Futures Option Explained

Interest Rate Future Option

- An interest rate future option gives the holder the right but not the obligation to buy or sell an interest rate future at a specified price on a specified date.
- Option on Eurodollar futures is a European type of call or put option on the Eurodollar futures price or equivalently. .
- Option sellers (writers) receive a fixed premium upfront and in return are obligated to buy or sell the underlying asset at a specified price.
- Option writers are exposed to unlimited liability.

Interest Rate Future Option

- An investor who expected short-term interest rates to decline would also be expecting the price of the future contracts to increase. Thus, they might be inclined to purchase a 3-month Eurodollar futures call option to speculate on their belief.
- The advantage of future options over options of a spot asset stems from the liquidity of futures contracts.
- Futures markets tend to be more liquid than underlying cash markets.

Interest Rate Future Option

- The price of a Eurodollar futures is

$$F_t = 100 - 100 \times f_t ,$$

where f_t is 3-month LIBOR rate starting from time t.

- The payoff of a Eurodollar futures option is

$$Max[(F_t - K),0] = 100 \times Max[(k - f_t),0] ,$$

where k = 1 – K/100.

- Therefore, a call option on Eurodollar futures is equivalent to a put option on LIBOR futures multiplied by 100

Interest Rate Future Option

- European option
  - The present value of a call option is given by

$$V(t) = N\tau D(L(t)\Phi(d_1) - K\Phi(d_2))$$

  - The present value of a put option is given by

$$V(t) = N\tau D\big(K\Phi(-d_2) - L(t)\Phi(-d_1)\big)$$

Interest Rate Future Option

- where
  - t - the valuation date,
  - $L(t) = 100 - Y(t; T, T_E) + C$ – the forward rate; C is used to match market future price.
  - K – the strike
  - N – the notional
  - τ – the day count fraction for the forward period $[T, T_E]$
  - T – the maturity of the future contract and also the start date of forward period
  - T_E – the end date of the forward period
  - $D = D(t, T)$ – the discount factor
  - Φ – the accumulative normal distribution function
  - $d_{1,2} = \left(\ln\left(\frac{L}{K}\right) \pm 0.5\sigma^2 (T - t)\right) / (\sigma\sqrt{T - t})$

Interest Rate Future Option

- American option
  - Numeric approaches, such as tree, PDE or lattice can be used to price an American option
  - Given interest rate future options are simple products, we use Black Scholes dynamics plus binomial tree to price an American interest rate future option.

Thanks!

You can find more details at

https://finpricing.com/lib/EqSpread.html