



# Eurodollar Futures



## Concepts

- Eurodollar Futures (EDF)
- Futures rate
- Convexity adjustment

## Reading

- Veronesi, Chapter 6
- Tuckman, Chapter 17
- Sundaresan, Chapter 15

## Eurodollar Futures (EDF)

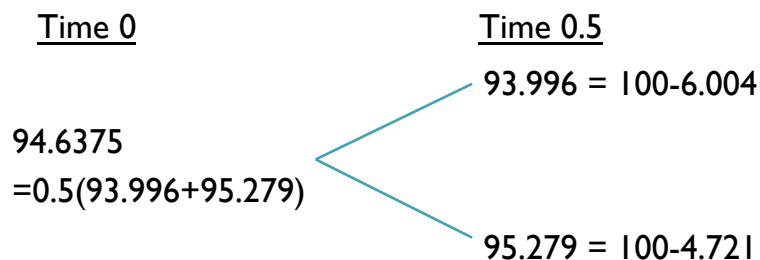
- Eurodollar futures are cash-settled futures contracts with final futures price based on three-month LIBOR at the expiration date:  
$$G(T) = 100(1 - {}_T L_{T+0.25})$$
- For example, if 3-month LIBOR is 1% on the futures expiration date, the EDF price is 99.00.
- Contracts are based on \$1,000,000 par, but marked to market based on the change in the unannualized rate. I.e., each one basis point change in the EDF price induces a mark-to-market of \$25 = 1,000,000 × 0.0001/4.

## The Eurodollar Futures Market

- EDFs are traded on the Chicago Mercantile Exchange.
- For quotes and contract specifications, see [http://www.cmegroup.com/trading/interest-rates/stir/eurodollar\\_quotes\\_globex.html](http://www.cmegroup.com/trading/interest-rates/stir/eurodollar_quotes_globex.html)
- Contracts with expiration dates every month for nearest 6 months, and then every quarter March, June, September, December, out ten years.
- Contracts with expiration up to three years are very liquid. These futures prices form the basis for calibrating the short end of the LIBOR term-structure for LIBOR-based derivative pricing models. LIBOR swap rates are used for the long end of the LIBOR term structure.

## Example

- Let's consider a stylized example of a EDF based on the 0.5-year riskless rate  $r_{T+0.5}$  in our model.
- Suppose the contract expires at time 0.5.



## The Futures Rate

- Define the *futures rate* as  

$$g = (100 - \text{EDF price}) / 100.$$
- The time 0 futures rate for this contract is  

$$g_{0.5} = (100 - 94.6375) / 100 = 5.3625\%$$
- **Class Problem:** What is the forward rate  $f_{0.5}$ ?

## The Convexity Adjustment (I)

- The futures rate is higher than the corresponding forward rate. Thus, to extract forward rates from EDF rates, it is necessary to make an adjustment commonly called the “convexity adjustment.”
- The difference arises for two reasons. Here is one:
- The futures rate is the risk-neutral expected future rate:  $G_T^{T+0.25} = E\{100(1-L_{T+0.25})\} \Rightarrow g_T^{T+0.25} = E\{L_{T+0.25}\}$  and similarly, in our stylized example,  $g_T^{T+0.5} = E\{r_{T+0.5}\}$ .
- But for  $T = 0.5$ , which is one period out in our model,  $1/(1+f_{0.5}^1/2) = F_{0.5}^1 = d_1/d_{0.5} = E\{d_1\} = E\{1/(1+0.5r_1/2)\} > 1/(1+E\{0.5r_1\}/2)$  because  $1/(1+0.5r_1/2)$  is convex in  $0.5r_1 \Rightarrow f_{0.5}^1 < E\{0.5r_1\} = g_{0.5}^1$ .

## The Convexity Adjustment (II)

- For expiration dates farther out, there is the additional effect of marking to market.
- For example, in a FRA, all the “marking-to-market”  $f-r$  comes at the end.
- In the EDF, the sum of marks-to-market are  $g(0)-g(1) + g(1)-g(2) + \dots + g(T-1)-r = g(0)-r$  but negative marks are reinvested at higher rates, while positive marks are reinvested at lower rates, so the futures rate  $g$  must be higher than the forward rate  $f$  to compensate for this adverse effect.
- This is the same as the way that the marking to market in a bond futures contract makes the futures price lower than the forward price of the underlying bond.

## Class Problem

- Consider again a stylized example of a EDF based on the 0.5-year riskless rate  ${}_1r_{1.5}$  in our model.
- Suppose the contract expires at time 1 and the contract is marked to market every 0.5 years.
- Fill in the tree of EDF prices below:

Time 0

Time 0.5

Time 1



## Class Problems...

- What is the time 0 futures rate  $g_1^{1.5}$ ?
- What is the time 0 forward rate  $f_1^{1.5}$ ?