

Eurodollar and Fed Funds Futures

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Eurodollars are USD deposited outside the US (not necessarily just Europe).

The funds are not subject to Fed regulation.

Eurodollars can be invested with various investment horizons, at the USD denominated London-Interbank-Offer-Rate (LIBOR).

Is the rate at which banks are willing to borrow to other banks in the London interbank market. It represents the borrowing rate of large banks.

Libor is a widely used benchmark for other floating rate loans. For example, a corporation may be offered a loan at X bp over LIBOR.

Since counter-parties do not have the credit quality of the US government, LIBOR contains a positive spread to US T-Bills.

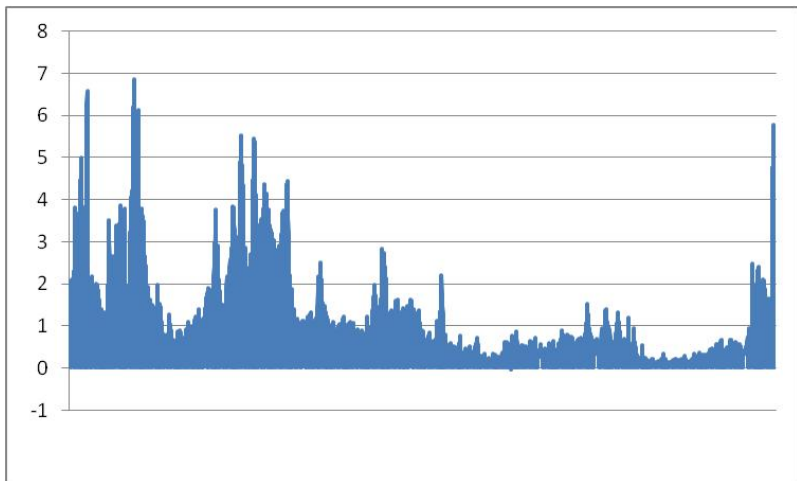


Figure: Historical 90 day LIBOR over T-Bill Spread. Daily data from Jan 1971 - Nov 2008.

The recent spike in the LIBOR - TBILL spread reflects the concerns over credit quality of banks following during the financial crisis.

The USD LIBOR is determined by a survey to 16 banks.

WSJ in May 29, 2008 ran a story suggesting banks underreported their borrowing cost, suggesting that they wanted to convey a picture of lesser borrowing costs or default spread amid concerns of their financial health. This would lead to a downward bias in reported LIBOR rates.

Libor/Tbill spread has come down from 5.5% to about 2% in recent weeks, reflecting government efforts to stabilize the banks.

Nov 14, 2008 LIBOR rates:

		52-WEEK		
	Latest	Wk ago	High	Low
One month	1.47750	1.62250	5.25188	1.40875
Three month	2.23625	2.29000	5.15063	2.13250
Six month	2.71375	2.63875	4.96750	2.36625
One year	2.90500	2.80000	4.55250	2.17813

Note that this compares to 0.07% (4 weeks), 0.355% (13 weeks) and 0.99% (26weeks) yields on T-Bills.

Example

The rates are quoted on a 30/360 basis. Suppose we invest 100,000 for three months at the current market rate of 2.23625. We collect

$$100,000\left(1 + \frac{2.23625}{100} \times \frac{90}{360}\right) = 100,559$$

in principal + interest.

Eurodollar Futures

The CME trades futures contracts on interest rates directly (ie. these are NOT futures on bonds...)

We will see that these contracts allow us to buy and sell duration directly.

Transacting in this market allow us to readily hedge interest rate risks.

Contracts written on 90 LIBOR.

Nov 14, 2008 CME prices (from cme.com):

MTH/ STRIKE	--- SESSION --- LAST	--- SETT	PT CHGE	EST VOL	----- PRIOR SETT	DAY VOL	----- INT
NOV08	97.73	97.74	-.0325	556	97.7725	42038	116400
DEC08	97.705A	97.705	-.10	5510	97.805	305669	566828
JAN09	----	97.81	-.115		97.925	285	9584
FEB09	----	97.84	-.11		97.95		766
MAR09	97.86A	97.855	-.095	5511	97.95	273343	278162
APR09	----	97.855	-.09		97.945		99
JUN09	97.835B	97.835	-.09	5910	97.925	258788	974666
SEP09	97.78A	97.775	-.075	1964	97.85	232756	893646
DEC09	97.63A	97.63	-.055	5548	97.685	233425	796881
MAR10	97.58A	97.58	-.025	3127	97.605	165396	605702
JUN10	97.38A	97.38	UNCH	2952	97.38	113575	400480
SEP10	97.09A	97.09	+.02	3222	97.07	91065	346916
DEC10	96.71A	96.70	+.04	3543	96.66	54989	243631

Example

First, the price is not actually a price, but rather a way to quote the a rate. The rate on the DEC 08 contract is

$$100 - 97.705 = 2.295$$

which compares to the 2.23625 spot.

The contract works as follows: Suppose we bought one futures yesterday at the quoted settlement price of 97.805, implying a rate of $100 - 97.805 = 2.195$.

The CME Eurodollar futures has an underlying notional amount of 1M and is *marked-to-market*.

Marked-to-market means that the contract is settled daily. Since the underlying instrument is a 90 day interest rate, the long receives

$$-1,000,000 \times \left(2.295 \times \frac{90}{360} - 2.195 \times \frac{90}{360} \right) = -2,500 \times 0.1 = -250$$

from the short (the market is in zero net supply, so for every long there is a short).

ie. he pays 250.

Alternatively, we can say that the contract pays $25 \times$ basis point change in the underlying rate every day.

In other words, the DV01 of the Eurodollar futures is exactly 25 (wrt LIBOR). It does not depend on the level of interest rates, as do bond DV01s.

Advantages of the Eurodollar futures

- Speculation. We can bet on interest rate changes with with a notional 1M exposure with much smaller margin than 1M.
- We can easily bet on interest rate increases (short positions make money when LIBOR increases) without shorting bonds (or borrowing)
- Limited counter-party default risk because contracts are marked to market

Hedging interest rate risk

Consider a corporation which receives 100M on March 20th and invest the money again on June 19 (90 days later). The current Eurodollar rate is 2.274%.

The corporation buys 100 eurodollar futures.

On March 20th, the 90 day Eurodollar rate has changed to 2.75%.

The total cash flow from the futures contract is $250,000 \times (2.274 - 2.75) = -119,000$.

Next, the corporation invests 100 M at 2.75. The value of the investment is

$$100,000,000 \times \left(1 + \frac{2.75}{100} \times \frac{90}{360}\right) = 100,687,500$$

out of which the 687,500 is interest.

Note that if the corporation had invested at 2.274 they would have received interest of

$$100,000,000 \times \frac{2.274}{100} \times \frac{90}{360} = 568,500.$$

The difference,

$$687,500 - 568,500 = 119,000$$

is identical to the capital loss on the Eurodollar futures.

The difference between forwards and futures

Our previous computation completely ignores the difference in timing of the cash flows. A forward contract would have produced the loss of 119K at the settlement date of the forward.

A futures contract could in principle produce the entire 119K loss right after we enter into the contract.

The difference is a loss of 119 today (futures) vs a loss of 119 on March 20th.

Economically, losing 119 today is worse than losing it on March 20th, and the difference is an *interest-on-interest* effect.

The timing difference of the cash flows in forward and futures contracts has two implications

- The futures contract has (slightly) higher interest rate sensitivity. In hedging with futures therefore, one should buy slightly fewer futures contracts than forward contracts. Tuckman further details the adjustment on p. 344-47.
- Theoretical futures prices differ slightly from theoretical forward prices.

Consider, in the abstract, a futures contract written on a bond with maturity T that settles on date S . Let $F^u(t)$ denote the time t futures price

It is straightforward to show that the futures price must be equal to the expected future price of the T zero at time S using risk neutral probabilities to compute the expected value

$$F^u(0) = E^*(P(S, T)). \quad (1)$$

Tuckman also argues that the rate futures rate

$r_{fut} = 100 - F^u(0)$ is

$$r_{fut} = E^*(r_t) \quad (2)$$

where r_t is the future short rate. This holds if we interpret the future short rate to be the rate on a discount basis. In other words, if $P(S, T)$ is the time S price of a T maturity zero with \$100 face, and we define

$$r_t = 100 - P(S, T)$$

If we define the short rate in the usual manner (i.e.,

$r_t = (100/P(S, T))^{-\frac{360}{T-S}}$) then (2) will not hold.

Eurodollar Futures and Treasury Futures

Eurodollar futures are simply not treasury futures.

LIBOR rates are rates that contain a significant spread to similar maturity treasuries *because LIBOR rates contain significant counter-party default premiums.*

To model LIBOR futures rates, we need to consider the possible moves in both benchmark treasury rates, and the spread between libor and t-bill rates (default spread). We can accomplish this in a two factor model, by letting the first factor be the default free rate and the second being the spread, or the default probability. More on this in another class (on default risk).

The Fed fund futures market is similar to the LIBOR futures, except that

- The underlying is the 30 day effective Fed Fund rate (not the target rate)
- The notional amount is 5M
- The contract is settled to the *average* of the FF rate over the month
- Trades at the CBOT

Given the contract parameters, we have that the cash flow to a long FF futures receives

$$5,000,000 \times \frac{0.0001 \times 30}{360} = 41.67$$

per basis point change in the average FF rate.

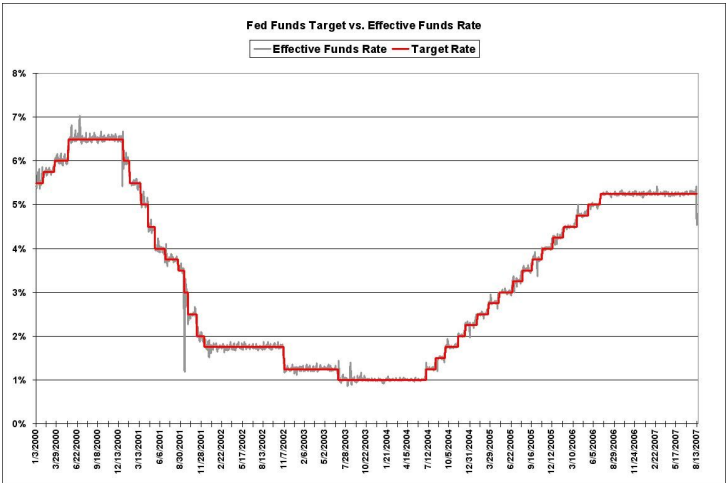


Figure: Target and effective Fed Funds rates.

As of Nov 14th, 2008, the FF futures traded at

	PRICE	RATE
NOV08	99.62	0.38
DEC08	99.54	0.46
MAR09	99.325	0.675
JUN09	99.195	0.805

As of Nov 14, 2008 the FF target rate is 1% while the effective rate 0.35%.

Betting on the FOMC

We will consider an example from the book on how to reverse engineer the markets expected Fed action from FF futures.

The following parameters apply:

- Current date is Dec 4, 2001.
- The current FF target is 2%.
- The average effective FF rate from Dec 1 to 4th was 2.025%.
- The next FOMC meeting is Dec 11th, 2001.
- The FF futures with settlement on Dec 31st, 2001 is trading at a rate of 1.845%

The 1.845 futures rate represents the expected, average rate from Dec 1st to Dec 31st of 2001. Let r denote the new FF target rate following the Dec 11 FOMC meeting.

We expect that the effective rate will equal the target rate from Dec 4-Dec 11, and also that the FF rate will not change following the meeting.

It must be that

$$1.845 = \frac{4 \times 2.025 + 7 \times 2 + 20E(r)}{31}$$

So we find the expected rate to be

$$E(r) = 1.766$$

Since this is lower than the current rate and close to a 25 basis point drop, we can guess that the probability of the target rate remaining unchanged is

$$2 \times p + (1 - p) \times 1.75 = 1.766$$

and we find $p = 0.064$ and $1 - p = 0.936$, implying that the market has puts a probability of about 94% on a 25 bp cut.

The Fed did indeed cut rates by 25 bp on Dec 11, 2001.

As of Nov 14, 2008, FF futures are trading at 0.38%, the effective rate is 0.35, while the target rate is 1%. The next FOMC meeting is Dec 16.

How is it that both the effective rate and the futures trade at such a discount to the actual target? Should we buy the futures in anticipation that the effective rate will revert back to its target? If so, just buying one Dec contract will produce a profit of $41.67 \times (1 - 0.46) = 2,250$ if the effective rate reverts back to the target by the end of Nov 08.

Does the market know something about the Fed's intended interest rate policy that we don't?