Electricity Derivatives

CONCEPT PAPER

National Stock Exchange of India
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Contents

Electricity Derivatives: An Introduction

What are derivatives?

A derivative is a product whose value is derived from the value of one or more basic variables, called bases (underlying asset, index or reference rate), in a contractual manner. The underlying asset can be equity, forex, commodity or any other asset. For example, a crude oil exploration company may wish to sell its production quantity of crude oil of a future date to eliminate the risk of a change in crude oil prices by that date. Such a transaction is an example of a derivative. The price of this derivative is driven by the spot price of crude oil which is the 'underlying'.

The emergence of the market for derivative products, most notably forwards, futures and options, can be traced back to the willingness of risk-averse value chain participants of an asset to guard themselves against uncertainties arising out of fluctuations in asset prices. Through the use of derivative products, it is possible to partially or fully eliminate price risks by locking–in asset prices. By locking-in asset prices, derivative products minimise the impact of fluctuations in asset prices on the profitability and cash flow situation of risk averse participants.

Economic functions imparted by a derivatives market

The derivatives market performs a number of economic functions. A brief summary follows.

First, the derivatives market helps to transfer risks from those who have them but may not like them to those who have an appetite for them. This is a very critical function.

Second, derivatives, due to their inherent nature, are linked to the underlying cash markets. With the introduction of derivatives, the underlying market witnesses higher trading volumes because of participation by more players who would not otherwise participate for lack of an arrangement to transfer risk. Transfer of risk enables market participants to expand their volume of activity.

Third, prices in an organised derivatives market reflect the collective perception of market participants about the future. Hence they provide important price signals which in the absence of derivatives markets are largely not available.

There are many other direct and incidental benefits because of the existence of derivatives markets viz. it acts as a catalyst for new entrepreneurial activity. The derivatives have a history of attracting many bright, creative, well-educated people with an entrepreneurial attitude. They often energise others to create new businesses, new products and new employment opportunities, the benefits of which are immense.

Types of derivatives

The most commonly used derivatives contracts are forwards, futures and options which we shall discuss in detail. Before that we take a brief look at various derivatives that have come to be used.

- Forwards: A forward contract is a customised contract between two entities, where settlement takes place on a specific date in the future at today's pre-agreed price.
- Futures: A futures contract is an agreement between two parties to buy or sell an asset at a certain time in the future at a certain price. Futures contracts are special types of forward contracts in the sense that the former are standardised exchange-traded contracts.
- Options: Options are of two types – calls and puts. Calls give the buyer the right but not the obligation to buy a given quantity of the underlying asset, at a given price on or before a given future date. Puts give the buyer the right, but not the obligation to sell a given quantity of the underlying asset at a given price on or before a given date.
- Swaps: Swaps are private agreements between two parties to exchange cash flows in the future according to a prearranged formula. They can be regarded as portfolios of forward contracts. The two commonly used swaps are:
    - Interest rate swaps: These entail swapping only the interest related cash flows between the parties in the same currency
    - Currency Swaps: These entail swapping both principal and interest between the parties, with the cash flows in one direction being in a different currency than those in the opposite direction.

Participants in the market

The following three broad categories of participants *viz.* hedgers, traders, and arbitrageurs trade in the derivatives market.

- Hedgers face risk associated with the price of an asset. They use futures or options markets to reduce or eliminate this risk. They access the market based on their needs and requirements at specified times usually.
- Traders wish to bet on movements in the price of an asset, they play the critical role of providing liquidity to the market by transferring risk between other market players, as they are usually present in the market at all times.
- Arbitrageurs are in business to take advantage of a discrepancy between prices in two different markets. If, for example, they see the futures price of an asset getting out of line with the cash price, they will take offsetting positions in the two markets to lock in a profit. They help to align derivatives markets to underlying cash markets and in turn are also liquidity providers.

Forwards, Futures and Options: In detail

A forward contract is an agreement to buy or sell an asset on a specified date for a specified price. Details of the contract like delivery date, price and quantity are negotiated bilaterally by the parties to the contract. The salient features of forward contracts are:

- They are bilateral contracts and hence exposed to counter–party risk.
- Each contract is custom designed, and hence is unique in terms of contract size, expiration date and the asset type and quality.
- The contract price is generally not available in public domain.
- On the expiration date, the contract has to be settled by delivery of the asset.
- If the party wishes to reverse the contract, it has to compulsorily go to the same counterparty, which often results in high prices being charged.

However, forwards are afflicted by several problems:

- Lack of centralisation of trading,
- Illiquidity, and
- Counterparty risk

In the first two of these, the basic problem is that of too much flexibility and generality. Counterparty risk arises from the possibility of default by any one party to the transaction. When one of the two sides to the transaction does not perform, the other suffers. Even when forward markets trade standardised contracts, and hence avoid the problem of illiquidity, still the counterparty credit risk remains a very serious issue.

Futures: Futures markets were designed to solve the problems that exist in forward markets. A futures contract is an agreement between two parties to buy or sell an asset at a certain time in the future at a certain price. But unlike forward contracts, the futures contracts are standardised and exchange traded. To facilitate liquidity in the futures contracts, the exchange specifies certain standard features of the contract. It is a standardised contract with standard underlying instrument, a standard quantity and quality of the underlying instrument that can be delivered, (or which can be used for reference purposes in case of cash settlement settlement) and a standard timing of such settlement.

A futures contract may be offset prior to maturity by entering into an equal and opposite transaction. A very large part of all outstanding futures transactions across asset classes are offset this way. Only a small percentage of futures transactions that are entered into are kept open till expiry of the futures contract. This is so mainly because of the time span/periods when hedgers are exposed to price risks for which they use futures to hedge. This period of price risk and exposure shall not necessarily merge the calendar of futures expiries and hence hedgers offset their futures positions based on this factor.

The standardised items in a futures contract are:

- Quantity of the underlying
- Quality of the underlying
- The date and the month of delivery (or expiry in case of cash settlement)
- The units of price quotation and minimum price change
- Location and such allied details of settlement

Options: Options are fundamentally different from forward and futures contracts. An option gives the holder of the option the right but not the obligation to either buy or sell an underlying asset. The holder does not compulsorily have to exercise this right. It is up to the holder of the option to decide to exercise the right or not. In contrast, in a forward or futures contract, the two parties have committed themselves and are hence obliged by contract to either buy or sell an underlying asset.

Buyer of an option: The buyer of an option is the one who by paying the option premium and hence buys the right but not the obligation to exercise his option on the seller/writer.
Writer of an option: The writer of an option is the one who receives the option premium and is thereby obliged to sell/buy the asset if the buyer wishes to exercise his option.

There are two basic types of options, call options and put options.

- Call option: A call option gives the holder the right but not the obligation to buy an asset by a certain date for a certain price.
- Put option: A put option gives the holder the right but not the obligation to sell an asset by a certain date for a certain price.

Distinction between Futures and options

Options are different from futures in several interesting senses. At a practical level, the option buyer faces an interesting situation. He pays for the option at the time it is purchased. After this, he only has an upside. There is no possibility of the options position

generating any further losses or cost to him (other than the funds already paid for the option). This characteristic makes options attractive to many occasional market participants, who cannot put in the time to closely monitor their futures positions.

Hence, buying options can be termed akin to buying insurance against a particular event of price crossing a particular level. For instance, buying a put option on Nifty can be considered akin to buying insurance which reimburses the full extent to which Nifty drops below the strike price of the put option. The cost to be paid for this insurance is the option premium to be paid while purchasing the option.

For that matter, buying a call option on electricity can be considered akin to buying insurance which reimburses the full extent to which prices of electricity rise above the strike price of the call option. The cost to be paid for this insurance is the option premium to be paid while purchasing the option.

A case scenario for use of electricity derivatives by Discoms in India

A discom signs a power purchase agreement for delivery after 6 months. This agreement is mainly to have assured supply of electricity for the contracted period. In addition, the agreement also fixes the price of the contracted amount of power to be purchased. Using analysis of projections of demand, supply and other market variables, there is a view that the price at which the agreement has been signed seems to be on the higher side. But still the discom does not have too many choices. To ensure and secure supply of electricity, the discom has to sign advance purchase agreements notwithstanding the fact that analysis clearly concludes that the price at which power is available is quite high.

However, if electricity futures are available on exchanges to trade, the discom can simply sell electricity futures on the exchange and reverse the positions when the supply of electricity actually happens. In such a scenario, the discom would have essentially realised the purchase price of electricity prevailing when the actual delivery of electricity happens and not that at which the advance purchase agreement has been entered into. The math of the above case scenario:

Month	Event	Remarks
July 2019	Discom enters into purchase agreement for supply in December 2019 @ ₹ 6.1 per unit	
July 2019	Discom sells electricity futures at the prevailing rate at say ₹ 6.1 per unit	Futures Short Position Created
From July to December 2019	No other activity pertaining to this above purchase agreement is required	Short Position held is carried forward
December 2019	Supply starts and continues for the contracted quantity as per agreement	
December 2019	Average prevailing price of electricity is say ₹ 4 per unit for the month of Dec 2019	

December 2019	Existing short positions are existed @ average say ₹ 4 per unit	Mark to market profit of ₹ 2.1 per unit
End of transaction	Effective price of purchase hence **is ₹ 4 per unit**	(6.1 - 2.1) = ₹ 4 per unit

The downside of the above model of hedging using futures, contracted at ₹ 6.1 per unit would arise if the prevailing price of electricity in December 2019 has risen to say ₹ 6.5 per unit. In such a scenario, the effective price applicable to the discom would be ₹ 6.5 per unit and not ₹ 6.1 per unit at which the advance purchase agreement was signed in July 2019. This downside can be overcome with the use of options on electricity for hedging.

If the discom purchases put options, then the final result would be that in December 2019, if the prevailing price of electricity is lower than the contracted price in the advance purchase agreement, say ₹ 4 per unit then the effective purchase price for the discom would be ₹ 4 per unit (plus the amount paid as option premium)

But unlike as in the case of electricity futures, if put options are used, then if the prevailing price of electricity in December 2019 has risen to say ₹ 6.5 per unit, still the effective purchase price would stay the same as the price contracted in the advance purchase agreement i.e. ₹ 6.1 per unit; thus ensuring efficient price management for the Discom. The cost for the above is the premium at which the put options have been purchased.

Derivatives in Electricity i.e. Electricity Futures and Options can have various other kinds of economic usage as well for Discoms; which do not exist in the current market scenario. For instance, currently when a Discom anticipates peak load requirement based on its

internal analysis and forecasts, enters into advance purchase agreements with power producers with definitive price and quantity commitments. These agreements are either irreversible or have prohibitive costs associated with a scenario where the Discom decides to not purchase the contracted amount of electricity in the purchase agreement. This is where derivatives would be very useful with regards to the Discom. One such scenario is arrival of monsoons earlier than forecast, leading to sharp drop in demand.

If such advance purchases and price hedging is done by the Discom using Futures or Options, such advance purchases can easily be reversed on the Futures and Options. Hence the Discom can buy Futures and Call Options of electricity based on forecasted demand in advance. And when the period of actual delivery arrives, based on the actual demand scenario, (if the demand is less than the advance purchase positions in Electricity Futures and Options) the Discom can choose to simply reverse and close out the positions. This not only achieves flexibility in forecast and actual demand management for the Discom; it additionally also ensures efficient hedging and price risk management tool. On top of it, to achieve such flexibility, there is no additional cost of such a transaction in case of Options. However, in case of Futures, the price differential between purchase price of Futures and closing out (sale) price of Futures would be the cost impact to the Discom.

In addition, it is a well-established fact that corporates that use price risk management tools backed by a proper hedging policy put in place; realise efficiency in cost and end up lowering their total cost in the process.