Since we have shown that we can replicate future option pricing, we can infer that the calculated distributions around the market-calibrated future prices are reliable. Since futures, like most other electricity derivatives, settle against the half-hourly spot market, we can in turn infer that our simulated price paths are reasonable and have the correct degree of variation. Thus we can propose that any derivative that ultimately settles against the spot price can be priced using the calibrated spot price simulations.

Since by extension we can use the simulation engine to create a risk report on a portfolio of instruments (provided that all instruments ultimately settle based on spot price outcomes), we have done so in this paper, specifically for a Potential Credit Exposure Report.

2 Potential Credit Exposure

In its Prudential Standard APS 112 'Capital Adequacy: Standardised Approach to Credit Risk' (2008), The Australian Prudential Regulatory Authority (APRA) set out a framework for credit risk reporting. The ultimate aim is that an "authorised deposit-taking institution holds sufficient regulatory capital against credit risk exposures."

While not all electricity market participants are authorised deposit-taking institutions (ADIs), the APRA standard may be used by the non-regulated industry participants as well. For "Market-related off-balance sheet transactions", the standard says:

> 1. For the purposes of calculating counterparty credit risk capital requirements, an ADI must calculate the [credit equivalent amount] of its market-related contracts. Where these contracts are not covered by an eligible bilateral netting agreement as set out in Attachment I, the ADI must calculate the [credit equivalent amount] by using the current exposure method; this method is the sum of current credit exposure and potential future credit exposure (the add-on) of these

contracts. Current credit exposure is defined as the sum of the positive mark-to-market value (or replacement cost) of these contracts.

2. An ADI must, for the purpose of calculating its potential future credit exposure for each transaction, multiply the notional principal amount of each of these transactions by the relevant [credit conversion factor] specified in Table 1.

Table 1 shows the APRA credit conversion factors[1].

Table 1: Current exposure method - market-related credit conversion factors

Residual maturity	Interest rate contracts (%)	Foreign exchange and gold contracts (%)	Equity contracts (%)	Precious metal contracts (other than gold) (%)	Other commodity contracts (other than precious metals) (%)
1 year or less	0.0	1.0	6.0	7.0	10.0
$>$ 1 year to 5 years	0.5	5.0	8.0	7.0	12.0
$>$ 5 years	1.5	7.5	10.0	8.0	15.0

Looking at table 1, we can immediately see some shortcomings:

- This standard is dated January 2008, well before the September 2008 collapse of Lehman Brothers and the related market turmoil of late 2008.
- The standard lumps electricity in with 'other commodity contracts', where in fact it is quite different due to a number of reasons:
  - The market is physical - there is an instantaneous supply-demand balance;
  - Electricity is a non-storable commodity;
  - There is high price volatility with the potential for negative prices;
  - Prices are strongly correlated to weather and strongly seasonal; and
  - The small number of market players combined with regional pricing leads to low liquidity.

[1] Attachment B - Credit equivalent amounts for off-balance sheet exposures, Table 1

3 Outcomes

In order to compare the APRA methodology to our simulation engine, we have taken the following approach:

- We created a mock portfolio[2] for illustrative purposes as shown in table 2.
- We calibrated the engine to futures market prices as at the 30th October 2009. Note that we have used futures and cap futures prices as an approximation of OTC swap and cap prices respectively. All data is for the NSW region.
- We then revalued this portfolio over 10,000 simulations and generated potential outcomes.
- We have plotted the distribution of outcomes as figure 1. On this distribution we have marked where the 95% and 99% confidence intervals fall.

We have also followed the APRA methodology and calculated the potential future credit exposure for each instrument based on the market values listed in table 2 and the credit conversion factors in table 1. The result is a potential future credit exposure of $3,447,936. This level has also been shown in figure 1.

Table 2: Portfolio Composition

Instrument	Period	Period Type	Quantity (MW)	Dealt Price ($)	30/10/09 Settlement ($)
Swap	Cal 2010	Flat	100	40.00	40.19
Swap	Q1 2010	Peak	50	85.00	80.00
$300 Cap	Cal 2010	Flat	25		10.92[3]
$300 Cap	Q1 2010	Peak	15		40.08[4]

[2]Note that for simplicity the instruments all start in the future, and we therefore do not have to worry about unsettled cashflows. Only potential market fluctuations are considered.

[3]Since calendar cap prices were not available we have taken the time-weighted average of the quarterly prices.

[4]Since quarterly peak cap prices were not available we have used the calculated Q1 peak price as a benchmark.

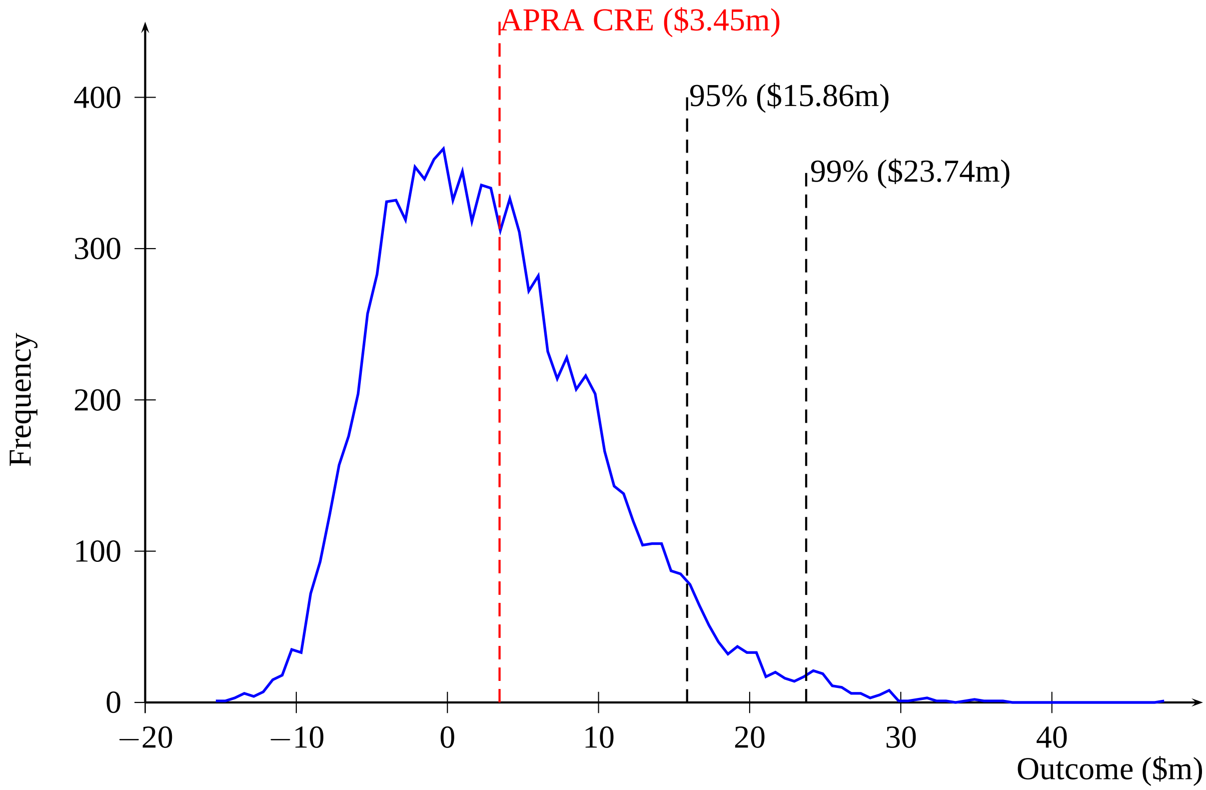

Figure 1: Histogram of Portfolio Outcomes

As can be seen in figure 1, the figure derived from the APRA methodology is significantly smaller than that generated as a 95% confidence interval from the simulation engine. In fact, the APRA figure is equivalent to a confidence interval of only 58.6%.

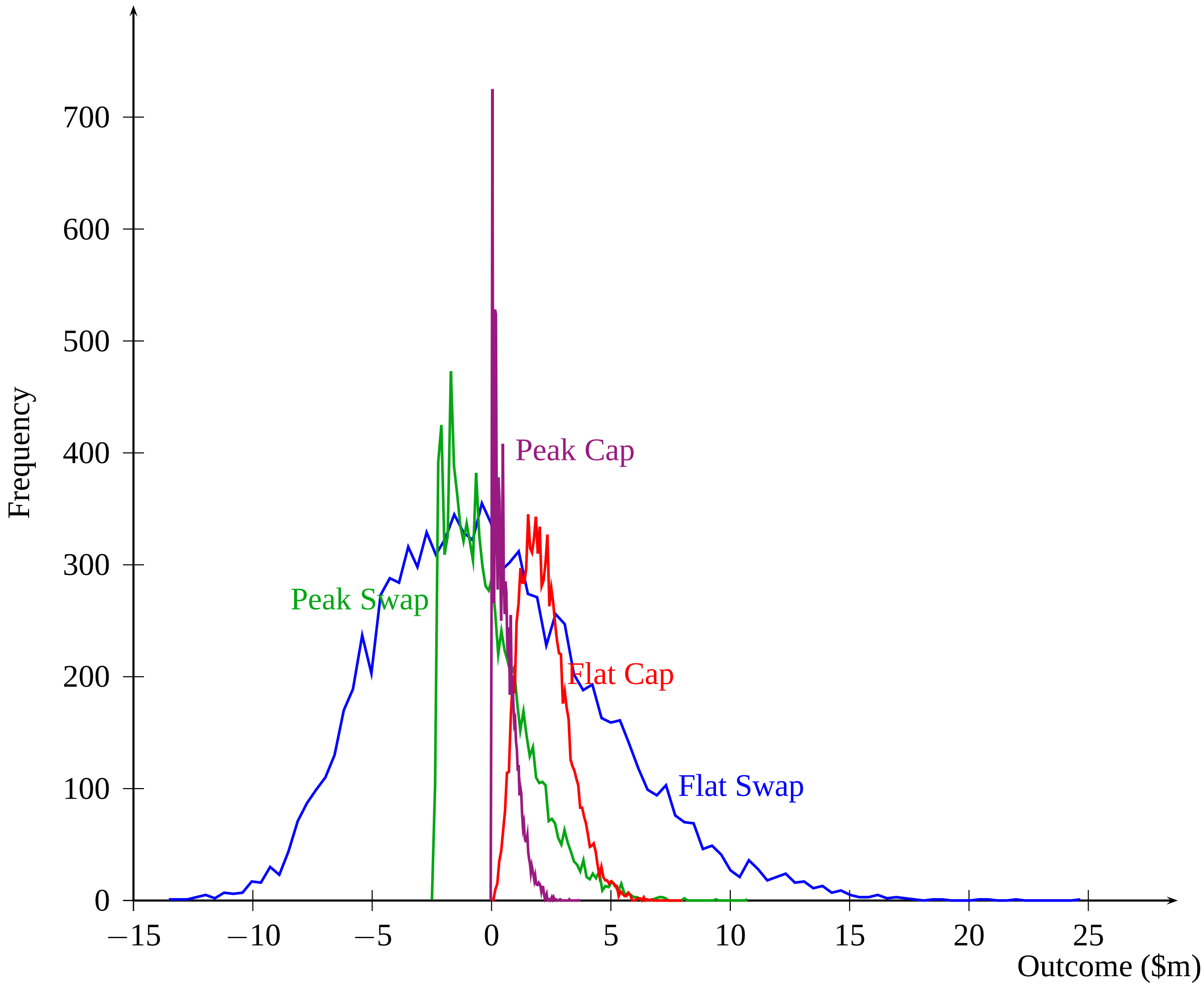

Figure 2: Histogram of Component Outcomes

Figure 2 shows the breakdown of risk profile for each of the component trades in the portfolio. This allows us to 'drill-down' to the main sources of risk in the portfolio. As expected, the large 100MW swap dominates the portfolio risk profile and effectively sets the credit exposure figure.

4 Conclusion

In conclusion we can say that, provided there is confidence in the results of the simulation engine[5], the simplistic APRA methodology results in an understatement of credit risk which may in turn result in insufficient regulatory capital being allocated against credit risk exposures.

One option to correct this would be to update Prudential Standard APS 112 to feature a new column for electricity derivatives that has a credit conversion factor in line with the risk observed in such markets.

For further information on this topic, please contact:

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[5] The case for this is made in the document 'Electricity Derivatives - Benchmark Pricing via Simulation' (December 2009).