DERIVATIVE MARKETS IN THE AUSTRALIAN NEM: ROLES AND ISSUES

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Abstract

This paper provides an overview of market risks faced by participants in the Australian NEM and tools to manage these risks. These tools include financial instruments in the form of swaps, options, settlement residue auctions, weather derivatives and futures contracts, and non-financial instruments, such as demand management, physical generating units and insurance products. Hedging strategies and tools can transform the risk position of the participants, lower the volatility of wholesale spot prices and encourage innovation in hedging instruments. It is also important to note that derivative markets, apart from risk management, also enable price discovery and capital formation.

1. INTRODUCTION

Prior to the wave of electricity industry restructuring seen around the world in the last two decades, risk management within the electricity sector was generally undertaken in the context of government owned monopoly utilities. Now, however, industry restructuring towards greater competition and private participation has created new sets of players and uncertainties that have markedly changed the challenge of risk management. These new players include private and public industry participants competing in generation, networks and electricity retailing, and the regulators and governments that must oversee them.

The regulator and, in the end, Government risk management focus is on the societal risks associated with the electricity industry. These include power system reliability, economic efficiency, longer-term security of supply and the wider impacts (social and environmental externalities) of industry operation.

This broad risk management role requires regulators and governments to influence industry participant behaviour in areas including investment in physical assets like generating plant and networks, possible wholesale market and retail price caps, environmental regulations and market monitoring. Clearly, such risk management actions will impact on the risks faced by industry participants.

Risk management by industry participants is focused, naturally enough, on their individual circumstances. The risks faced by these participants include:

- Market risk – price risk due to changes in the electricity spot prices.
- Credit risk – inability to recover or make payments.
- External operational risk – risks due to exogenous phenomena, for example transmission constraints may limit production capabilities of a generator.
- Internal operational risk – risks from internal decision making and asset performance.
- Regulatory risk – risk associated with changes and uncertainties in interpreting existing law and regulations that govern the industry.

The focus of this paper is on the risks faced by participants within the Australian National Electricity Market (NEM) and the risk management tools available to them. Particular attention will be given to the role of derivative markets in such risk management.

In Section 2, we discuss the different markets risks facing particular NEM participants – generators, merchant network service providers and retailers. The use of derivatives by participants to help manage these risks is explored in Section 3. The wider range of risk management options available to industry participants is then considered in Section 4, while the impacts of such actions are discussed in Section 5.

2. NEM PARTICIPANTS AND THEIR MARKET RISKS

Market risks are those that arise from wholesale market trading. In the NEM, the participants exposed to these market risks are generators, unregulated network service providers or also known as merchant network service providers (MNSPs), electricity retailers and large end-users who buy directly from the market.

The market risks can be grouped into the following [1]:

- Spot price risk – movements in the pool price.
- Derivative price risk – movements in forward electricity prices.
- Basis risk – price differences between two prices, for example inter-regional price differences or the difference between spot and derivative prices.
- Volatility risk – changes in the volatility of spot and derivative prices.
- Volume risk – unforeseen changes in generation or demand by a participant.
- Force majeure risk – a term used to cover events which cannot be anticipated, controlled or avoided.

Force majeure risk can be managed, in at least part, through insurance instruments or incorporating certain events into the terms and conditions of contracts. We do not discuss it further here. Instead, we will consider the risk position of different types of wholesale market participants in the absence of hedging arrangements in Section 3.

2.1 Generators

In the NEM and many other wholesale electricity markets, a participant's cost for generating electricity is typically far less volatile than the wholesale spot price received for this electricity. Depending on the type of generating plant, fixed costs, mainly due to capital investment, may be more significant than the variable operating cost. Without hedging arrangements, the revenue for participating generators is dependent on the amount of electricity energy sold through the wholesale market and the spot prices received for this dispatched energy.

Generators, especially those with limited fuel reserves such as hydro generators; will try to schedule their production to maximise revenue. There is always a risk of producing at the spot prices and/or volume that does not give the best revenue outcome.

Plant failures could mean loss of revenue opportunities [3] and apart from ensuring plant reliability, the generators will also aim to ensure they earn sufficient revenue to meet operating costs and capital costs, specifically loan repayments.

2.2 MNSPs

Currently there is only one MNSP in the NEM. Directlink connects Queensland and NSW with a DC link. The Basslink MNSP which will connect Tasmania to Victoria is currently under construction and due to be in operation by 2006.

The NEM has a regional market node in each of the five states and territories that participate. The prices at each of these nodes can vary from each other according to transmission losses and possible constraints between them. The MNSPs earns revenue through arbitrage opportunities that exist when these regional prices are significantly different. An MNSP submits offers to sell and bids to buy into the wholesale market. It earns spot market income if it's successfully dispatched to carry energy from one region to another.

Similarly to generators, failure of an unregulated interconnector can mean loss of revenue opportunities. There is also a price risk if the price difference between the two interconnected regions is low for extended periods as there are then no arbitrage opportunities.

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2.3 Retailers

Retailers purchase energy from the spot market at varying spot prices while selling at relatively fixed prices to retail customers. Currently, small retail customers in NSW can continue either to buy electricity at regulated tariffs or to negotiate contracts with retailers of their choice. Tariff arrangements for both generally have fixed prices per MWh of electricity consumed. Contracts for larger customers can be considerably more complex but also typically involve no, or only limited, direct exposure to spot prices.

The lack of real-time pricing on the retail customers' side means that the price risks cannot be entirely transferred to the customers, in the short-term at least.

Uncertainty in the peak and average load for customers, and the retailer's open-ended obligation to supply any customer demand that may arise, expose retailers to volume risks. This risk is further exacerbated with the introduction of full retail competition if it enables retail customers to switch between retailers at short notice and little inconvenience.

2.4 Large End-Users

While large end-users can purchase electricity from retailers, they may find it cheaper to purchase from the wholesale market at spot prices.

The high volatility in the spot prices does, however, present a significant price risk to the end-user, particularly if they have an inelastic short-term demand.

3. DERIVATIVE MARKETS

A derivative instrument is an instrument whose price depends on, or is derived from, the price of another asset. In the case of electricity derivatives, the prices of the derivatives are often derived from the electricity spot prices in the wholesale market.

Derivatives can be used for physical delivery or financially settled at expiry. However, since NEM is a gross market[1], derivatives used by market participants are all financially settled.

The trading of derivatives takes place in either exchange-traded markets or the over-the-counter (OTC) markets. There are significant differences between these.

Firstly, in the exchange-traded markets, the derivative contracts are standardised to a limited range of options, and traded on an exchange. OTC markets, in comparison, may involve highly customised bilateral contracts.

Cash flows of the contracts are also different, with exchange-traded derivatives being marked to market on a daily basis. The OTC derivatives are usually only settled once at maturity, although some derivatives are marked to market on a regular basis as well [4].

The Australian Stock Exchange (ASX) and the Sydney Futures Exchange (SFE), which lists derivatives for d-cyphaTrade (www.sfe.com.au), provides exchange-traded derivative markets for NEM participants. The exchange markets trade futures contracts and options, while the most common OTC contracts are swaps and options [2].

3.1 Types of Derivatives

Futures contracts allow buyers to receive/pay the price difference between the strike price and the market spot price if the strike price is below/above the spot price. Since futures contracts are daily marked to market, the price settlement occurs daily.

[1] A gross market requires all electricity that is produced, and not sold locally, to be offered into the pool. Physical delivery contracts between generators and end-users or retailers are not allowed.

The swap, also known as a contract-for-differences (CFD) is a bilateral agreement where two parties agree to exchange a series of cash flows based on the electricity spot price and the contracted strike price for the duration of some given contract period. In this arrangement, the seller of the swap will pay/receive the price difference between the strike price and the market price to the buyer if the spot price is above/below this strike price. Swaps are very popular in many markets, and in NEM, it accounts for over 50 percent of traded electricity OTC contracts [10]. Its popularity as a risk management tool is due to its flexibility to closely approximate a target risk profile, and amenable to any accounting treatment, accrual or mark-to-market, and need not be rolled or actively managed [8].

There are two forms of options, the *call* option and the *put* option. A call option, also known as a cap, gives the buyer the right, but not an obligation to financial compensation for a specified volume of electricity if the spot price exceeds the strike price. Conversely, a put option or floor would give the buyer the right to compensation if the spot price is below the strike price. Retailers would usually buy a call option and write a put option to hedge against price risks, while generators would write calls and buy puts. If the options are European options, the options can only be exercised at the maturity, while American options can be exercised at any time up to the point of maturity.

Another derivative that might also be used by market participants to manage price and volume risks is the weather derivative. Although these are not widely used in Australia, they are increasingly used in some overseas markets, such as in the United States.

The National Electricity Market Management Company (NEMMCO), which manages the NEM offers a Settlement Residue Auction (SRA) to help manage basis risks due to inter-regional price differences. Settlement residue is the difference in regional reference prices multiplied by regulated interconnector power flow for each spot market interval [11]. The winning bidders of the quarterly SRA receive this settlement residue stream. Generators with inter-regional contracts will typically seek to protect themselves against basis risk through these SRAs.

3.2 Role of Derivative Markets

One of the key roles of these derivative markets is to allow electricity industry participants to manage their exposure to price risks.

Market participants who have hedged their spot market position through the use of these derivatives no longer have their electricity revenue or costs entirely exposed to the volatile spot prices. Instead, these revenue or cost streams now depend on a combination of the hedged energy contract prices and the unhedged energy exposed to the spot price. Since the strike prices have much lower volatility than spot price, participants with more hedge cover benefit from a more stable cash flow.

Since load is highly correlated to the weather or seasonal patterns, weather derivatives can help manage some market risks, particularly days of extreme temperatures that cause sharp increases in load through heating or cooling equipment.

The derivative market also allows for greater price discovery into the future. Derivative prices and demand reflect the market participants' expectations of future spot prices, volatility and market conditions.

These expectations of future spot prices can signal the need for new generation and network investments. This helps manage public risk in the industry of ensuring reliable and cost-effective power supply in the medium to longer term. For example, the selling of derivative contracts by generation companies can provide capital to fund new generation plant investment.

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3.3 Issues with Derivative Markets for NEM Participants

Currently, both the OTC and exchange-traded electricity derivative markets in Australia suffer from low liquidity. The lack of trading in the exchange markets is due to volatile cash-flow requirements for margining calls given the volatile underlying spot prices, and flaws in the contract designs [2]. The OTC markets lack short-term (less than 30 days) and long-term (beyond 3 years) contracts. Short-term illiquidity is due to high cost of contracts and participants' strategies to obtain the required hedge cover well in advance of spot. Long-term illiquidity is due to credit concerns and regulatory uncertainties [10]. Low liquidity limits the ability for participants to adjust their hedging positions as circumstances change, and increases their difficulties in obtaining cover at reasonable prices [2].

Large scale inter-regional contracting between generators and retailers are hampered by the absence of a firm inter-regional hedge [2]. The SRA doesn't provide hedging when there is an outage on the interconnector because the settlement revenue is the price differential multiplied by the electricity flow between the two nodes. Worse, periods where an interconnector is down (and therefore energy flows are zero) will often also result in very high price differentials between these regions – the event where hedging is most required.

Government arrangements such as the NSW Electricity Tariff Equalisation Fund (ETEF) also impact on market liquidity. ETEF provides government backed hedging for retailers with respect to their default retail customers in NSW. This lowers demand for derivatives by retailers from other market participants, as well as causing other distortions.

There are also no standard derivative pricing methods at present and the only reference price for OTC products is through the AFMA forward curve [2][10]. This curve is based on voluntary participants' expectations of OTC prices and the benchmark price can therefore be somewhat questionable. With no standard pricing method or reliable forward price reference, participants may have widely different price expectations for derivatives, thus contributing to a wide bid-offer spread and reduced liquidity.

The impending adoption of the new international accounting standards (IAS39) in Australia has created concerns among participants. While the standards aim to provide investors with more information on the companies' risk management practices and derivative transactions, it is tremendously complex. Earnings volatility may increase, as well as changes to current hedging with derivatives due to the new standards [12].

4. OTHER FORMS OF MARKET RISK MANAGEMENT

The use of derivative markets in risk management depends on the ability to transfer some risk from one party to another [5].The issues discussed in the previous section highlight some of the challenges for generators and retailers attempting to manage risks in this way. Therefore, some of the risks they face may be better managed using other risk management tools.

4.1 Demand Management

The range of demand management activities available to electricity industry participants include load management, energy efficiency and distributed generation. Through these activities, overall demand elasticity can be increased. At sufficient scale, this has the potential to bring about a reduction in the magnitude and number of price spikes in the wholesale market. In the longer-term, this could lower average spot price and prices of derivatives [9].

Together with new types of retail contracts, such as time-of-use, interruptible and spot market linked tariffs, some market risks can be transferred from the retailers to end-users to manage. End-users can then balance taking on these added risks against potentially lower electricity tariffs.

4.2 Physical Generating Units

Retailers wanting to hedge against high spot prices and high peak demands (volume risk) can underwrite the building of new peak-load generators.

There can be some flexibility in the timing of making such investments, making them somewhat similar to an American call option, also known as a real option.

4.3 Insurance Instruments

Insurance instruments are associated to specific events that trigger defined losses. There are a variety of insurance products that are known to have been offered to electricity market participants including business interruption, weather, outage and hybrid (interest rate + power price combinations and "bottom line" insurance that puts all risks into a single bucket). However, to date only outage insurance has been used to any great extent [7].

Since derivatives are dependent on large and liquid markets for price discovery and successful trading, the low liquidity and wide bid-offer spread evident in NEM derivative markets may make insurance instruments a more attractive option in the future.

5. IMPACTS FROM MARKET RISK MANAGEMENT

The risk management strategies by market participants will firstly change the risk position of the participants themselves. The various risk exposures that were discussed in Section 2 can be transformed as a result of the hedging strategy adopted.

As a result of the change in risk positions of market participants, the wholesale spot market and the derivative markets are affected in turn.

5.1 New Risk Positions

Generators that have entered into derivative contracts with other parties will now have spot payment obligations [3]. As long as the spot price is above the generators' marginal cost, they will have to ensure that they have generated sufficient electricity to meet their contracted obligations. If the spot price is below their marginal cost, the generators may find it more attractive to purchase the capacity from the wholesale market. Any shortfall from the generators' contracted obligations will require them to purchase the difference from the wholesale market at the volatile spot prices.

Retailers with excess hedge cover will have to absorb the loss, and hope that the spot prices will be high to make up for the excesses [10]. Excess hedge cover for large end-users will add to their operating costs.

The use of derivatives will also expose the participants to derivative price risk, basis risk due to differences between the derivative prices and the spot prices, and volatility risk from the derivatives.

Market participants with exchange-traded contracts will have to ensure adequate cash flow to meet the daily market marking. Those with OTC contracts will have to be concerned with counterparty credit risks.

5.2 Less Volatile Spot Prices

The hedging of spot price uncertainties by generators and retailers will greatly influence the operational decisions and spot market bidding behaviour of generators.

Generators with large hedging positions would have less incentive to engage in anti-competitive practices, such as capacity withholding. This will result in less volatile spot prices, but will not eradicate all price spikes.

Price spikes could also be caused by constrained generation and transmission capacity. These price spikes are not abnormal or necessarily undesirable, as they reflect the physical state of the market and can encourage economically efficient generation and transmission investment.

If improper regulatory measures, such as very low price caps, are imposed in the market to lower the spot price volatility beyond the economically efficient level, this may reduce demand for hedging instruments in the short-run[2]. In the long-run, however, investment signals may be dampened and high price volatility could occur

[2] Market participants would have less incentive to hedge if spot price volatility decreases as market risk would be lowered.

at a later stage due to more generation and transmission constraints.

5.3 Innovation and Hedging Instruments

The risk positions and hedging strategies of market participants will determine the demand and supply of hedging instruments.

The introduction of various forms of exotic options and flexible-load derivatives in some electricity markets is expected, as the derivatives evolved to better match the needs of the market participants' risks. Discussions of the latest derivatives in electricity markets are available in [8].

Financial intermediaries could also see greater participation in the derivative markets by offering weather derivatives and relevant insurance products.

6. CONCLUSION

In this paper we have briefly outlined the various market risks that NEM participants are exposed to. Risk management tools from the financial markets to physical options provide useful but, at present, inadequate options for managing this exposure. The use of these tools also has important impacts on the underlying wholesale electricity market.

There appear to be some key issues in the Australian electricity derivative markets that impede risk management. Successful derivative markets in other electricity markets can perhaps provide answers to managing some of these issues.

Comparisons between the Australian NEM and other electricity markets, especially the Scandinavian Nordpool, the UK NETA and the PJM market for Pennsylvania, New Jersey and Maryland in U.S, are made in [2] and [10]. Some areas where the NEM compares poorly to these markets -the lack of diversity in participants, inadequate supply of financial contracts due to non-standard clauses and the wide bid-offer spreads, are highlighted.

An interesting area of market risk management for future work is in the impact of public risk management by regulators and government on the private risk management by market participants. These interact in important ways that can greatly add to the challenge of risk management by all industry participants.

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