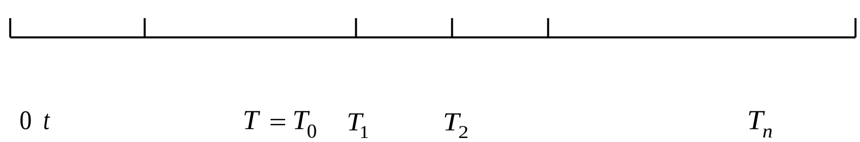
Pricing Ratchet Swap

A ratchet swap is an interest rate swap where one party pays a standard floating rate and the other party pays a ratchet floating rate. The ratchet floating rate coupon is based on an interest rate index with a minimum decrease and a maximum increase.

The valuation is based on the Monte Carlo spot LIBOR rate model. The model generates spot rates which log-normally distributed at each reset date. These spot rates are derived from corresponding forward rates whose stochastic behavior is constructed in an arbitrage-free manner.

The ratchet floating rate coupon is based on an index, e.g., 6-month EURIBOR. The rate is further subject to a minimum decrease of 0 bps and a maximum increase of a threshold, such as, 15 bps. These rates are reset two business days prior to the first day of each coupon period.

We denote these payments dates, which are 0.5 years apart under 30/360 and are subject to modified business day conventions, by $T_1, T_2, \ldots, T_n$. Suppose we are at time t, we can visualize the situation by



where $T = \text{February} 28, 2001$ and $T_n = \text{February } 28, 2004$. The following notation is used:

- N is the notional amount (here N = EUR 20,000,000)
- C is the (annualized) coupon rate for the first pay period (here C = 4.50%)
- Δ_i is 0.5 years (under 30/360) between the payments dates T_{i+1} and T_i.
- $L(t,T,T+\Delta)$ is the forward EURIBOR rate for the period T to $T+\Delta$ as seen at time t
- T_i - δ_i is two business days prior to T_i
- R_i is the ratchet rate over $[T_i, T_{i+1}]$
- $D_i(t)$ is the discount factor from time T_i as seen at time t

The coupon rate is stated as an annualized rate or real rate based on market conventions. Adjustment is made for long/short first/last coupon periods. When a coupon date falls on non-business day, payment may be made next business day with no amount adjustment, see https://finpricing.com/lib/FiBondCoupon.html

Thus $L(T_i-\delta_i, T_i-\delta_i, T_i-\delta_i+\Delta_i)$ denotes the spot 6 month EURIBOR rate observed two business days prior to payment date T_i, for convenience we will denote this quantity by L_i. At time T_{i+1} one party must pay $N\Delta_i R_i$ where R_i is defined recursively by

$$R_i = R_{i-1} : \text{If } L_i < R_{i-1}$$

$$R_i = L_i : \text{If } R_{i-1} \le L_i < R_{i-1} + 0.15\%$$

$$R_i = R_{i-1} + 0.15\% : \text{If } L_i > R_{i-1} + 0.15\%$$

$$R_0 = 4.50\%.$$

The valuation methodology is based on the Monte Carlo spot LIBOR rate model. The model generates spot rates which log-normally distributed at each reset date. These spot rates are derived from corresponding forward rates whose stochastic behavior is constructed in an arbitrage-free manner. Outcomes for the spot rate are generated for each reset date. These rates are then applied to the ratchet-type payoff structure. The ratchet instrument is then valued by discounting and averaging these payoffs.