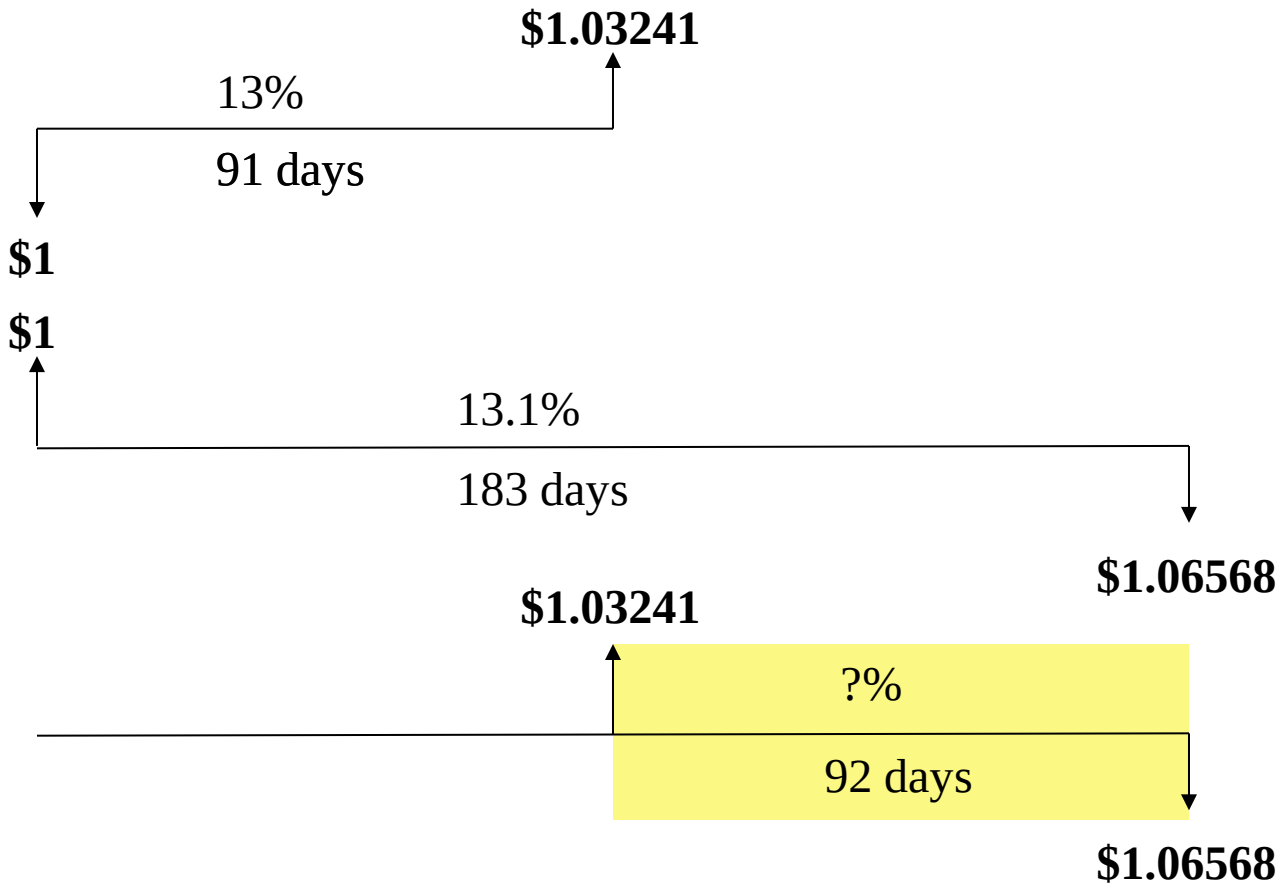
Forward Rate Agreements (FRAs)
Interest Rate Futures (IRF)

Forward-forward

- A cash borrowing or deposit which starts on one forward date and ends on another forward.
- The term, amount and interest rate are all fixed in advance.

Constructing forward-forward



Forward-forward rate

$$\text{forward - forward rate after 91 days}$$

$$= \left(\frac{1.06568}{1.03241} - 1 \right) \times \frac{365}{92} = 12.79\%$$

$$\text{forward - forward rate} = \left[\frac{\left(1 + i_L \frac{d_L}{\text{year}} \right)}{\left(1 + i_S \frac{d_S}{\text{year}} \right)} - 1 \right] \times \left(\frac{\text{year}}{d_L - d_S} \right)$$

L and S stand for longer and shorter period respectively

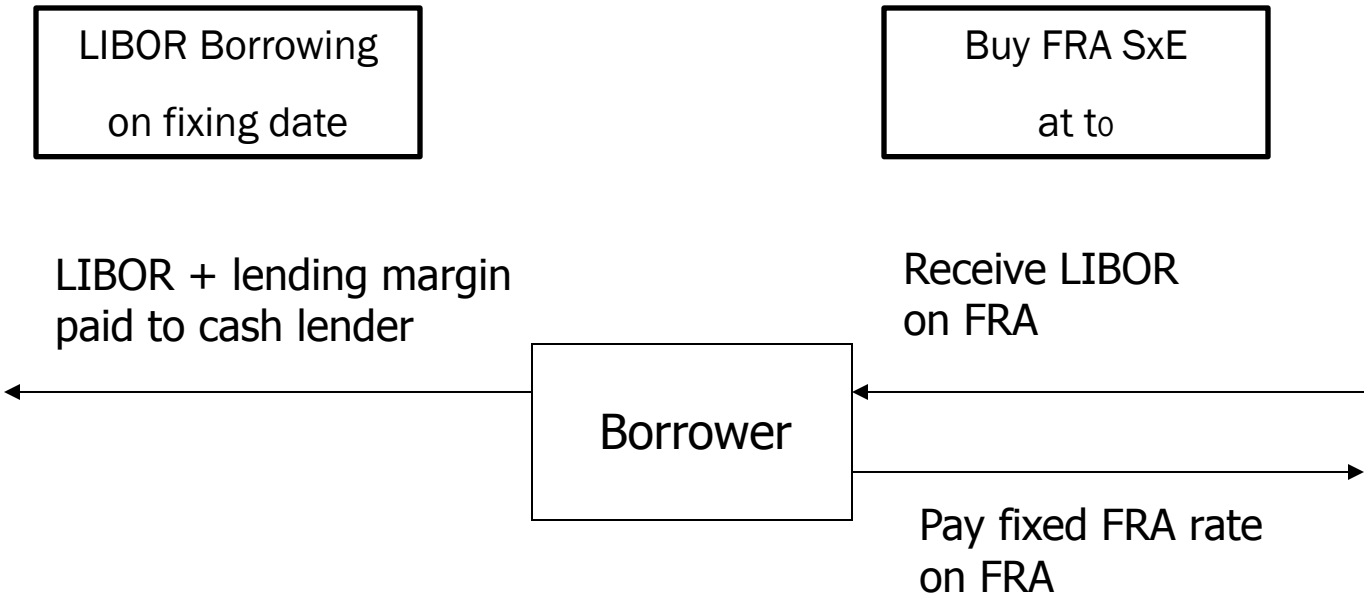
Forward Rate Agreements (FRAs)

- Off-balance sheet instrument
- Agreement to fix a future interest rate
- On the agreed date (fixing date), receives or pays the difference between the reference rate and the FRA rate on the agreed notional principal amount
- Principal is not exchanged
- No obligation for either party to borrow or lend capital
- Settles at the beginning of the period

Use of FRA

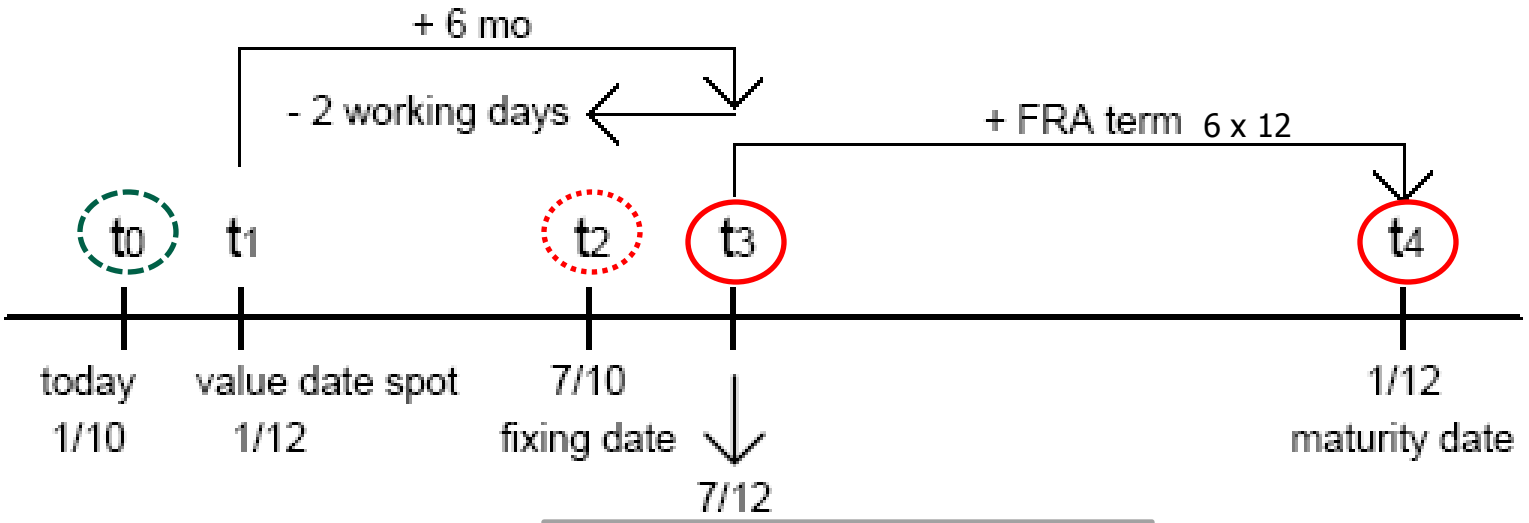
- by market participants who wish to hedge against future interest rate risks by setting the future interest rate today (at trading date)
- by market participants who want to make profits based on their expectations of the future development of interest rates
- by market participants who try to take advantage of the different prices of FRAs and other financial instruments, e.g. futures, by means of arbitrage.

Hedging with an FRA Buyer



FRA Events

spot FRA, sell 6 / 12 100 Mio 4½ %



settlement date

**** the day to settle the PV of net interest difference between rec fixed and pay floating legs**

- LIBOR fixed on 7/10
+ FRA rate agreed on 1/10

**** no principal exchange settlement**

FRA Example

A large company wishes to fix the interest rate for a loan of USD 20 Mio for 3 months, beginning in 2 months. The company might buy an FRA from a bank that is trading such instruments. The bank quotes an FRA rate. This FRA rate is applied to the principal (USD 20 Mio), but not to the 3-month loan itself. Thereby, the FRA rate serves as the fixed rate the company wanted to secure for the 3-month term of interest (from the end of the 2nd until the end of the 5th month). This fixed rate is known to both of the counterparties on trading day, but they do not know the future level of the reference rate.

Usually two days before the settlement date, the FRA rate is compared to the agreed reference rate (LIBOR).

FRA Example (Cont'd)

If the reference rate is higher than the defined FRA rate, the amount due is paid to the customer. This is a compensation for the higher interest payments for his (more expensive) re-financing.

If the reference rate happens to be lower than the FRA rate, the customer must settle the balance. This effect in turn is balanced by lower interest expenses.

In this process, there is no exchange of principal; only the interest rate gaps are balanced. With the settlement payment, the interest rate for the future re-financing has been fixed at the FRA-rate.

FRA Quotation

- Establish the theoretical FRA price. How?
- Dealer would put a spread, say ±6 bp, around the theoretical FRA price, giving for example 12.82% / 12.88%
- Buying FRA would deal at ?
- Selling FRA would deal at ?

Settlement Amount

For FRA period not more than 1 year

$$\text{Buyer paid} = \text{notional} \times \frac{(\text{FRA rate} - \text{LIBOR}) \times \frac{\text{days}}{\text{year}}}{\left(1 + \text{LIBOR} \times \frac{\text{days}}{\text{year}}\right)}$$

This is the profit and loss between interest difference of floating leg (rec LIBOR) and fixed leg (FRA rate) on settlement date.

- If the LIBOR > FRA, then -ve, FRA Buyer receive the net interest difference from counterpart
- If the LIBOR < FRA, then +ve, FRA Buyer pay the net interest difference to counterpart

For FRA period longer than 1 year, LIBOR rate assumes interest payment at the end of each as well as at maturity. What is the settlement amount?

Constructing a strip

Suppose now is January and we have the following rates:

3-month LIBOR	8.5% (92 days)
3 v 6 FRA	8.6% (91 days)
6 v 9 FRA	8.7% (91 days)

Assume basis of year is 365 days.

Construct a fixed-rate borrowing for 9 months?

Constructing a strip

To create the synthetic 9M borrowing NOW
1) t0 -> t3, 3M borrowing at 3M LIBOR 8.5%
2) t3 -> t6, Buy 3x6 FRA at 8.6%
3) t6 -> t9, Buy 6x9 FRA at 8.7%

	Principal	FRA rate	LIBOR rate	Days in period	FV	
t0 -> t3						
Jan						
3M LIBOR financing Repayment at maturity	1		8.50%	92	1.021722	FV (t3)
t3 -> t6						
April						
Buy 3v6 FRA fixing 8.6%	1.021722	8.60%		91	1.043933	FV (t6)
t6 -> t9						
July						
Buy 6v9 FRA fixing 8.7%	1.043933	8.70%		91	1.066891	FV (t9)
Alternatively						
t0 -> t9						
9M borrowing for t0 -> t9 @R0x9	1	R0x9		274	1.066891	
That is	R0x9 =	8.79%				

Futures

- A contract in which the commodity being bought or sold is considered as being delivered (may not physically occur) at some future date
- Exchange traded (vs OTC in “forward”)
- Contract standardized by exchange
- Pricing depends on underlying commodity

Users

- Hedgers, who use futures to cover their risk on positions in the underlying assets
- Speculators, who use futures to create highly leveraged positions in a market

CME
Eurodollar Futures Spec

CME Eurodollar Futures	
Trade Unit	Eurodollar Time Deposit having a principal value of $1,000,000 with a three-month maturity.
Settle Method	Cash Settled
Point Descriptions	1 point = .01 = $25.00

CME
Last Trading & New Listing

Last Day of Trading Rule	Futures trading shall terminate at 11:00 a.m. (London Time) 5:00a.m. (Chicago Time on the second London bank business day before the third Wednesday of the contract month. (Due to the 5:00 a.m. terminate time, the last day of trading for contracts listed on RTH will be the third business day immediately preceding the third Wednesday of the contract month).
New Contract Listing Rule	A new serial futures contract month will be listed: At 7:20 a.m. on the same day the serial front month expires, (the serial front month usually expires on a Monday morning at 5:00 a.m.) unless that day is a holiday, in which case the new contract month will be listed on the following business day. A new quarterly futures contract month that terminates ten years in the future will be listed on the first Exchange business day following the day of settlement for the nearest quarterly futures contract month.

CME – Product Codes

CME Interest Rates				
Product	CME Globex Futures	Pit-traded Futures	AON	Options on Futures (Globex/RTH)
CME 1-month LIBOR	GLB	EM	n/a	EM
CME 13-week Treasury Bill	GTB	TB	n/a	calls: CQ puts: PQ
CME 2-year SWAP	S2	S2	n/a	n/a
CME 5-year SWAP	S5	SW5	n/a	n/a
CME 10-year SWAP	SW0	S0	n/a	n/a
CME Consumer Price Index	CPI	n/a	n/a	n/a
CME Eurodollar	GE	ED	n/a	GE
CME Eurodollar 5-Year E-Mini Bundle	E5B	n/a	n/a	n/a
CME Euroyen	n/a	EY	IY	EY
CME Euroyen LIBOR	EL	n/a	IL	n/a
CME Japanese Government Bonds	n/a	JB	n/a	n/a

Month Codes	
Month	Abbr
January	F
February	G
March	H
April	J
May	K
June	M
July	N
August	Q
September	U
October	V
November	X
December	Z

CME
Listing Eurodollar Futures

Seq. No.	Contract Month	Product Code	First Trade Date	Last Trade Date	Cash Settlement Date	Delete Date
1	Sep 2007	EDU7	09/18/97	09/17/07	09/17/07	09/20/07
2	Oct 2007	EDV7	04/16/07	10/15/07	10/15/07	10/19/07
3	Nov 2007	EDX7	05/14/07	11/19/07	11/19/07	11/26/07
4	Dec 2007	EDZ7	12/15/97	12/17/07	12/17/07	12/20/07
5	Jan 2008	EDF8	07/16/07	01/14/08	01/14/08	01/18/08
6	Feb 2008	EDG8	08/13/07	02/15/08	02/15/08	02/22/08
7	Mar 2008	EDH8	03/19/98	03/17/08	03/17/08	03/20/08
8	Jun 2008	EDM8	06/18/98	06/16/08	06/16/08	06/19/08
9	Sep 2008	EDU8	09/15/98	09/15/08	09/15/08	09/18/08
10	Dec 2008	EDZ8	12/15/98	12/15/08	12/15/08	12/18/08

HIBOR Future Contract Spec

HIBOR Future Contract Spec

Interest Rate Futures

Product		Client Margin Initial (HK$)	Client Margin Maintenance (HK$)	Clearing House Margin (HK$)
Three-Month HIBOR Futures	Full Rate (/lot)	3,359	2,688	2,688
	Spread Rate (/spread)	Please refer to the attached table		
One-Month HIBOR Futures	Full Rate (/lot)	6,648	5,319	5,010
	Spread Rate (/spread)	Please refer to the attached table		
Three-year Exchange Fund Note (EFN) Futures	Full Rate (/lot)	9,800	7,840	7,840
	Spread Rate (/spread)	2,940	2,352	2,352

Quotation

Price of contract is quoted not as a rate of interest but as 100 minus the rate of interest

Futures

Financials » Interactive Charts

EURODOLLAR 3 MONTH

Data retrieved at Sep 10 14:59:49 GMT • All quotes are in Greenwich Mean Time • Data provided by eSignal

Contract	Month	Last	Chg	Open	High	Low	Volume	OpenInt	Exchange	Date	Time
EURODOLLAR 3 MONTH	Sep '07	**94.3950**	-0.0450	94.4700	94.4700	94.3750	156145	1589865	CME	09/10/07	14:50:36
EURODOLLAR 3 MONTH	Oct '07	**94.6750**	-0.0450	94.7000	94.7000	94.6500	17514	67977	CME	09/10/07	14:44:58
EURODOLLAR 3 MONTH	Nov '07	**94.9300**	-0.0900	94.9900	95.0300	94.9300	207	17741	CME	09/10/07	14:50:31
EURODOLLAR 3 MONTH	Dec '07	**95.2500**	-0.0100	95.2450	95.2600	95.1900	158407	1550046	CME	09/10/07	14:50:37

Dealing

- Open outcry
  buyer and seller deal face to face in public in the exchange's "trading pit"
- Screen trading
  designed to simulate the transparency of open outcry

Clearing

Following the confirmation of a transaction, the clearing house substitutes itself as a counterparty to each user and becomes

- the seller to every buyer and
- the buyer to every seller

Margin Requirements

Initial Margin

- Collateral for each deal transacted
- Protect clearing house for the short period until position can be revalued

Variation (Maintenance) Margin

- Marking to market
- Paid daily based on adverse price movements

Marking to Market

Contract Specifications Three-Month Hong Kong Interbank Offered Rate (HIBOR) Futures Contract	
Minimum Fluctuation	one (1) basis point (0.01 of a percent) The value of a Minimum Fluctuation is HK$125.00 calculated as the Contract Size multiplied by a basis point multiplied by one quarter of a year. HK$5,000,000 x 0.0001 x 0.25 = HK$125.00

Example: Price moves from 95.25 to 95.15 (a fall of 10 ticks).
The loss on a long future contract is HK$125 x 10 = HK$1,250

Profit and Loss

$$\text{Profit/loss on long position in a 3-month contract} = \text{notional contract size} \times \frac{(\text{sale price} - \text{purchase price})}{100} \times \frac{1}{4}$$

OTC vs Exchange-traded

amount	future contract is standardized
delivery date	future contract is standardized
margin	futures requires "initial margin" and "variation margin" to reflect day's loss and profit
settlement	not discounted for futures
liquidity/spread	liquid market and narrower spread for future
credit risk	virtually no credit risk for future. why?

Simple Questions

If interest rates rise

- buyer of FRA will ?
- buyer of futures will ?

If a trader sells an FRA to a counterparty

- He should ? futures to cover his position

FRA price from Futures prices

On 17 March for USD:

June futures price (settlement 19 June): 91.75 (fwd interest rate: 8.25%) (92 days)

Sept futures price (settlement 18 Sept): 91.50 (fwd interest rate: 8.50%) (91 days)

Dec futures price (settlement 18 Dec): 91.25 (fwd interest rate: 8.75%) (91 days)

** The Eurodollar Future notional contract size is $ 1million per contract, last trading date is 2 day before delivery date.

Sell a 3 v 6 FRA for $10 million, to hedge - buy/sell futures? which month?

- FRA will be for period 19 June to 19 Sept (92 days) and will settle against LIBOR fixed on 17 June.
- The June futures will also be LIBOR on 17 June (fixing at last trading day).
- The FRA rate should therefore be the implied June futures rate of **8.25%**

Hedging FRA with Futures

$$\text{Settlement for FRA} = \frac{\$10\text{million} \times (0.0825 - \text{LIBOR}) \times \frac{92}{360}}{1 + \text{LIBOR} \times \frac{92}{360}}$$

Profit or loss on sold futures

$$= \text{number of contracts} \times \$1\,\text{million} \times (0.0825 - \text{LIBOR}) \times \frac{90}{360}$$

$$\text{no. of contracts} = 10 \times \frac{\frac{92}{90}}{1 + \text{LIBOR} \times \frac{92}{360}} = 10 \times \frac{\frac{92}{90}}{1 + 0.0825 \times \frac{92}{360}} = 10.01$$

Hedging FRA with Futures

Sell 3 v 9 FRA, what should be the rate?

➢3 v 9 FRA should be equivalent to ?

a strip combining ? 3 v 6 FRA and ? 6 v 9 FRA

$$3\,\text{v}\,9\ \text{FRA rate}$$

$$=\left[\left(1+0.0825\times\frac{92}{360}\right)\times\left(1+0.085\times\frac{91}{360}\right)-1\right]\times\frac{360}{183}=8.463\%$$

No. of contract hedge? How?

Hedge required is the combination of the hedges for each leg:

- Sell 3x6 FRA + Sell 6x9 FRA, hence hedged by
- Sell 10 June futures + Sell 10 Sept futures

Can you do the same for 6 v 12 FRA?

Imperfect FRA Hedging with Futures

- Future contracts are for standardized amount
- Futures P&L are based on 90-day period rather than 91 or 92 days as in FRA
- FRA settlements are discounted but futures settlements are not.
- Future price when the Sept contract is closed out in June may not exactly match the theoretical forward-forward rate at that time
- Slight discrepancy in dates.

Volume and Open Interest

Open Interest

number of purchases of contract not yet been reversed or "close out"

Volume

total number of contracts traded during the day

If futures price is rising, volume and open interest are also rising, suggest ?

If open interest is falling, suggest ?

Speculation

- If trader expects interest rates to rise, he ? futures contract
- If trader expects rates to fall, he ? futures contract

Arbitrage

Market prices:	Bid / Offer
2 v 5 FRA	7.22 / 7.27%
3 month futures	92.67 / 92.68

futures delivery date is in 2 months time

Any must win strategy?