Estimating energy purchase adjustment costs

A FINAL REPORT PREPARED FOR IPART

December 2013

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1 Introduction

1.1 Background

Under the existing arrangements governing the retail electricity market in New South Wales, retailers and customers are free to negotiate and enter into 'market' contracts for the supply of electricity. To the extent that an agreed retail supply contract is broken by a customer seeking to exit the agreement ('early termination') the retailer is permitted to charge the customer an 'early termination fee': this fee forms part of the original contract struck between the customer and retailer and at present this fee is not regulated in New South Wales.

In July 2013 the Premier of NSW issued the Independent Pricing and Regulatory Tribunal (IPART) with a Terms of Reference[1] instructing it to determine the maximum amount by which a retailer can charge for the early termination of fixed term retail electricity and dual fuel contracts.

IPART's Terms of Reference specifies, *inter alia*:

> ... this maximum amount (or amounts) must reflect a retailer's reasonable costs in giving effect to the early termination of the contract. It must not include an estimate of costs based on lost supply and lost profit, or an estimate of inducement costs not recovered due to the early termination of the contract.

IPART has engaged Frontier Economics to advise on aspects of the reasonable costs that should be considered when setting the allowable early termination fee that retailers can charge.

1.2 This Final Report

Frontier Economics has previously provided IPART with a Draft Report providing our advice on energy purchase adjustment costs faced by retailers as a result of early termination. Our Draft Report was released on IPART's web site.[2]

Since the release of IPART's Draft Report and our Draft Report, stakeholders have had an opportunity to provide submissions in response. We have reviewed all submissions received by IPART, but none have raised any issues with the analysis set out in our Draft Report. For this reason, for the purposes of this Final Report we have not made any changes to the analysis presented in our Draft Report.

1 IPART's ToR is available here.

2 Frontier Economics, Estimating energy purchase adjustment costs, A Draft Report prepared for IPART, October 2013. Available here.

1.3 Scope of this report

There are several broad classes of cost that a retailer faces due to the early termination of a retail market contract. These costs include fixed costs (such as the inability to fully recover upfront acquisition costs of winning a customer initially, or costs associated with the disposal and disconnection of a terminating customer) as well as incremental costs (such as the impact that an early terminating customer has on a retailer's wholesale energy costs).

The advice outlined in the remainder of this report sets out our estimate of the incremental cost that a retailer faces when a customer seeks early termination. Specifically, our advice relates to the incremental cost facing a retailer from having to re-balance its hedge contract position in the event that a customer seeks early termination.

2 Approach to estimating incremental costs of early termination

This section outlines our advice to IPART on the estimated incremental cost associated with early termination.

2.1 Impact of early termination on optimal hedge position

One of the primary functions performed by electricity retailers who serve end-use customers is risk management: retailers stand between a highly volatile wholesale spot market and the end-use customer who typically faces a flat (or slightly shaped) retail tariff that is typically fixed for the duration of a retail market contract.

A key requirement facing retailers is managing the highly volatile input cost they face with the fixed output price they receive. To achieve this retailers typically enter derivative contracts with counterparties (most often generators) which provide a 'hedge' against volatile spot prices. The cost of this reduced volatility (in the form of contract premiums paid to the sellers of hedge contracts) forms part of the wholesale energy cost that a retailer faces and ultimately passes on to its customers.

Due to the highly volatile nature of the wholesale spot market retailers typically make contracting decisions based on a forward estimate of their expected retail load. This forward estimate of retail load is in turn influenced by the number of customers the retailer expects to serve. In simple terms, once a retailer acquires a new retail customer it must subsequently acquire hedging contracts to hedge that incremental customer's load against the volatile spot price. This contracting decision is made on a forward-looking basis, having regard to the period over which a customer is expected to remain with the retailer.

An efficient retailer will structure its hedge book in order to achieve a given level of risk (which is driven by both volatility in contract difference payments and spot price exposure) at least cost. When a customer seeks early termination, the issue facing a retailer is that this 'optimised' hedge portfolio will no longer be optimal all else equal: this is since the optimal hedge position was determined based on an assumption of a load forecast that included the terminating customer's load. In the simplest case the retailer is likely to find itself over-hedged relative to its optimal position after losing a customer due to early termination.

2.2 Different ways of assessing incremental cost and risk posed by early termination

There are three broad ways that early termination can lead to increased cost and risk for a retailer:

- **Cost of buying an option to adjust the hedge position:** one option that a retailer has in managing the risk posed to its optimal hedge position from early termination is to buy on option that will allow it to adjust its hedge position at a time in the future. This form of option is a put swaption. A put swaption gives the buyer the right, but not obligation, to enter the sell side of a swap at a pre-determined strike price. For this option the buyer pays a premium for every hour of the duration of the underlying swap contract. In the event that a customer chooses to terminate early, the retailer can exercise its put option to enter the sell side of a swap contract and 'un-hedge' itself by an amount that reflects the lost customer's load.
- **Cost of re-balancing hedge position on termination:** the second option a retailer facing early termination has it to attempt to re-balance its hedge portfolio at the time that the customer terminates. While this option will allow the retailer to re-optimise its hedge position, this option does not come without risk (and hence cost). This risk arises because between the time that the retailer hedges the customer's load initially, and the time that the retailer re-balances its hedge position on termination, market conditions may have (in fact are likely to have) changed.
- **Cost of being imperfectly hedged:** the third option a retailer facing early termination has is to remain imperfectly hedged after losing a customer. Like the second option above, depending on market conditions this option may have a positive or negative cost. However, this uncertainty creates additional risk that the retailer must bear as the result of the early termination.

When advising IPART on the wholesale energy component of regulated retail prices in New South Wales for the purposes of IPART's 2013 determination, Frontier's modelling approach and methodology sought to quantify the wholesale energy cost facing a retailer at the 'conservative' point of the risk-reward trade-off between the cost of energy and the corresponding volatility in underlying purchases. Our approach to estimating energy purchase assumes that retailers will seek to minimise their energy purchase cost volatility.

The first approach discussed above is consistent with this assumption: it assumes that retailers seek to reduce the risk they face when purchasing wholesale energy to serve their retail load. This is done by purchasing an option to sell down their contract position at a pre-determined price in the future if required. This approach is also consistent with the approach proposed by AGL and EnergyAustralia in their submissions to IPART's Issues Paper.

Consistent with both the approach adopted by IPART in its 2013 retail price determination and the approach suggested by AGL and EnergyAustralia, IPART has instructed Frontier to consider the first approach when estimating the incremental costs associated with early termination. As distinct from the second and third approaches (which involve the retailer bearing additional risk), the first approach involves the retailer paying a certain premium to manage the risk involved in adjusting its hedge book position should a customer choose to terminate early.

3 Results of analysis

It is typically the case that a retailer serving a retail load shape will hold a combination of swap and cap contracts to hedge its expected spot purchases: particularly if its load shape is relatively 'peaky'. In such cases, in order to hedge the risk of early termination a retailer would need to purchase both put swaptions and captions: the swaption would be exercised and used to sell down its swap position, while the caption would be exercised and used to sell down its cap position.

Given that the majority of hedging costs are typically associated with swap contracts and that there is a lack of transparent data on the price of put captions, our approach considers the cost of acquiring options to re-balance the swap portion of a retailer's hedge position only.

Subject to the above caveat, calculating the incremental cost of early termination under option one involves three steps:

- First, the cost of put swaptions that can be used to hedge the risk of a customer choosing to terminate its agreement early must be calculated.
- Second, the expected size of the put swaption contract needed to hedge the risk of an earlier terminating customer must be calculated.
- Third, the above two components must be combined to provide a final cost per customer per annum of hedging the risk of an early terminating customer.

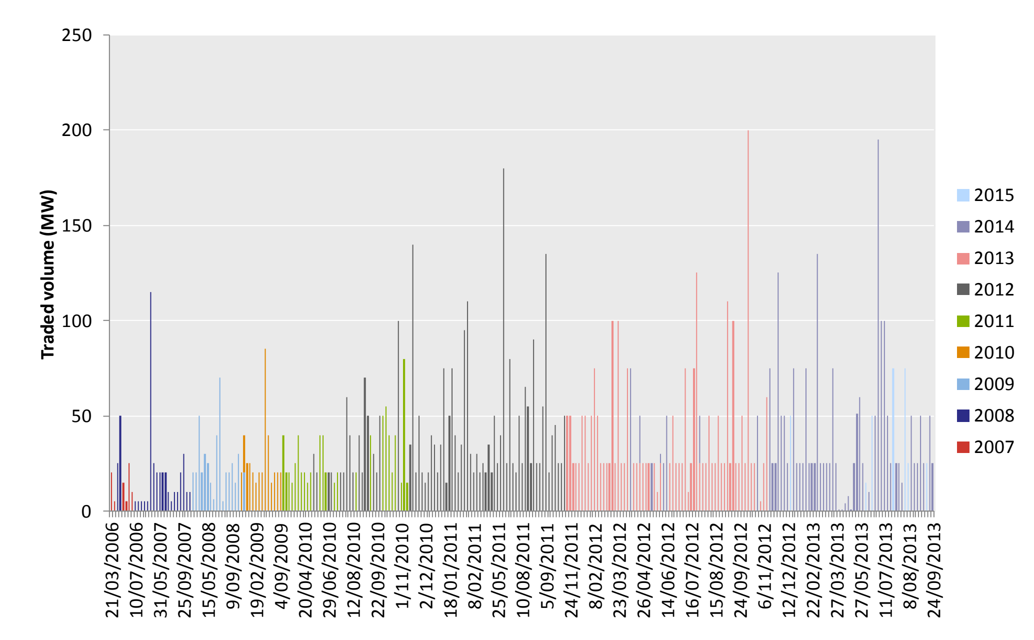
The remainder of this section outlines Frontier's estimates of the above three steps.

3.1 Step 1: Estimating the cost of required swaptions

Swaptions trade through two main channels: through the ASX futures exchange (formerly d-cyphaTrade) and over-the-counter (OTC) via brokers. In line with IPART's decision to use public and transparent d-cyphaTrade contract price data during its 2013 determination of retail electricity prices, we have based our estimate of the cost of put swaptions on ASX futures prices for these contracts.

There has been a reasonable volume of put swaptions traded through the ASX futures exchange over the past several years. Outlined in Figure 1 is the sum of trading volumes covering the period 2006 to 2013 for the most frequently traded put swaptions: calendar year strips. The height of each bar represents the traded volume of put swaptions on that day across all strike prices for a given calendar year vintage (indicated by the colour of each bar).

Figure 1: Historical traded volumes of calendar year strip put swaptions (all strikes)



Source: ASX, Frontier analysis

3.1.1 Choice of swaption contract

There are various swaption contracts available via the ASX futures exchange. These contracts differ according to the following key characteristics. The characteristics of the particular swaption contracts chosen for this analysis are explained in turn.

Calls vs puts

Both calls (right but not obligation to enter the **buy side** of a swap) and puts (right but not obligation to enter the **sell side** of a swap) are traded. For our purposes we are interested in the price of put swaptions, as this option gives the retailer the option to enter a swap contract to sell a volume of load equivalent to the size of the early terminating customer's load for a pre-determined swap price.

Duration and time period of underlying swap

Swaptions are offered to cover underlying base and peak quarterly swaps as well as annual base 'strip' swaps, which cover an entire year (four quarters) on either a calendar or financial year basis. Frontier's analysis of historical trading data suggests that the most frequently traded swaptions are those covering calendar year base 'strip' swaps: that is, the underlying contract is a collection of four quarterly base swaps that cover a given calendar year (Q1-Q4). Due to the higher frequency of trades for base calendar year strip swaptions our analysis focuses on the price of these contracts.

Strike price of underlying swap

Swaption contracts trade for a large number of underlying strike prices (the strike price is the ultimate swap price that applies if the swaption is exercised by the buyer). Due to the nature of the optionality of swaptions there is an intrinsic relationship between the swaption premium and its strike price. In the case of a put swaption, for a given expected future swap price for the contract underlying the swaption one would expect:

- the premium for a swaption with a strike price that is **above** the current expected swap price to be relatively **high**
- the premium for a swaption with a strike price that is **below** the current expected swap price to be relatively **low**.

The intuition for this is simple: if a seller sells a CY2014 put swaption with a $50/MWh strike and the current expected swap price for CY2014 swaps is $40/MWh, then on an expected basis the seller of the swaption will lose $10/MWh for each MW covered by the contract. This is since the buyer of the swaption at the expiry of the option will choose to enter the underlying CY2014 swap covered by the swaption for a swap price of $50/MWh when the market price of the swap (assuming the original expectation is realised) is $40/MWh.

Since the swaption is initially expected to be "in the money" relative to the markets expectation of swap prices, the seller will charge a premium to the buyer to cover this expected cost. The converse is true if the seller sells a swaption with a strike price of only $30/MWh. In this case the seller would be willing to accept a lower premium given the swaption has less chance of being exercised / "in-the-money".

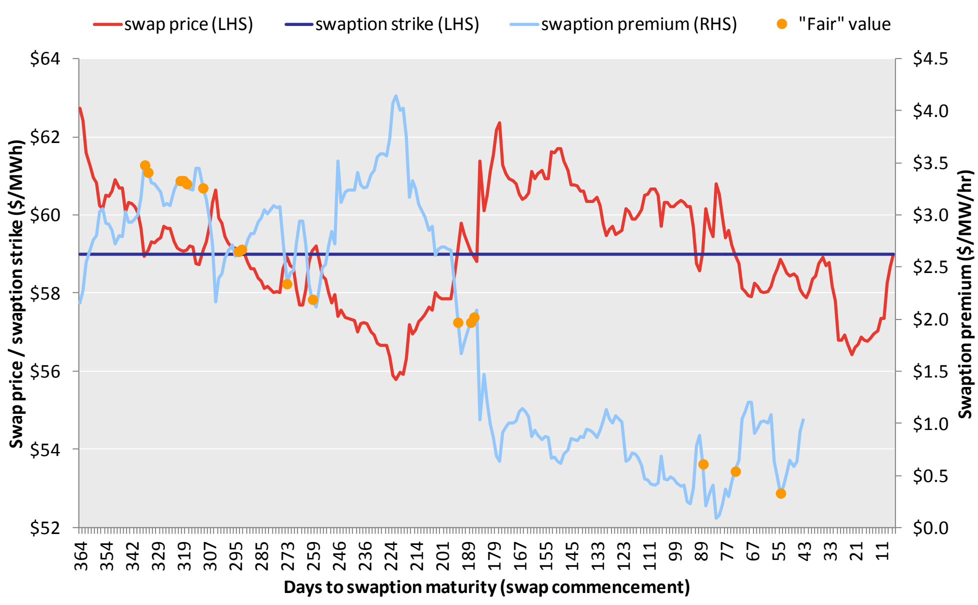
An example of this concept is outlined in Figure 2. The chart shows swap prices (red line) for a CY2013 NSW base swap trading for a year prior to the commencement of the swap (i.e. 1 January 2012 to 31 December 2012). The ultimate 'fair value' for the swap on the final day of trade was $59/MWh (dark blue line). Also shown are the put swaption premiums trading over the same time period for a swaption with a $59/MWh strike price covering a CY2013 NSW base swap. The orange dots highlight daily premiums when the underlying contract (the swap) was trading at a price that reflected the swaption strike price.

As noted above, on days when the underlying swap contract was trading above the strike price of the swaption the swaption premium tends to fall and vice versa.

By construction Figure 2 only shows swaption premiums for a single swaption strike price: $59/MWh, which ultimately was the 'fair value' of the underlying swap on the final day of trade (i.e. the day before the commencement of the swap).

For our purposes the important question is: what swaption strike price is most appropriate to consider when estimating the cost of put swaptions? Based on the above logic the approach we use in estimating the cost of swaptions considers the cost of put swaptions trading at a strike price that reflects the market's current expectation of the swap price for the underlying swap covered by the swaption.

Figure 2: CY2013 swaption and underlying swap prices



Source: ASX, Frontier analysis

Using Figure 2 as a further example, on those days highlighted by the orange dots the premiums associated with a swaption with a $59/MWh strike price are considered, since on these days the market's consensus of the underlying swap price was also $59/MWh. On days when the market's consensus for the underlying swap price was some other value (say $60/MWh), the premium for swaptions with a strike price as close as feasible to the fair value of the underlying swap on that day are considered (i.e. swaptions with strike prices as close as possible to $60/MWh).

3.1.2 Calculating premiums for contracts at 'fair value'

As noted above, the approach employed to calculate the price of swaptions involves analysing all historical trade data for swaptions (across all strike prices) and the contracts underlying the swaptions. The process involves:

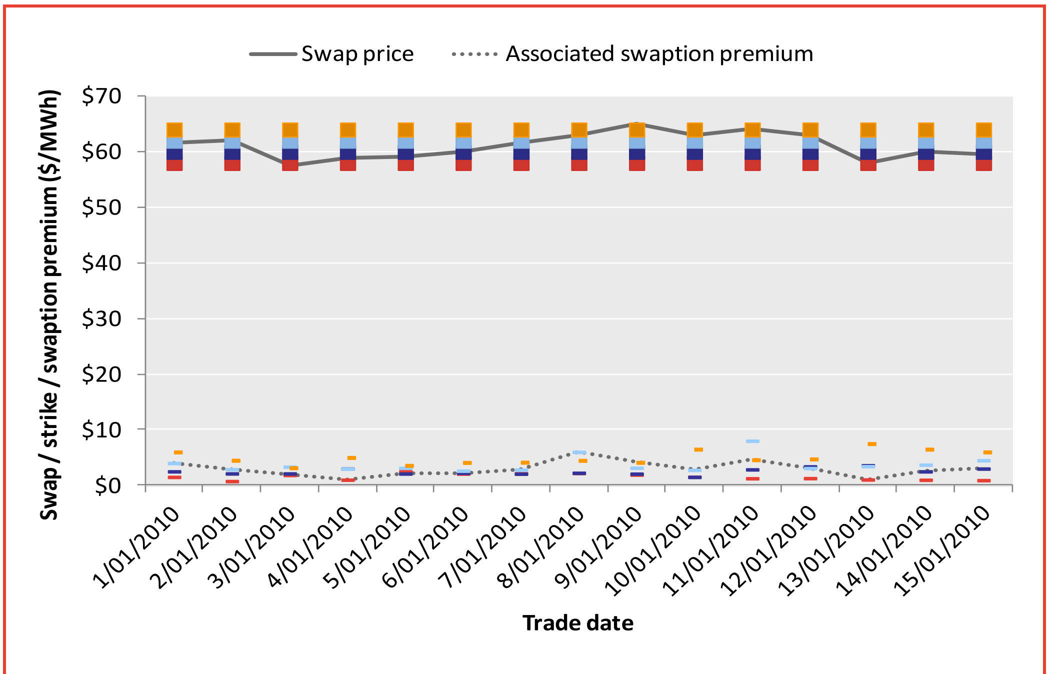
- For each day in the lead up to the start of the underlying swap contract covered by the swaption the traded price of the underlying swap is calculated.

Since the underlying swap contracts considered are calendar year strips, the underlying swap price is calculated by taking a weighted-average of the four quarterly base swap prices that traded on a particular day (e.g. for a CY2013 strip, the weighted average of Q1-Q4 2013 base futures prices is taken).

- The premium for the swaption covering the underlying swap at a strike price as close as possible to the calculated price of the underlying swap on each day is then recorded. If no swaption was traded on that day then no price is recorded. If only a single swaption traded on that day then that price is recorded.
- The above exercise is repeated for each calendar year base strip contract covering the calendar years 2009-2014. Earlier and later years were omitted due to a lack of either quarterly swap or swaption trade data.

The approach is represented stylistically in Figure 3. On each trading date, a swap price is calculated. This swap price is shown as the grey solid line. The strike prices of the available swaptions on each trading date are shown by the coloured bars, and the premiums for these swaptions are represented by the correspondingly coloured dashes. The premium for the swaption whose strike price most closely matches this daily swap price is then taken to be the 'fair value' swaption premium on that day. This is shown as the grey dashed line. This process is repeated for each day and for each base strip period (CY2009-14 inclusive).

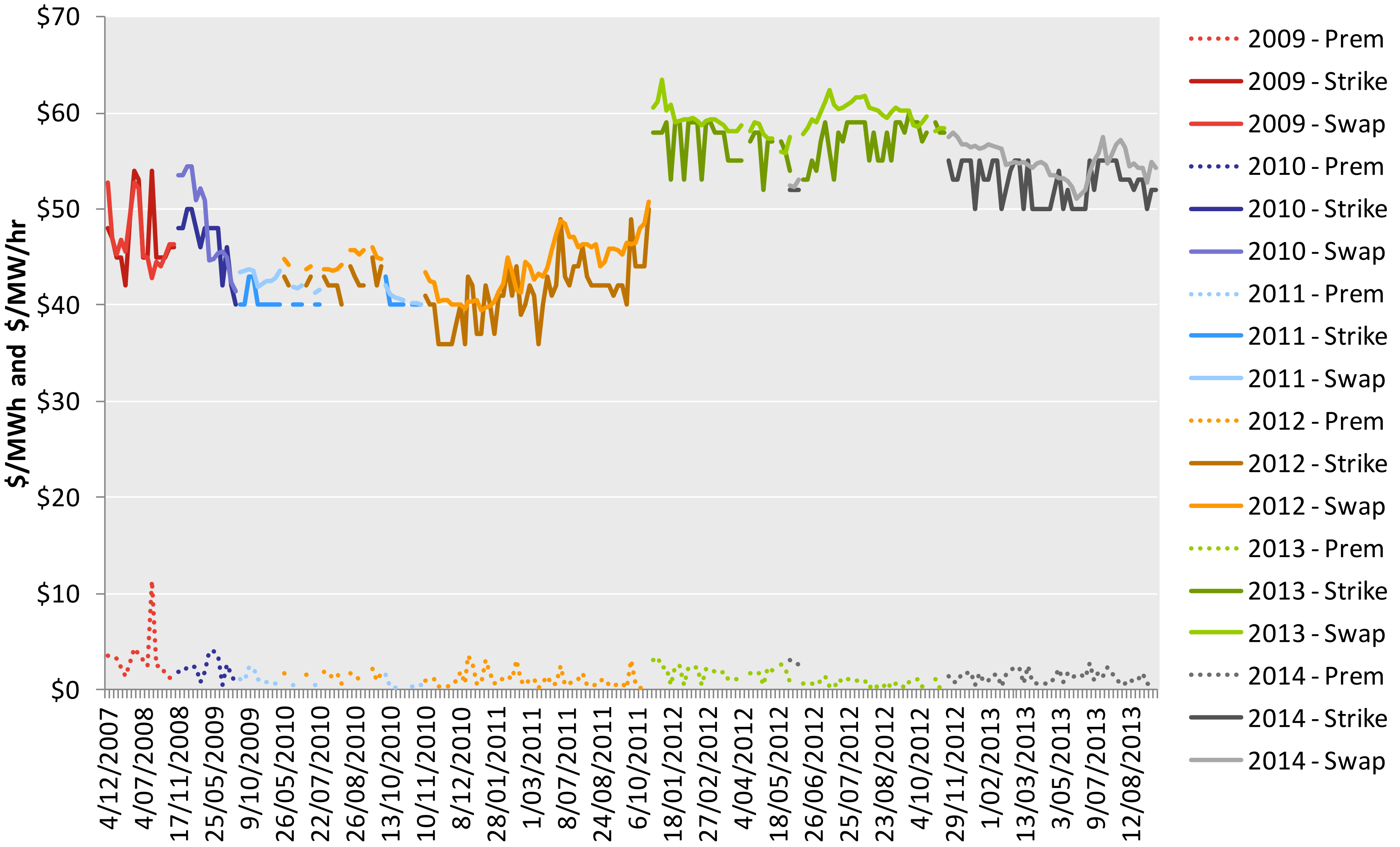
Figure 3: Stylised example of approach to calculating swaption premiums



Source: Frontier analysis

Results of analysis

Figure 4: Calculated "fair value" swaption premiums



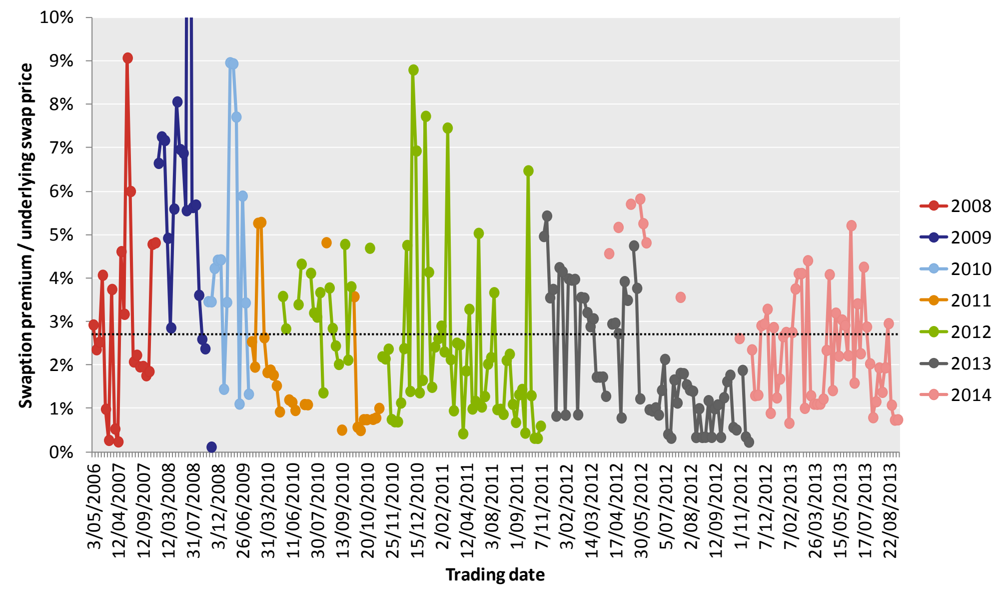
Source: ASX, Frontier analysis

The results of this analysis are outlined in Figure 4. The chart shows for each calendar year base strip (colours):

- the daily swap price for that base strip contract (light solid line)
- the "closest match" swaption strike price for swaptions covering the same underlying contract on that day (dark solid line)
- the premium associated with the "closest match" swaption covering the same underlying contract on that day (dotted line).

To aid readability, these results are reproduced in Figure 5: in this case the swaption premiums have been represented as a percentage of the underlying base strip swap price (dotted line value divided by light solid line value).

Figure 5: Ratio of swaption premium to underlying swap price



Source: ASX, Frontier analysis

The results outlined in Figure 5 demonstrate several features:

- The ratio of swaption premiums to underlying swap prices for swaption strike prices at (or near) fair value is considerably volatile: this is a function of underlying volatility in both swaption premiums and (to a greater degree) swap prices in general.
- There is (mild) evidence of "option value decay", consistent with option pricing theory. The ratio of the swaption premium to underlying swap price tends to fall as the date to option maturity (or underlying swap commencement) nears.

- Inter-year volatility varies considerably. There is mild evidence (at least visually) to suggest that the ratio of swaption premiums to underlying swap prices was more volatile in earlier (2008-2012) than the two latest (2013-2014) years considered.

Our analysis suggests that over the timeframe considered the average ratio of swaption premiums to underlying swap prices is **2.73%**: this average is highlighted by the black dotted line on Figure 5.

Applying this average ratio of swaption premiums to underlying swap prices of 2.73% to the current NSW base strip calendar year 2014 swap price of $54.33/MWh[3] yields an estimated cost of swaption cover of **$1.49/MW/hr**.

3.2 Step 2: Estimating the volume of required swaptions

The required volume of swaption contracts to hedge against a loss of load due to early termination is a function of:

- The expected annual consumption of the lost customer.
- The expected load shape of the lost customer. The expected load shape of the lost customer influences the proportion of that customer's load that would be expected to be hedged via swap contracts.

We calculate the estimated volume of required swaptions to hedge a representative early terminating customer who consumes 7 MWh per annum. If this customer's load shape was perfectly flat (i.e. if they consumed ~0.8 kW across every hour of the year) then if the customer's load was fully hedged the required volume of swaptions would be 0.8 kW.

In practice, however, determining the required volume of swaptions is complicated by the fact that a representative retail customer does not have a perfectly flat load shape. In fact, regulated customers (small business and residential) typically have quite 'peaky' load shapes: their average level of consumption is significantly less than their peak level of consumption.

To inform the required volume of swaptions required to hedge a typical regulated customer load shape, Frontier has utilised the load and contract position data developed and determined while advising IPART on its 2013 determination of regulated retail electricity tariffs. In advising IPART, Frontier provided an estimated 'conservative point' hedging position for each Standard Retailer in New South Wales for the 2013/14 period. Each hedging position was subtly different, given the different load shapes of each Standard Retailer. To arrive at a

3 Settled price as at 2nd October 2013.

single estimated representative swap volume (and hence required swaption volume) Frontier has taken the average conservative point hedging position[4], the average maximum demand and the average load factor across the three Standard Retailers for 2013/14 from the data utilised in our previous advice to IPART.

Based on an average load factor of **45.8%** a representative customer consuming 7 MWh per annum would be expected to have a peak demand of **1.74 kW**. Based on the average ratio of swap contract cover to peak demand of **52.4%,** the volume of base swap contracts needed to hedge a representative customer with peak demand of 1.74 kW is 0.915 kW – this is equivalent to 8.015 MWh per annum. Consequently, to hedge against the early termination of a customer consuming 7 MWh per annum would require **0.915 kW** of swaption contracts.

3.3 Step 3: Estimating the cost of hedging early termination

The results of combining our estimate of the price of required swaptions (outlined in Section 3.1) with our estimate of the volume of required swaptions (outlined in Section 3.2) is outlined below.

Table 1: Summary of Frontier's advice

Expected price of swaptions ($/MW/hr) (a)	Required volume of swaptions (MW) (b)	Contract hours (baseload annual strip) (c)	Expected cost of hedging early termination of 7 MWh pa customer ($ pa, $2013/14) (a) x (b) x (c)
$1.49	0.000915	8760	$11.91

Source: Frontier

For a customer consuming 7 MWh per annum the cost of purchasing swaption contracts to hedge against the early termination of this customer is estimated to be **$11.91** per customer per annum.

4 In our advice to IPART for the 2013 Determination of retail electricity prices a conservative point hedge position was provided utilising peak and off-peak swap and base cap contracts by quarter. The peak and off-peak swap position by quarter has been appropriately aggregated to a base annual position for this analysis.

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