



Derivatives

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Derivatives

- Financial instruments whose value is derived from the prices of one or more other assets such as equity securities, fixed-income securities, foreign currencies, or commodities



Derivatives

- Financial instrument that does not constitute ownership, but a promise to convey ownership



History of Derivatives

■ Biblic times

- In Genesis Chapter 29, believed to be about the year 1700 B.C., Jacob purchased an option costing him seven years of labor that granted him the right to marry Laban's daughter Rachel.
- His prospective father-in-law, however, reneged, perhaps making this not only the first derivative but the first default on a derivative. Laban required Jacob to marry his older daughter Leah. Jacob married Leah, but because he preferred Rachel, he purchased another option, requiring seven more years of labor, and finally married Rachel, bigamy being allowed in those days. Jacob ended up with two wives, twelve sons, who became the patriarchs of the twelve tribes of Israel, and a lot of domestic friction, which is not surprising.
- Some argue that Jacob really had forward contracts, which obligated him to the marriages but that does not matter. Jacob did derivatives, one way or the other



History of Derivatives

- Around 580 B.C.
- Account of an option trade is found in Aristotle's Politics.
- Thales Milesian is said to have purchased the right to rent the olive presses at a future point in time for a predetermined price.
- Made a fortune off of a bumper crop in olives
- Real Option



History of Derivatives

- Royal Exchange in London
 - First forward trading
- Dutch Tulip bulb mania
- Yodoya rice market
 - First „futures“ market – around 1650
- Chicago Board of Trade
 - 1848
 - „to-arrice“ contract
 - Utilization of local storage



History of Derivatives

- Early twenties
 - Bucket shops
- 1972 - International Monetary Market
 - Chicago Mercantile Exchange
- 1973 – Black-Scholes option pricing model
- 1983 – First index option
- 2006 – CME & CBOT announced merger



Types of Derivatives

- Unconditional derivatives
 - Forward
 - Future
 - Swap
- Conditional derivatives
 - Options
 - Warrants



Types of derivatives

■ Over-the-counter (OTC) derivatives

- contracts that are traded (and privately negotiated) directly between two parties, without going through an exchange.
- Products such as swaps, forward rate agreements, and exotic options are almost always traded in this way.
- Outstanding notional amount is USD 298 trillion (as of 2005)

■ Exchange-traded derivatives

- those derivatives products that are traded via exchanges.
- A derivatives exchange acts as an intermediary to all transactions, and takes Initial margin from both sides of the trade to act as a guarantee
- Combined turnover in the world's derivatives exchanges totaled USD 344 trillion during Q4 2005.



Underlying assets

- Index
- Single stock
- Bond
- Currency
- Commodity
- Weather
- Economic data
- ...



Contract types

- Term contracts
 - Futures – exchange traded
 - Forward – OTC traded
- Option contracts
 - Options
 - OTC contracts – warrants, cap, floor, collar
- Swap contracts



Forward

- Agreement between two parties to buy or sell an asset (which can be of any kind) at a pre-agreed future point in time.
- The delivery is made in the future, the price is determined on the initial trade date.



Forward Rate Agreement (FRA)

- forward contract in which one party pays a fixed interest rate, and receives a floating interest rate equal to a reference rate (the underlying rate).
- The payments are calculated over a notional amount over a certain period, and netted, i.e. only the differential is paid.
- It is paid on the termination date.
- The reference rate is fixed one or two days before the termination date, dependent on the market convention for the particular currency.
- FRAs are over-the counter derivatives



FRA Data

- Agreed interest rate
- Interest period (FRA period)
- Beginning of interest period, i.e. the future date from which the deposit will bear interest
- The nominal amount, i.e. the size of the deposit
- The market interest rate used as the reference rate upon performance of the FRA in the future (usually LIBOR)



FRA

- The interest period on an FRA is defined by two time-limits determining the time distance from the execution of the FRA to the beginning of the FRA period and to the end of the FRA period.
- Example: "6 to 9" FRA
 - The FRA period begins 6 months after the date of the FRA's conclusion and lasts for three months.
 - Or, in other words, an interest rate is agreed today for a three-month deposit which will begin to bear interest in 6 months time.



FRA pricing

$$Payment = \text{Notional Amount} * \left(\frac{(\text{ReferenceRate} - \text{FixedRate}) * \alpha}{\text{ReferenceRate} * \alpha + 1} \right)$$

- The Fixed Rate is the rate at which the contract is agreed.
- The Reference Rate is typically Euribor or LIBOR.
- α is the day count fraction, i.e. the portion of a year over which the rates are calculated, using the day count convention used in the money markets in the underlying currency. For EUR and USD this is the number of days divided by 360, for GBP it is the number of days divided by 365 days.
- The Fixed Rate and Reference Rate are rates that should accrue over a period starting on the termination date, and then paid at the end of the period. However, as the payment is already known at the beginning of the period, it is also paid at the beginning. This is why the discount factor is used in the denominator.

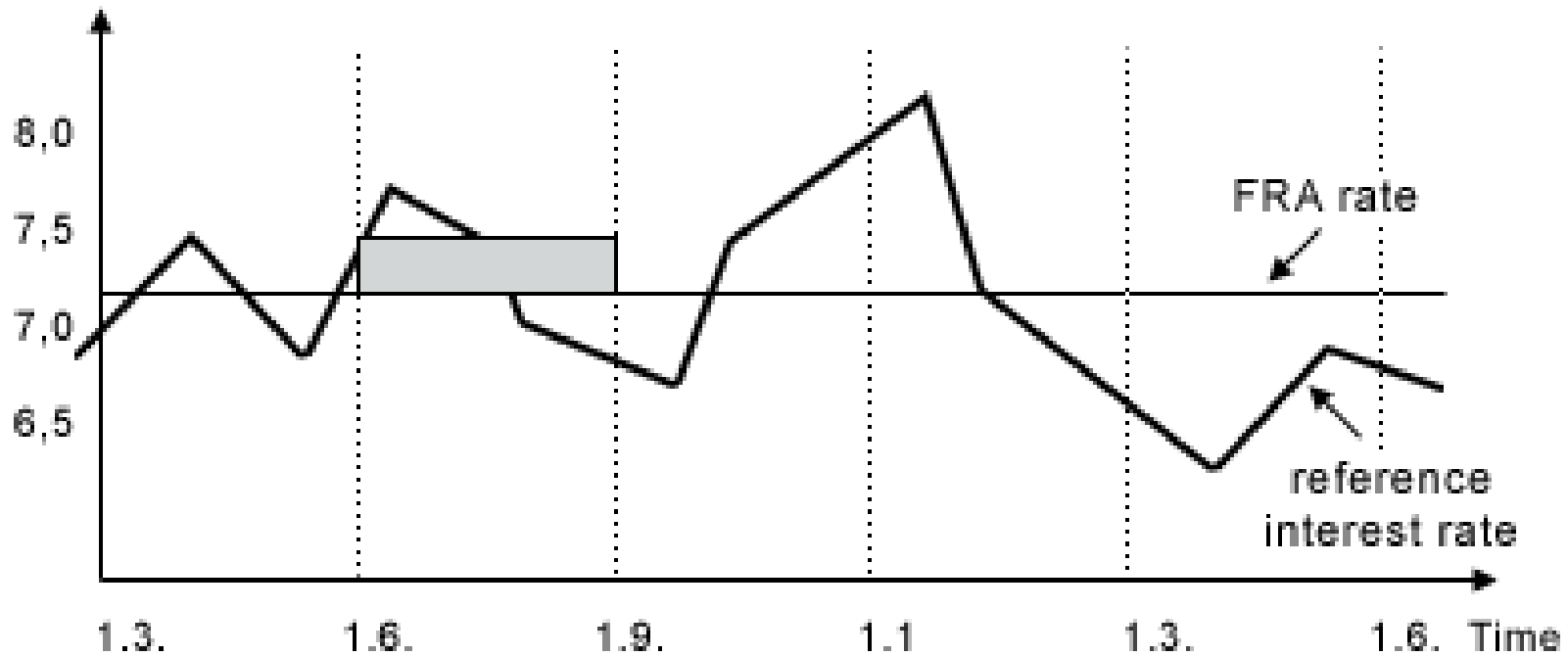


FRA trading

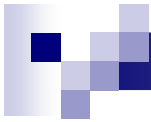
- The **payer of the fixed interest rate** is also known as the borrower or the **buyer**
- The **receiver of the fixed interest rate** is the lender or the **seller**



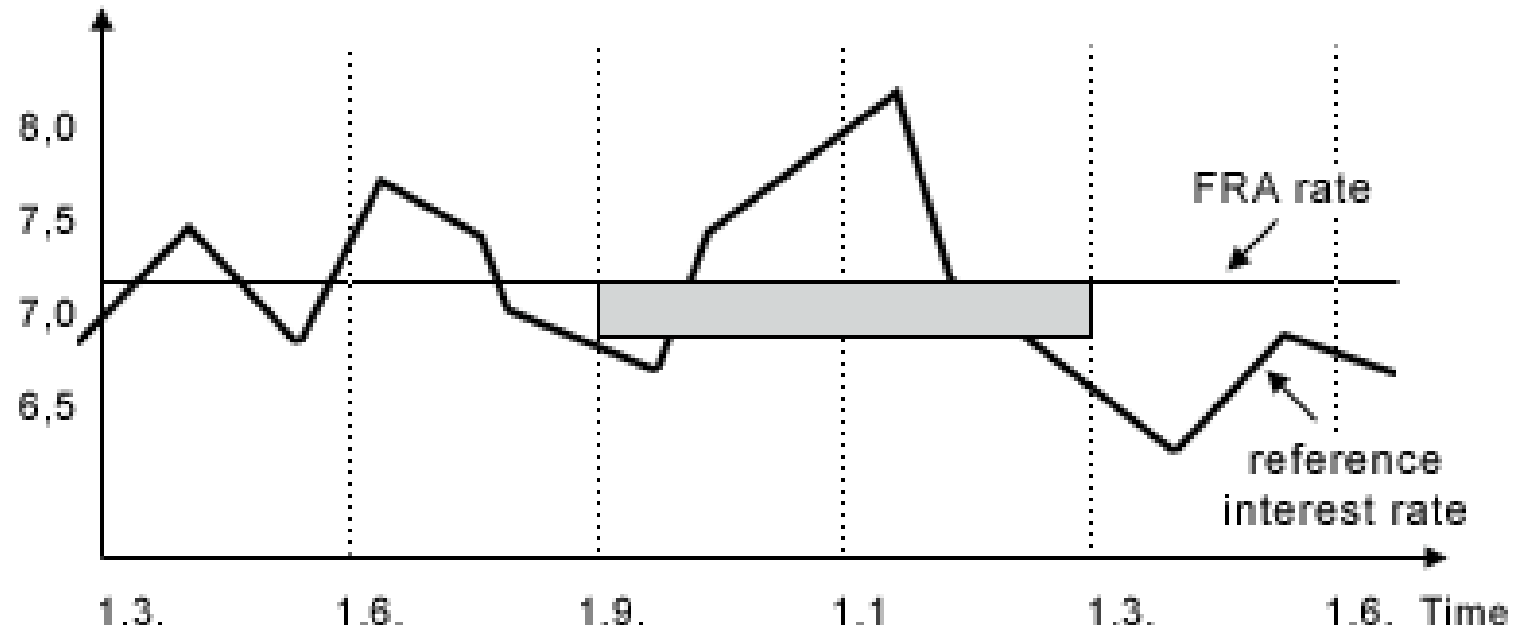
FRA



3 x 6



FRA



6 x 12



FRA Advantages

- Hedging against interest rate risk
- Transaction agreed remotely (usually by phone)
- Possibility of agreeing individual amounts, length and beginning of interest period,
- Relatively liquid market exists for this type of product

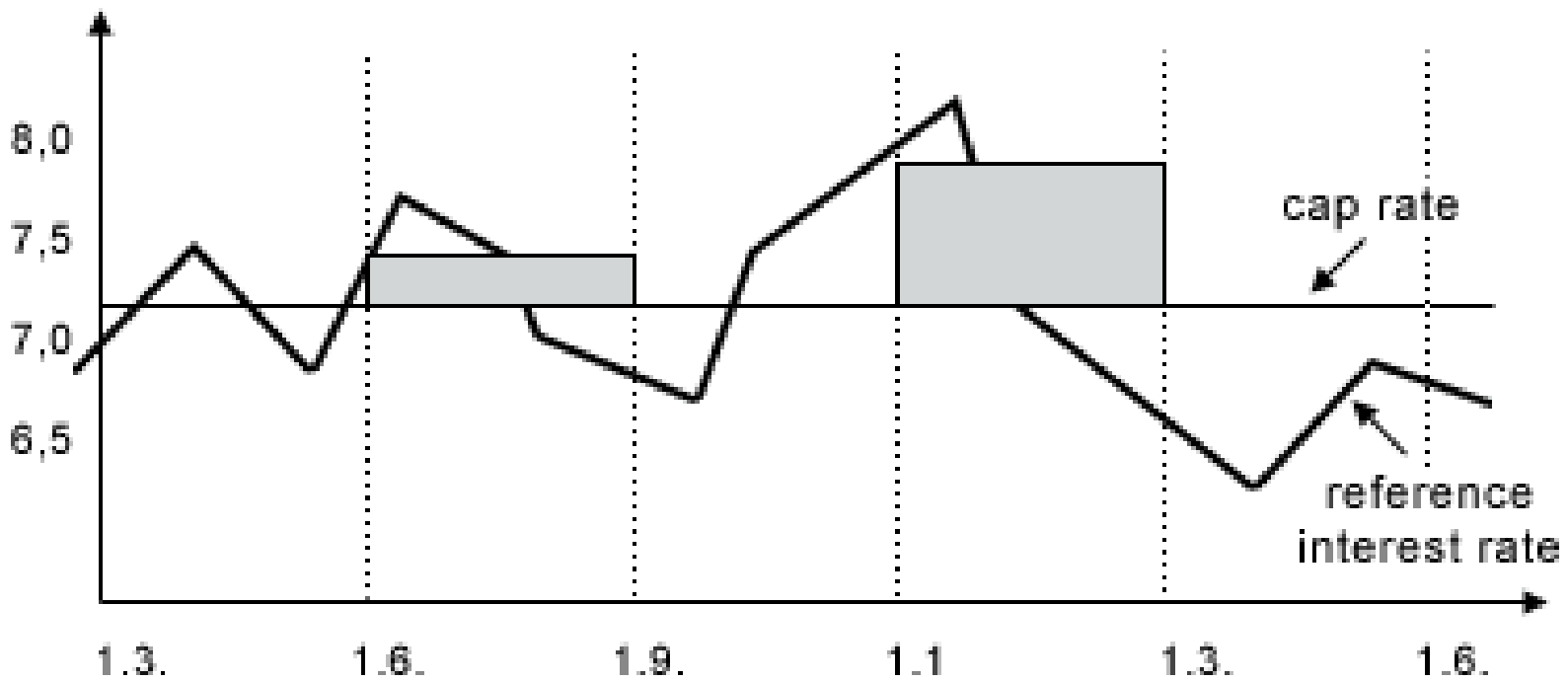


CAP

- This deal consists of a series of call options on the interest rate of the European type.
- The buyer hedges his/her position against the increase of the rates (e.g. while having a loan).
- The discharge of payments occurs if the reference interest rate exceeds the agreed cap rate on the fixing date.
- The amount of payment depends on the fixing of the reference interest rate on fixing days, which are always the beginnings of the interest periods.
- The payment occurs consequentially after the end of the interest period, to which it relates.

CAP

Interest rate



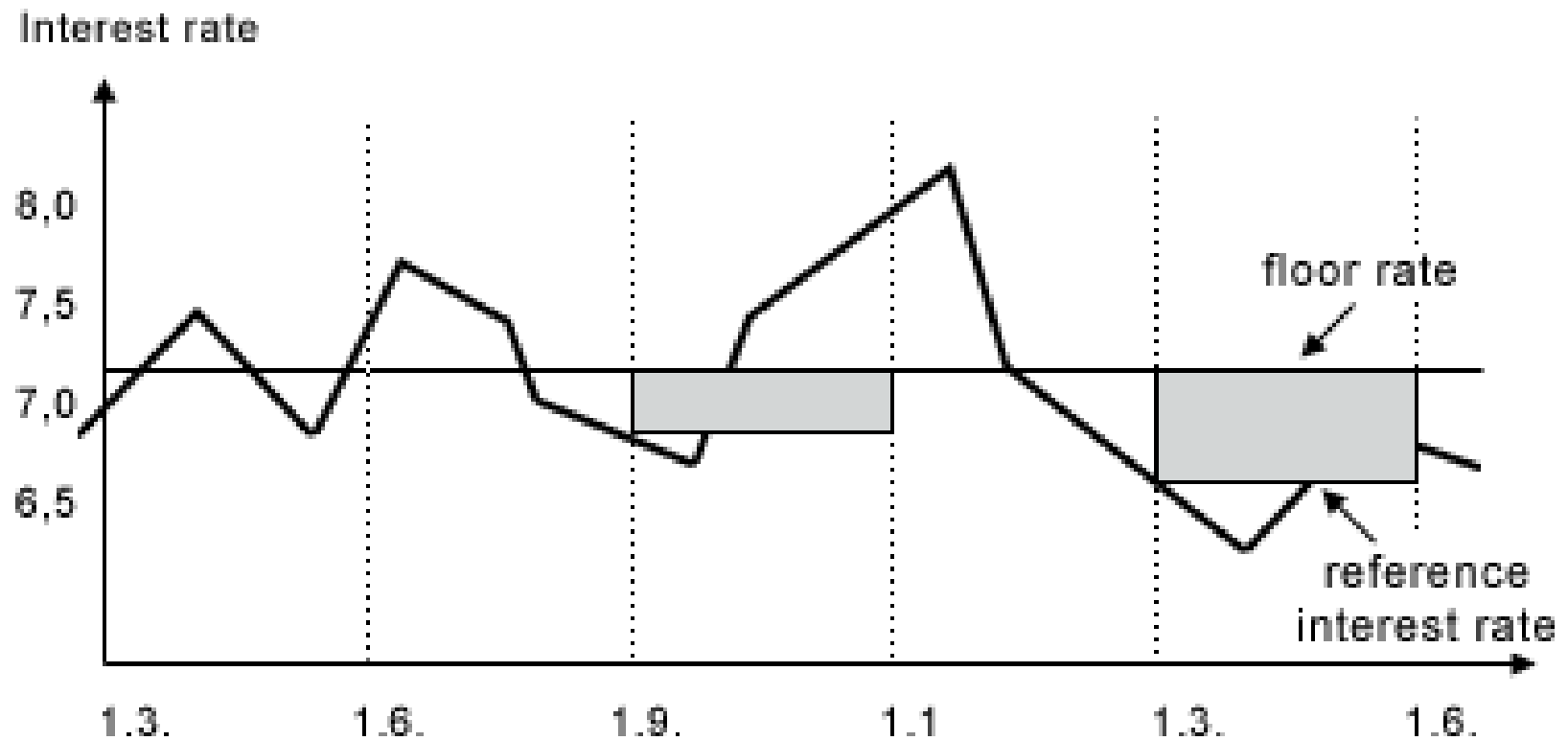


FLOOR

- This deal consists of a series of put options on the interest rate of the European type.
- The buyer hedges his/her position against a decrease of interest rates (e.g. while having a deposit).
- This is a contraposition to Cap.
- The discharge of payments occurs if the reference interest rate comes down under the agreed floor rate on the fixing date.
- The amount of payment depends on the fixing of the reference interest rate on fixing days. The fixing days are always the beginnings of interest periods.



FLOOR

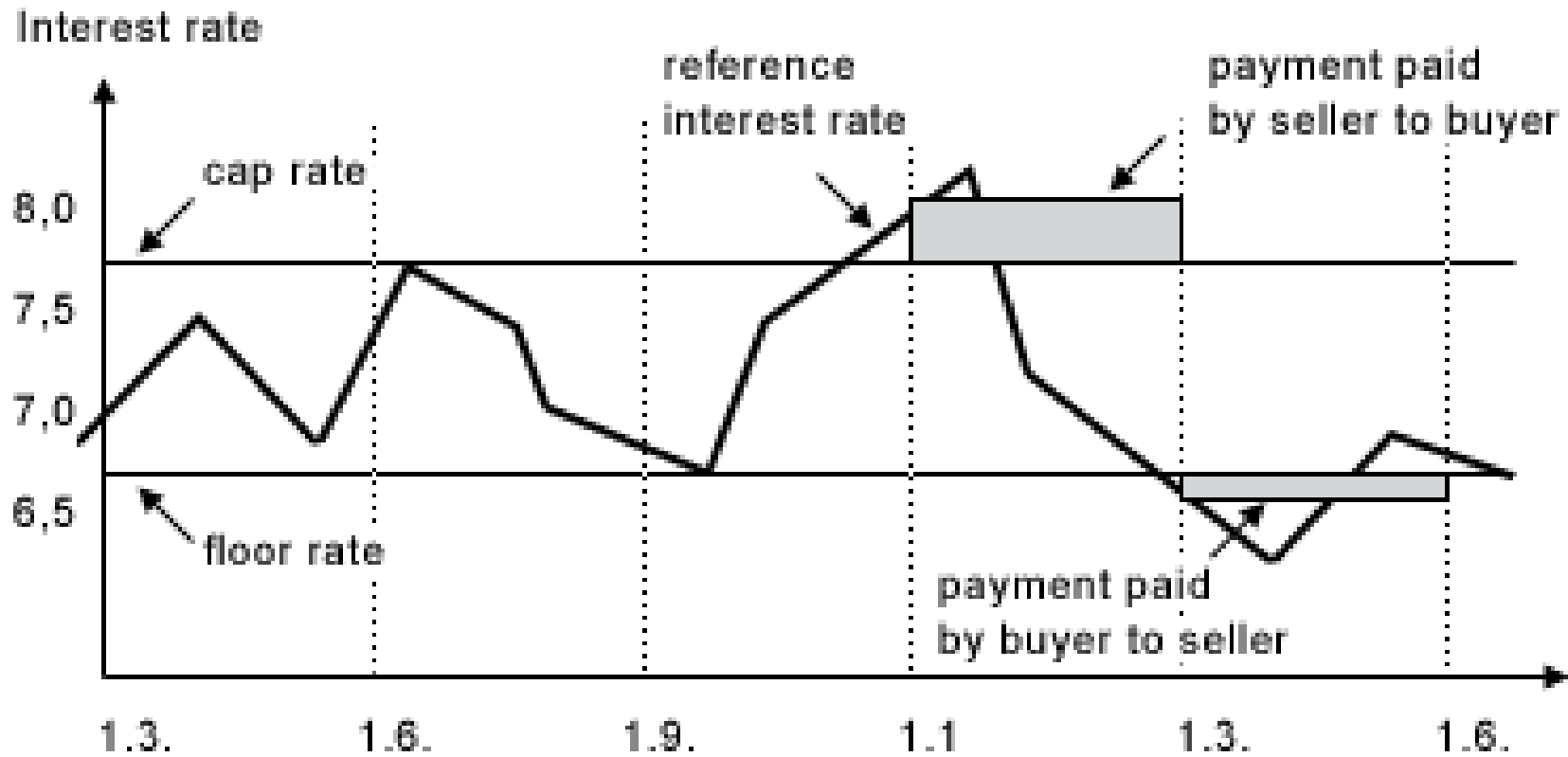




COLLAR

- The Collar buyer is in the position of the Cap buyer and the Floor seller at the same time.
- The cap rate is higher than the floor rate.
- The Collar buyer receives a payment on the condition that the reference interest rate on the fixing date is above the cap rate. The Collar buyer sends a payment on the condition that the reference interest rate on the fixing date is below the floor rate.
- The Collar buyer hedges his/her float interest obligations in the same way as the Cap buyer; the Collar buyer pays a lower premium by paying the cap premium and receiving the floor premium.
- The Collar seller hedges his/her float interest receivables in the same way as the Floor buyer. Then the Collar buyer pays a lower premium by paying the floor premium and receiving the cap premium.

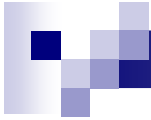
COLLAR



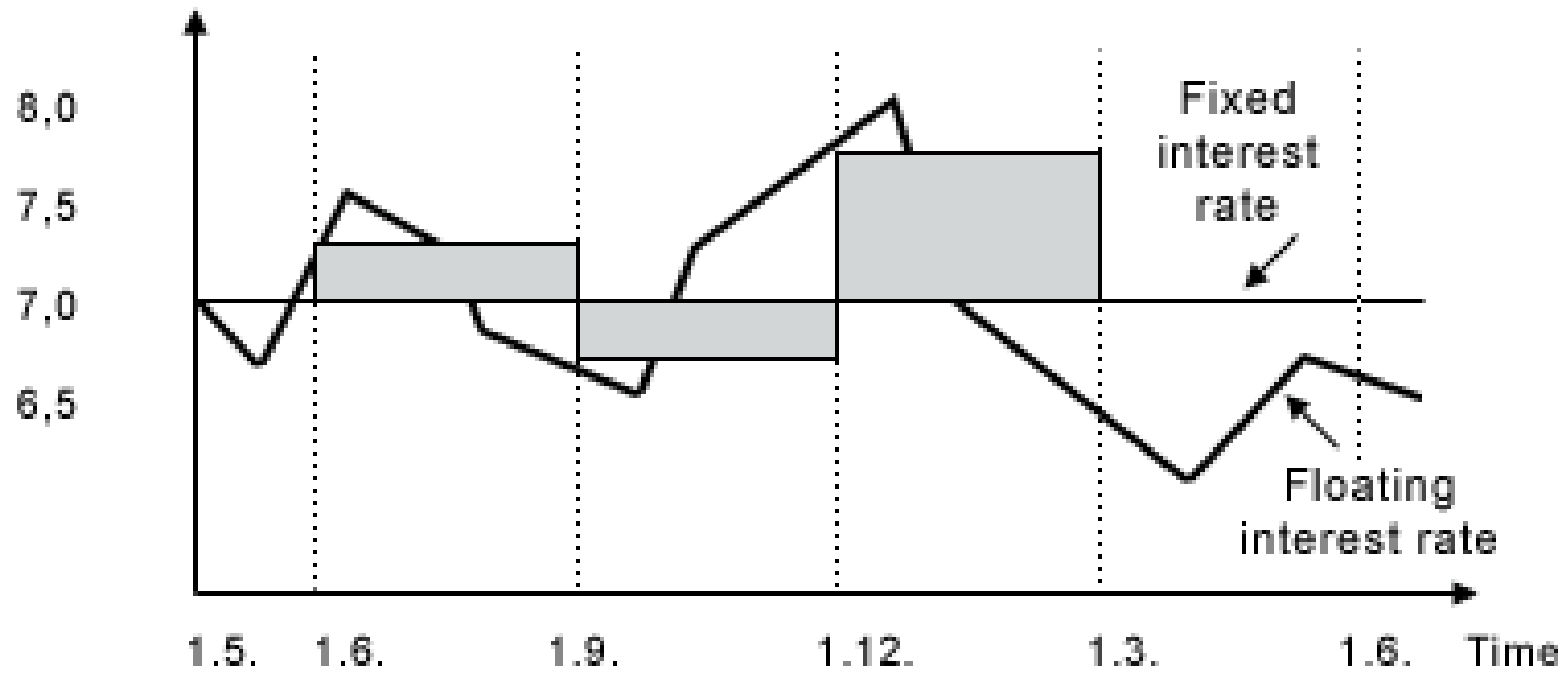


Interest Rate Swap

- Derivatives in which one party exchanges a stream of interest for another party's stream.
- Interest rate swaps are normally 'fixed against floating'
- Interest rate swaps are often used by companies to alter their exposure to interest-rate fluctuations, by swapping fixed-rate obligations for floating rate obligations, or swapping floating rate obligations to fixed-rate obligations.



IRS





■ A Written-off IRS

- a nominal value on the basis of which the interests are being calculated, is within the contracts duration reduced by a pre-set way,

■ A Step-up IRS

- a nominal value on the basis of which the interests are being calculated, is within the contracts duration increased by a pre-set way



IRS

- From the legal point of view concerning swaps, the initial creditor and debtor relations of the involved subjects do not change.
- This means that the subjects of the swap transaction remain fully responsible for their initial interests due (and/or they remain in the position of creditors of the interests due), which belong to swap



Futures

- Futures contract is a standardized contract, traded on a futures exchange, to buy or sell a certain underlying instrument at a certain date in the future, at a pre-set price.
- The future date is called the delivery date or final settlement date.
- The pre-set price is called the futures price.
- The price of the underlying asset on the delivery date is called the settlement price. The settlement price, normally, converges towards the futures price on the delivery date.

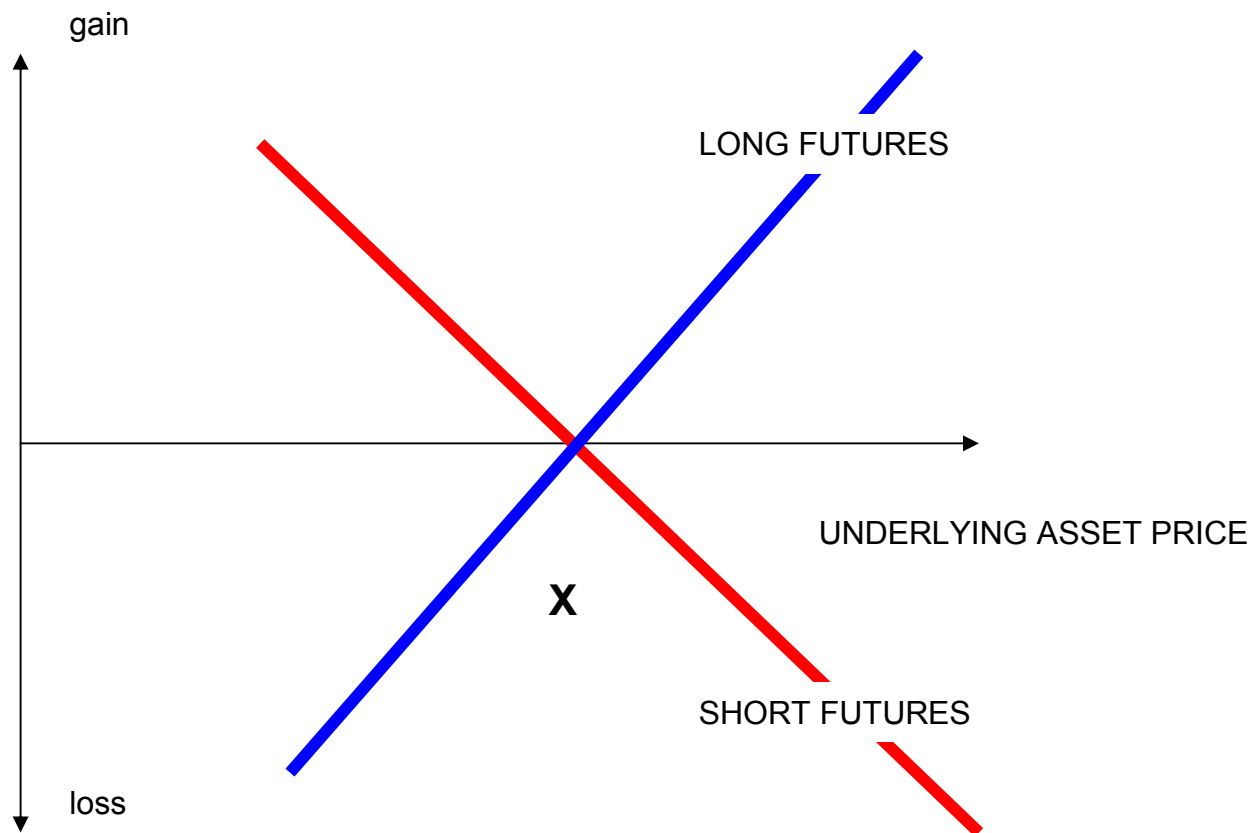


Futures

- A futures contract gives the holder the right and the obligation to buy or sell
- Both parties of a "futures contract" must exercise the contract (buy or sell) on the settlement date.
- To exit the commitment, the holder of a futures position has to sell his long position or buy back his short position, effectively closing out the futures position and its contract obligations.



Futures





Futures x Forwards

- Futures are always traded on an exchange, whereas forwards always trade over-the-counter
- Futures are highly standardized, whereas each forward is unique
- The price at which the contract is finally settled is different:
 - Futures are settled at the settlement price fixed on the last trading date of the contract (i.e. at the end)
 - Forwards are settled at the forward price agreed on the trade date (i.e. at the start)



Futures x Forwards

- The credit risk of futures is much lower than that of forwards:
 - Traders are not subject to credit risk due to the role played by the clearing house.
 - The day's profit or loss on a futures position is exchanged in cash every day (known as a 'margin payment'). After this the credit exposure is again zero.
- The profit or loss on a forward contract is only realized at the time of settlement, so the credit exposure can keep increasing
- In case of physical delivery, the forward contract specifies to whom to make the delivery. The counterparty on a futures contract is chosen randomly by the exchange.
- In a forward there are no cash flows until delivery, whereas in futures there are margin requirements and periodic margin calls.



Futures Trading

- Chicago Board of Trade (CBOT)
- Chicago Mercantile Exchange
- ICE Futures
- Euronext
- London Commodity Exchange
- Tokyo Commodity Exchange TOCOM
- London Metal Exchange
- New York Board of Trade
- New York Mercantile Exchange



Futures Trading

- Usual settlement - march, June, September, December
- Nearby contract
 - The closest settlement date
- Next contract
 - The closest settlement after nearby contract

Open Interest

- The total number of options and/or futures contracts that are not closed or delivered on a particular day.

Time	Trading Activity	Open Interest
Jan 1	A buys 1 option and B sells 1 option contract	1
Jan 2	C buys 5 options and D sells 5 options contracts	6
Jan 3	A sells his 1 option and D buys 1 options contract	5
Jan 4	E buys 5 options from C who sells 5 options contracts	5

- On Jan 1, A buys an option, which leaves an open interest and also creates trading volume of 1.
- On Jan 2, C and D create trading volume of 5 and there are also 5 more options left open.
- On Jan 3, A takes an offsetting position and therefore open interest is reduced by 1, and trading volume is 1.
- On Jan 4, E simply replaces C and therefore open interest does not change, trading volume increases by 5.



Futures Clearing

- Clearinghouse
 - Guarantee function
 - Physical vs cash settlement
- Margin requirements
 - Initial margin
 - Variation margin
 - „good faith“ money



Futures pricing

- Base

- Difference between spot price & futures price

- Futures & spot price converges to the expiration date

- Cost of Carry

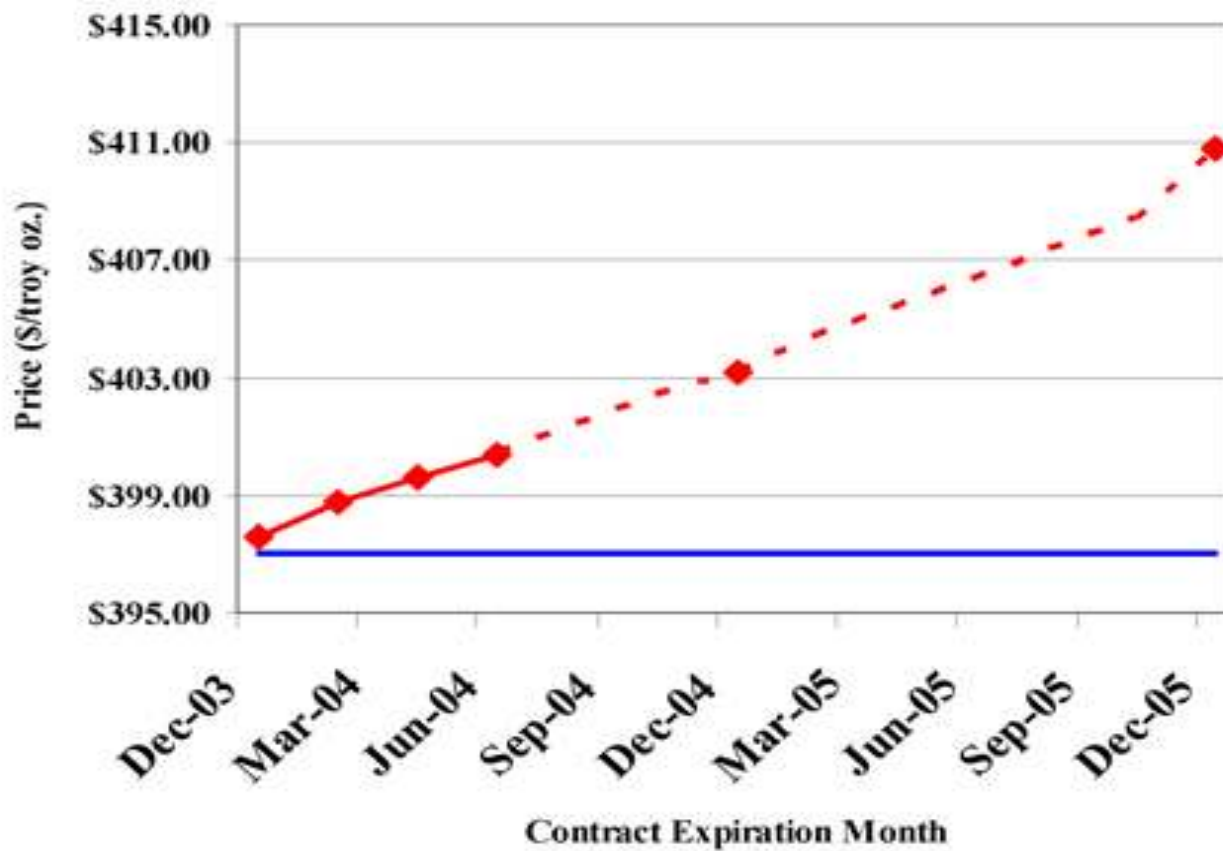
- Cash & Carry
 - Reverse Cash & carry



Contango

- The price of a commodity for future delivery is higher than the Spot price.
- Far future delivery price higher than a nearer future delivery.
- A contango is normal for a non-perishable commodity which has a cost of carry

Contango

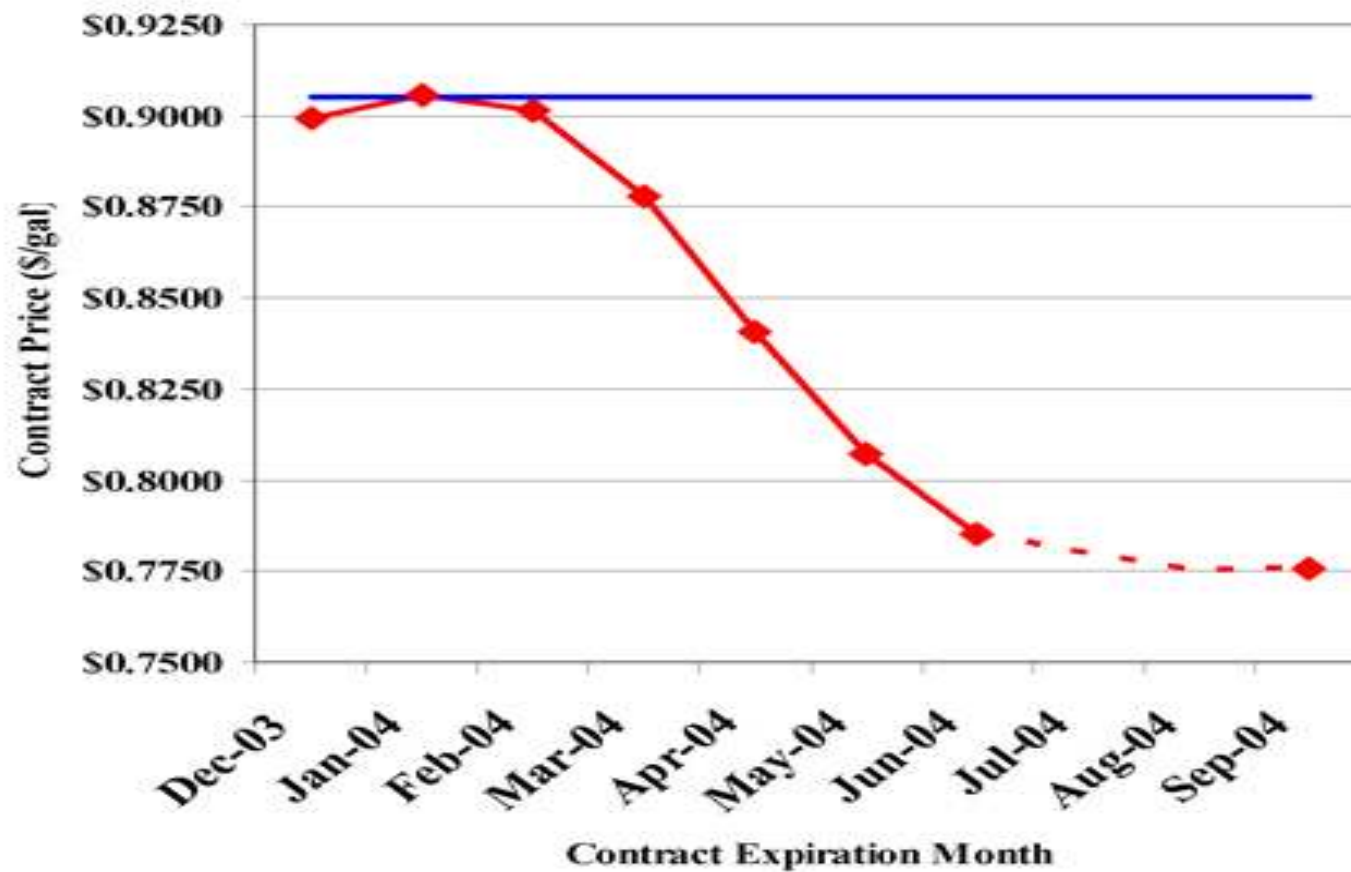




Backwardation

- situation where futures contracts closer to expiration trade at higher prices than those that are far from expiration.
- Backwardation is an abnormal situation, and is suggestive of supply insufficiencies in the corresponding (physical) spot market.

Backwardation





Contango vs Backwardation

CHARACTERISTIC	Gold	Heating Oil
<i>Spot Market Pricing</i>	Global	Regional
<i>Seasonality of Production and Consumption</i>	None	Highly Seasonal
<i>Risk of Supply Interruption</i>	Low	High
<i>Transportation/Storage and Insurance Costs</i>	Low	Moderate
<i>Consumption Levels Relative to Inventory</i>	Low	High
<i>Risk of Spoilage/Loss</i>	None	Moderate
<i>Collateral Value for Borrowing</i>	High	Low



Option contract

- A contract that gives the buyer the right, but not the obligation, to buy or sell an underlying asset at a specific price on or before a certain date



Participants

- Buyers of calls
 - Sellers of calls
 - Buyers of puts
 - Sellers of puts
-
- Seller = writer
 - Buyer = holder



Options

- Premium
- Strike price
- Expiration date



The Relationship of the Underlying to the Strike Price

	Put	Call
In-the-money option	The price of the underlying is <i>less than</i> the strike price of the option	The price of the underlying is <i>greater than</i> the strike price of the option
Out-of-the-money option	The price of the underlying is <i>greater than</i> the strike price of the option	The price of the underlying is <i>less than</i> the strike price of the option
At-the-money option	The price of the underlying is <i>equal to</i> the strike price of the option	The price of the underlying is <i>equal to</i> the strike price of the option

Note: Underlying refers to the asset (i.e., stock or commodity) upon which an option trades.



Premium drivers

- Stock price
- Strike price
- Time value
- Volatility



Option types

- European / American
- Vanilla / Exotic

How to read an option table

StkExp	P/C	Vol	Bid	Ask	OpInt	
360networks (TSX)					20.15	
20	Feb	C	3	1.00	1.25	26
22	Mar	C	10	1.60	1.85	138
24	Mar	C	2	1.05	1.25	366
18	June	P	2	2.50	2.75	11
20	June	C	12	4.05	4.30	83
24	June	C	1	2.65	2.90	77
Total option vol. 50			Total open int. 7,492			

Column 1

Column 2

Column 3

Column 4

Column 5

Column 6

Column 7



How to read an option table

- **1: Strike Price** - Option strike prices typically move by increments of \$2.50 or \$5 (even though in the above example it moves in \$2 increments).
- **2: Expiry Date** - This shows the termination date of an option contract. Remember that U.S.-listed options expire on the third Friday of the expiry month.
- **3: Call or Put**
- **4: Volume** - This indicates the total number of options contracts traded for the day. The total volume of all contracts is listed at the bottom of each table.
- **5: Bid**
- **6: Ask**
- **7: Open Interest** - Open interest is the number of options contracts that are open; these are contracts that have neither expired nor been exercised.



Exotic options

- OTC traded



Chooser option

- An option that gives the investor the right to choose whether the option is a put or a call at a certain point during the option's life. Unlike regular options that are purchased as a call or a put at inception, these exotic options can change during the life of the option.



Barrier option

- A type of option whose payoff depends on whether or not the underlying asset has reached or exceeded a predetermined price. The right to purchase the underlying at an agreed strike price only kicks in when the price hits the agreed upon 'barrier'. This is unlike a regular option because the holder of a vanilla option can buy the underlying at the strike price at any time after inception.



Asian option

- Anyone who invests in regular options will attest to their volatility. Asian options are a good way to reduce this volatility. These exotic options have a payoff that depends on the average price of the underlying asset over a certain period of time as opposed to at maturity. Also known as an average option.