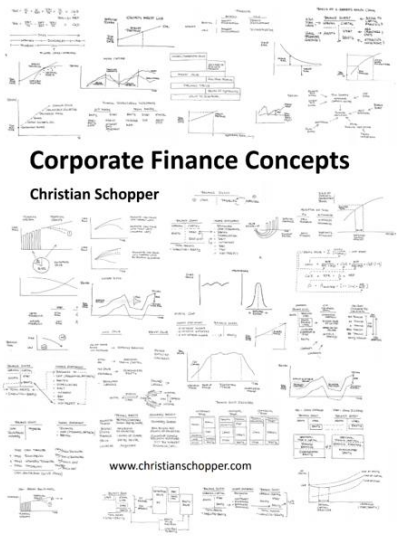
Financial Derivatives

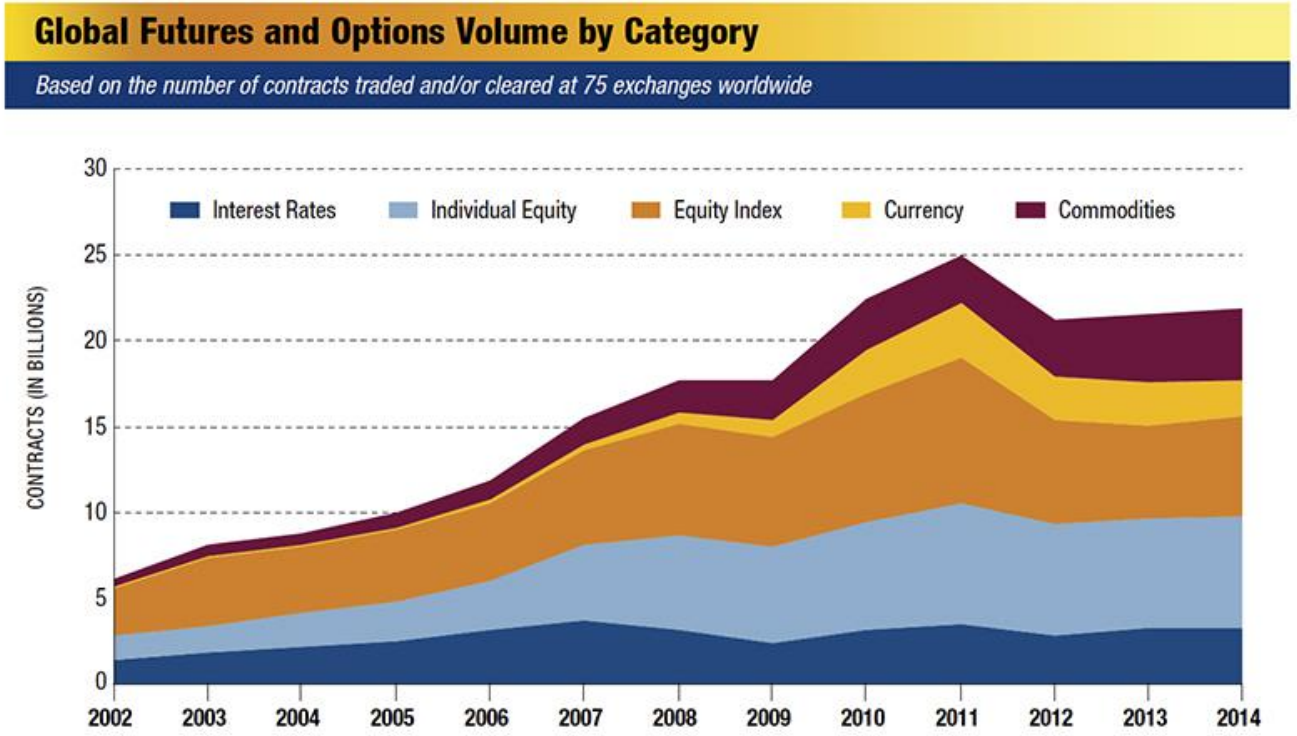
Overview

2016

For more concepts click on:



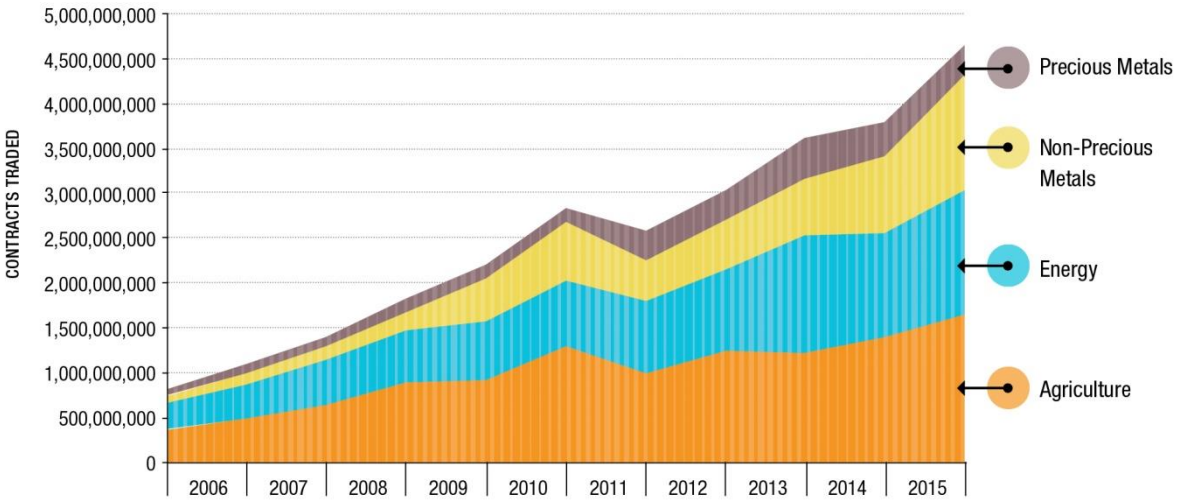
Global Futures and Options Volume



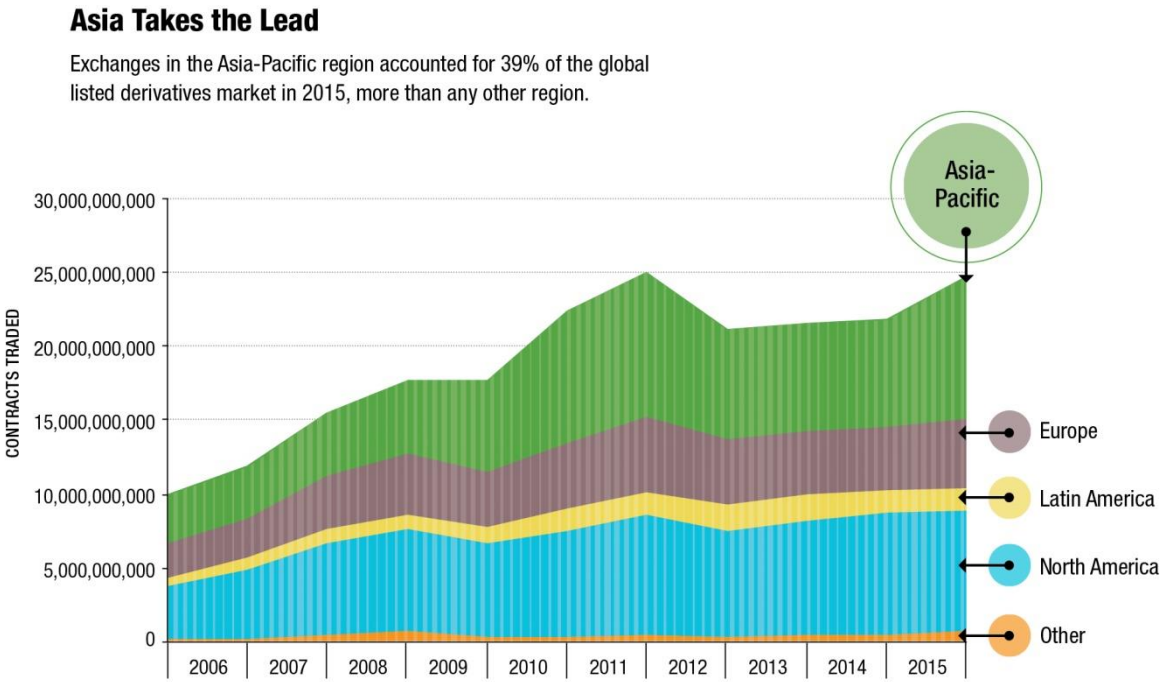
Global Futures and Options Volume (cont´d)

Commodity Boom

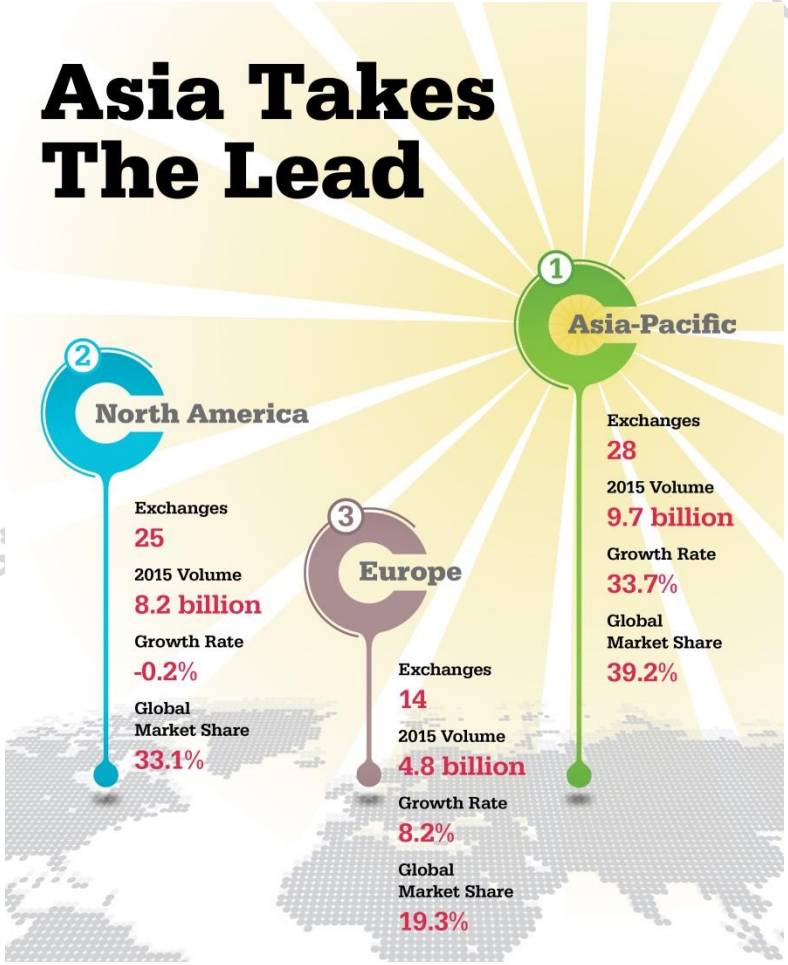
Since 2005, trading of commodity futures and options has risen faster than any other sector of the global listed derivatives markets.



Global Futures and Options Volume (cont´d)



Global Futures and Options Volume (cont´d)



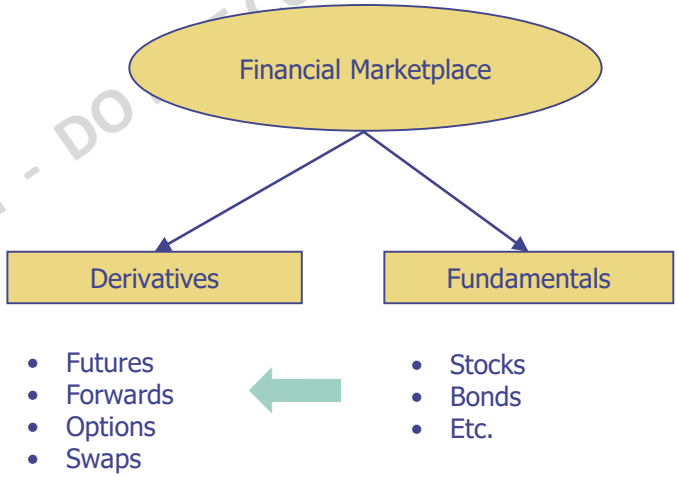
Introduction

What is a Financial Derivative?

A financial derivative is a **contract** between two (or more) parties …

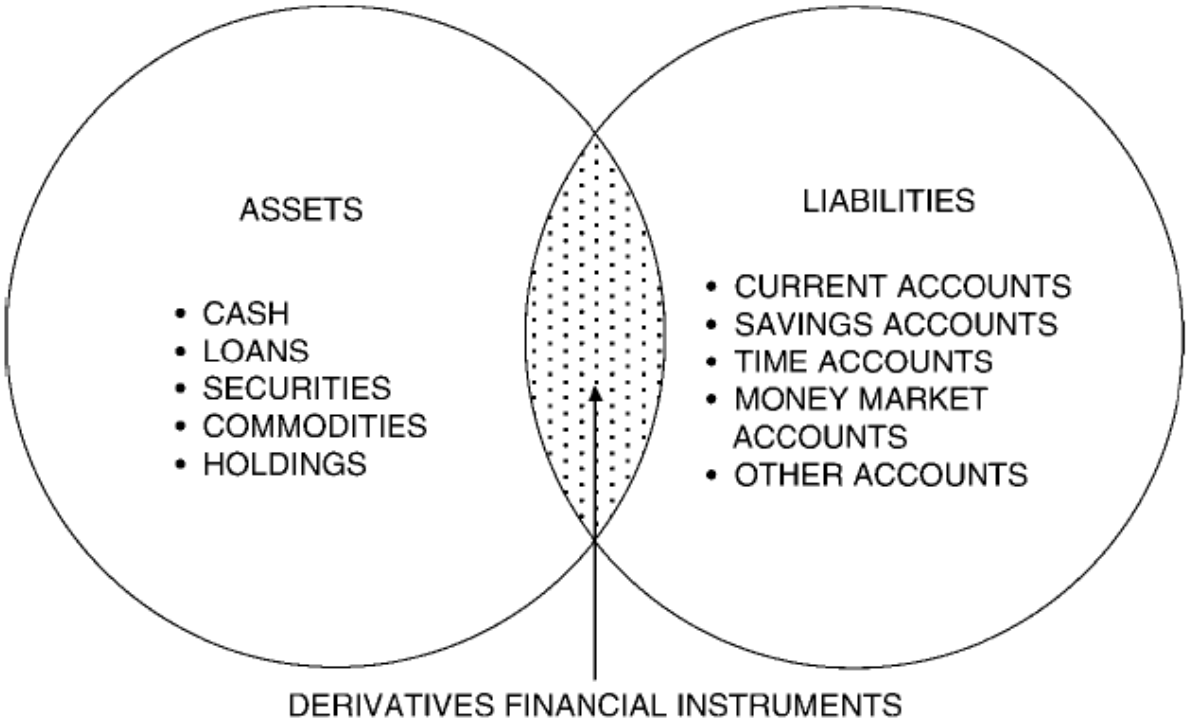
… where **payment** is based on (i.e., "**derived**" **from**) some agreed-upon **benchmark**

- Since a financial derivative can be created by means of a mutual **agreement**, there are **endless possibilities** of derivative products
- However, some common financial derivatives, do exist
- "**Hedge funds**" use financial derivatives as their most important tool for investment and risk management



Reporting of Financial Derivatives

- **Most derivatives activities are reported on the balance sheet …**
- **… but some are off-balance sheet (i.e., those with positive values are assets and those with negative values are counted as liabilities)**



Basic Derivatives Terms and Features

- In a financial derivative specified are
  - **Means** for payment
  - **Basis** of payment, and
  - **Rate** of payment
- Payment may be by **many means**
  - Currency, securities, a physical entity - such as gold -, an agricultural product - such as wheat or pork -, a transitory commodity -such as communication bandwidth or energy …
- The amount of payment may be tied to **many drivers**
  - Movement of interest rates, stock indexes, or foreign currency …
- Financial derivatives also **may involve leveraging**
  - Leveraging thus acts to multiply (favorably or unfavorably) impacts on total payment obligations of the parties to the derivative instrument

Holding Long Position

- Investors are legally **owning** an asset

Short Selling

- Selling of an asset that the seller does **not own**
- Assume the **risk** to be able to buy the asset at a more favorable price than the price at which sold short

Rationale for Using Derivatives

Hedging

- Interest rate volatility
- Stock price volatility
- Exchange rate volatility
- Commodity prices volatility

VOLATILITY

Speculation

- High portion of leverage
- Huge returns

RISK

Derivatives create …

- … a **complete market** and …
  - All identifiable payoffs can be obtained by trading the securities available in the market
- … **market efficiency**
  - Low transaction costs and greater liquidity

Forwards and Futures

Forward Contracts

- **The owner of a forward has the OBLIGATION to sell or buy something in the future at a predetermined price**
  - A forward contract is not an option
  - Both the buyer and the seller are obligated to perform under the terms of the contract
- **The difference to a future contract is that forwards are not standardized**
  - Forward Contracts generally are traded OTC

Example

- You walk into a bookshop on 1 February to buy the best-seller *Harry Potter and the Philosopher´s Stone*
- The cashier tells you that the **book is currently sold out**, but he takes your phone number, saying that he **will reorder it** for you
- He says the book will cost £10.00
- If **you agree** on 1 February **to pick up and pay** £10.00 for the book **when called**, you and the cashier have engaged in a forward contract
- That is, you have agreed both to pay for the book and to pick it up when the bookshop notifies you

- Because you are **agreeing to buy the book** at a **later** date, you are ***buying* a forward contract** on 1 February
- The book is called the *deliverable instrument*
- The **cashier**, acting on behalf of the bookshop, is *selling a forward contract* (***writing* a forward contract**)
- The bookshop has agreed to turn the book over to you at the predetermined price of £10.00 as soon as the book arrives
  - The act of turning the book over to you is called making delivery
- The agreement takes place on 1 February
  - The price is set and the conditions for sale are set at that time
  - The sale will occur when the book arrives
  - In other cases, an exact date of sale would be given

Forward Contracts (cont´d)

1 February	Date when book arrives
Buyer:	**Buyer:**
1 Agrees to pay the purchase price of £10.00.	**1** Pays purchase price of £10.00.
2 Agrees to receive book when book arrives.	**2** Receives book.
Seller:	**Seller:**
1 Agrees to give up book when book arrives.	**1** Gives up book.
2 Agrees to accept payment of £10.00 when book arrives.	**2** Accepts payment of £10.00.

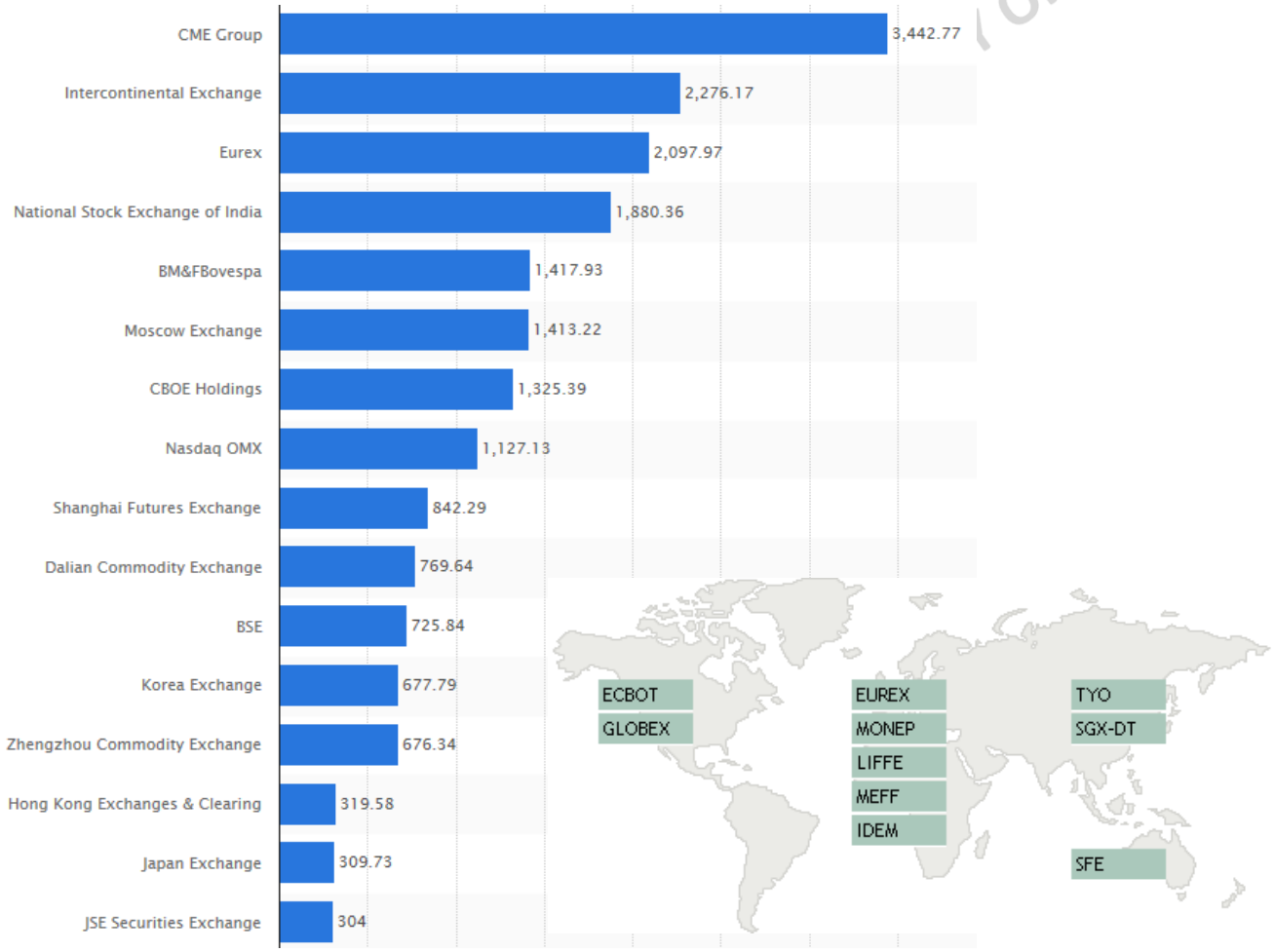
Note that cash does not change hands on 1 February. Cash changes hands when the book arrives.

Futures Contracts

- **The owner of a future contract has the OBLIGATION to sell or buy something in the future at a predetermined price**

- A variant of the forward contract takes place on *financial exchanges*
- Contracts on exchanges are usually called futures contracts
- There are a number of **futures exchanges** around the world, and more are being established
  - The big three futures exchanges are Euronext Liffe, Eurex, and the Chicago Mercantile Exchange
  - While trading on the exchanges spans whole geographic regions, there are many smaller exchanges, such as OMX (Nordic and Baltic markets), BELFOX (Belgium), IDEM (Italy), MEFF (Spain), and LME (London)

Futures Contracts (cont´d)



Futures Contracts (cont´d)

FT COMMODITIES & AGRICULTURE

09/01/2009

BASIC METALS

$/tonne	Cash Official	3 Mth Official
Aluminium	1520-20.5	1555-56
Alum Alloy	1100-10	1135-45
Amer Alloy	1020-21	1050-60
Copper	3279.5-80	3329-30
Lead	1180-85	1199-200
Nickel	11370-75	11425-50
Tin	11300-50	11275-300
Zinc	1219.5-20	1245-45.5

LONDON METAL EXCHANGE

	Kerb PM 3 Mth close	Day's High/Low (3 Mth)	Open Interest (Lots)	Turnover (Lots)
Aluminium	1569-70	1590/1542	668,730	150,978
Alum Alloy	1190-1200	1190/1170	6,646	6,609
Amer Alloy	1095-1100	1100/1090	22,628	3,036
Copper	3400-3405	3450/3244	243,694	100,517
Lead	1200-1205	1208/1150	66,123	43,768
Nickel	12150-12175	12175/11250	84,083	31,512
Tin	11800-11850	12000/11250	19,463	10,616
Zinc	1290-1295	1300/1230	221,852	59,032

Spot: 1.5248 3 mths: 1.5222 6 mths: 1.5211 9 mths: 1.5201 AM Official £/$ rate: 1.5318.
LME Closing £/$ rate: – . Kerb close 17:00.
Source: Amalgamated Metal Trading www.amt.co.uk

For further trading information see www.lme.co.uk

SOFTS

COCOA LIFFE (10 tonnes: £/tonne)

	Sett price	Day's change	High	Low	Vol 000s	O int 000s
Mar	1808	–28	1855	1802	5.89	72.86
May	1764	–24	1805	1757	1.56	38.61
Jul	1751	–18	1780	1748	0.24	30.99
Sep	1735	–13	1755	1733	1.02	11.42
Dec	1681	–13	1705	1679	0.66	14.31
Mar	1649	–20	1677	1649	0.68	1.40
Total					10.1	169.6

COCOA NYBOT (10 tonnes: $/tonne)

Mar	2585	–31	2674	2569	0.46	60.22
May	2579	–28	2663	2569	0.19	24.86
Jul	2570	–19	2635	2555	0.19	12.45
Sep	2546	–13	2611	2529	0.19	7.46
Dec	2511	–11	2568	2494	0.08	10.59
Mar	2487	–4	2533	2502	0.12	2.83
Total					9.39	120.2

COCOA ICCO (SDR's/tonne)

Jan 8	Price	Prev.day
Daily	1758.23	1728.53

COFFEE LIFFE (5 tonnes: £/tonne)

Jan	2012	+60	2030	1960	0.29	14.43
Jul	1969	–46	2035	1967	5.35	67.30
Total					11.5	125.3

COFFEE 'C' NYBOT (37,500lbs: cents/lbs)

Mar	116.90	+3.45	119.50	113.75	0.53	72.37
May	118.95	+3.40	121.60	116.00	0.15	27.54
Jul	121.05	+3.40	123.55	118.50	0.01	8.59

MEAT & LIVESTOCK

LIVE CATTLE CME (40,000lbs: cents/lbs)

	Sett price	Day's change	High	Low	Vol 000s	O int 000s
Feb	83.100	–0.050	83.900	82.850	27.75	82.84
Apr	86.825	–0.125	87.550	86.550	23.25	65.74
Jun	85.700	+0.325	86.150	84.850	9.60	35.06
Aug	86.700	+0.600	86.900	85.725	2.67	17.21
Total					64.5	210.0

LEAN HOGS CME (40,000lbs: cents/lbs)

Feb	62.450	+0.025	63.150	62.350	21.52	56.73
Apr	68.600	–0.450	69.850	68.475	18.74	43.84
May	80.425	–0.550	80.500	79.825	0.08	1.78
Jun	80.750	–0.800	81.750	80.325	7.57	32.80
Total					50.4	150.2

PORK BELLIES CME (40,000lbs: cents/lbs)

Feb	83.575	–1.075	84.950	83.400	0.06	0.66
Mar	83.550	–0.100	85.600	83.550	–	0.15
May	85.300	+0.050	85.400	85.100	–	0.23
Jul	84.150	+0.850	84.250	83.250	–	0.14
Total					0.07	1.19

FEEDER CATTLE CME (40,000lbs: cents/lbs)

Jan	94.100	+0.600	94.475	93.450	0.81	2.73
Mar	92.675	+0.425	93.400	92.250	2.60	11.87
Apr	94.000	+0.500	94.550	93.650	0.30	2.58
May	95.600	+0.675	96.100	95.100	0.61	2.13
Total					0.48	20.6

HIGH GRADE COPPER COMEX

	Sett price	Day's chge	High	Low	Vol	Open int
Jan	154.55	+8.25	154.50	146.00	0.23	0.92
Feb	155.30	+8.10	155.60	148.65	0.15	1.96
Mar	155.95	+8.05	156.50	147.40	16.17	51.40
Apr	156.65	+7.95	156.50	150.65	0.23	2.15
Total					15.9	77.0

LME WAREHOUSE STOCKS (tonnes)

Aluminium	+12,050	to	2,406,225
Aluminium Alloy	+1,260	to	105,200
Copper	+5,875	to	363,575
Lead	+425	to	45,025
Nickel	–210	to	78,594
Zinc	+25	to	259,775
Tin	+50	to	7,975

PRECIOUS METALS

GOLD COMEX (100 Troy oz: $/troy oz)

	Sett price	Day's chge	High	Low	Vol 000s	O int 000s
Feb	855.0	+0.5	869.3	845.0	111.9	190.2
Apr	856.5	+0.6	870.5	847.1	11.02	50.34
Total					139.2	328.3

LONDON BULLION MARKET

Gold (Troy oz)	$ price	£ equiv	€ equiv
Close	854.35-856.35		
Opening	855.90-857.30		
Morning fix	854.00	560.26	622.72
Afternoon fix	847.25	559.17	626.48
Day's High	860.05		
Day's Low	845.60		
Previous Close	857.00-858.60		

SPOT MARKETS

CRUDE OIL FOB (per barrel) + or –

Duhai	$39.29-39.31	–0.9

Source: Financial Times.

Data on futures contracts, Friday 9 January 2009

Futures Contracts (cont´d)

Example: Liffe cocoa contracts

- For delivery of 10 tonnes of cocoa
- Quoted in STG per tonne

■ COCOA LIFFE (10 tonnes: £/tonne)

	Sett price	Day's change	High	Low	Vol 000s	0 int 000s
Mar	1808	–28	1855	1802	5.89	72.86
May	1764	–24	1803	1757	1.56	38.61
Jul	1751	–18	1780	1748	0.24	30.99
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Total					**10.1**	**169.6**

- **Price for delivery** in the future **expected to fall over 2009**
  - For example, the price of a 2 March 2009 cocoa futures contract is £1,808, falling to £1,751 for a July contract and £1,649 for a December 2009 contract

- Liffe cocoa contract **March maturity**
  - ***Settlement price*** (£1,808), essentially the **closing** price for the day (basis for **mark to market**)
  - Change, listed next, is the movement in the settlement price since the previous trading session (−£28)
  - Highest price (£1,855) and lowest price (£1,802) over the life of the contract
  - Contracts traded, and *open interest* (72,860)

- **Suppose** you **wrote** a ***forward*** contract **for September** cocoa at £1,735
  - You would agree to turn over an agreed-upon weight of cocoa beans for £1,735 per 10 tonnes on some specified date in the month of September

Futures vs Forwards

■ COCOA LIFFE (10 tonnes: £/tonne)

	Sett price	Day's change	High	Low	Vol 000s	O int 000s
Mar	1808	–28	1855	1802	5.89	72.86
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- The **seller** of a future can ***choose to deliver*** the cocoa on ***any day during the delivery month*** – that is, the month of September
  - When the seller decides to deliver, he **notifies** the exchange **clearing house**
  - The clearing house then notifies the **buyer** of a September cocoa contract that she **must stand ready to accept** delivery within the next few days
  - Because there are so many buyers at any one time, the buyer selected by the clearing house to take delivery almost certainly did not originally buy the contract from the seller now making delivery

- Futures contracts are traded on an **exchange**, whereas forward contracts are generally traded off an exchange
  - Because of this, there is generally a **liquid** market in futures contracts
  - A **buyer** can **net out** her futures position with a **sale**
  - A **seller** can **net out** his futures position with a **purchase**
  - **If** a **buyer** of a future **does not** subsequently **sell** her **contract**, she **must take delivery**

- The prices of futures contracts are ***marked to the market daily***
  - Suppose the price falls to £1,705 on Monday's close
  - Because all buyers lost £30 per contract on that day, …
  - … they each **must turn over** the £30 per contract to their brokers **within 24 hours**, …
  - … who **subsequently remit** the **proceeds to the clearing house**
  - All sellers gained £30 per contract on that day ...,
  - … - … - … with the clearing house eventually must break even every day

Futures vs Forwards (cont´d)

- Contract to buy or sell a **standard quantity and quality** at a specified date and price
- Traded on an **exchange**, and are **valued daily**
- The **daily value** provides an **accounting of financial obligations** under the terms of the future
- **Counterparty** to the buyer or seller is the **clearing corporation** on the appropriate exchange
- **Often settled in cash** or cash equivalents, rather than requiring physical delivery

- **Forwards are flexible, but**
  - **…** there is **lack of liquidity** (counterparty hard to find) and …
  - … they are **subject to default risk**
- Thus, the **pricing which is exact for the forward contract**, should be a **decent approximation for** the **futures** contract

Futures – Mark to Market

■ COCOA LIFFE (10 tonnes: £/tonne)

	Sett price	Day's change	High	Low	Vol 000s	0 int 000s
Mar	1808	–28	1855	1802	5.89	72.86
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Illustration of Example Involving Marking to Market in Futures Contracts

Both buyer and seller originally transact at Friday's closing price. Delivery takes place at Tuesday's closing price.*

	Friday 9 January	Monday 12 January	Tuesday 13 January	Delivery (notification given by seller on Tuesday)
Closing price	£1,735	£1,705	£1,750	
Buyer				

What Happens?

Seller

What Happens?

Futures – Mark to Market (cont´d)

■ COCOA LIFFE (10 tonnes: £/tonne)

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Illustration of Example Involving Marking to Market in Futures Contracts

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	Friday 9 January	Monday 12 January	Tuesday 13 January	Delivery (notification given by seller on Tuesday)
Closing price	£1,735	£1,705	£1,750	
Buyer	Buyer purchases futures contract at closing price of £1,735/10 tonnes.	Buyer must pay £30 per contract to clearing house within one business day.	Buyer receives £45 per contract from clearing house within one business day.	Buyer pays £1,750 per contract and receives cocoa within one business day.
Buyer's net payment of –£1,735 (= –£30 + £45 – £1,750) is the same as if buyer purchased a forward contract for £1,735.				
Seller	Seller sells futures contract at closing price of £1,735/contract.	Seller receives £30/contract from clearing house within one business day.	Seller pays £45/contract to clearing house within one business day.	Seller receives £1,750 per contract and delivers cocoa within one business day.
Seller's net receipts of £1,735 (= £30 – £45 + £1,750) are the same as if seller sold a forward contract for £1,735.				

*For simplicity, we assume that buyer and seller both (a) initially transact at the same time and (b) meet in the delivery process. This is actually very unlikely to occur in the real world, because the clearing house assigns the buyer to take delivery in a random manner.

Futures – Mark to Market (cont´d)

The mark-to-the-market provision on futures contracts

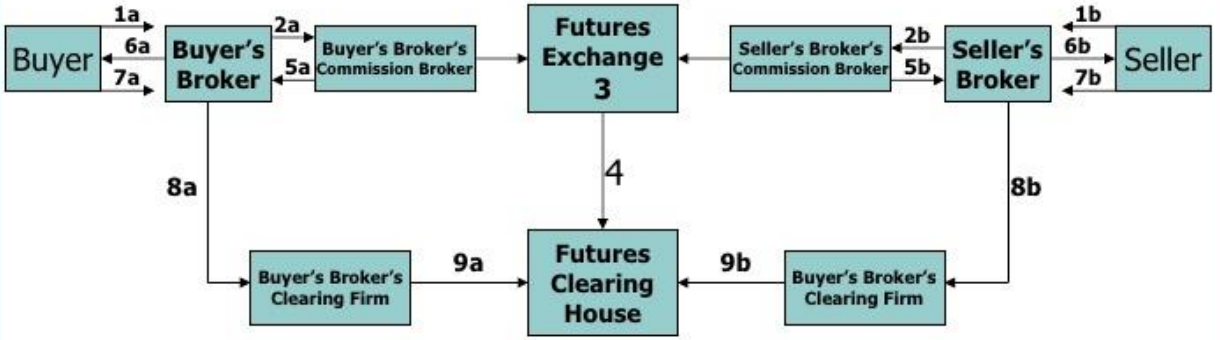
- A (large) **price drop** means an **immediate** (large) **out-payment for the buyer** of a futures contract
  - **Though a net outflow is the same as under a forward contract, the present value of the cash outflows is greater to the buyer of a futures contract**
  - Of course, the present value of the cash outflows is less to the buyer of a futures contract if a price rise follows purchase

- The parties **must have extra liquidity** to meet a sudden outflow prior to expiration …
  - This added risk may make the futures contract less attractive …

- … **which** – however - **minimizes the chance of default** on a futures contract
  - If the price rises, the seller has an incentive to default on a forward contract
  - However, after paying the clearing house, the seller of a futures contract has little reason to default
  - If the price falls, the same argument can be made for the buyer
  - Because changes in the value of the underlying asset are recognized daily, there is **no accumulation of loss**, and the incentive to default is reduced
  - **Because of this default issue, forward contracts generally involve individuals and institutions who know and can trust each other**
  - However, lawyers earn a handsome living writing supposedly airtight forward contracts, even among friends
  - The genius of the mark-to-the market system is that it can prevent default where it is most likely to occur – among investors who do not know each other

Futures – Transaction Flow

A Transaction on the Futures Exchange

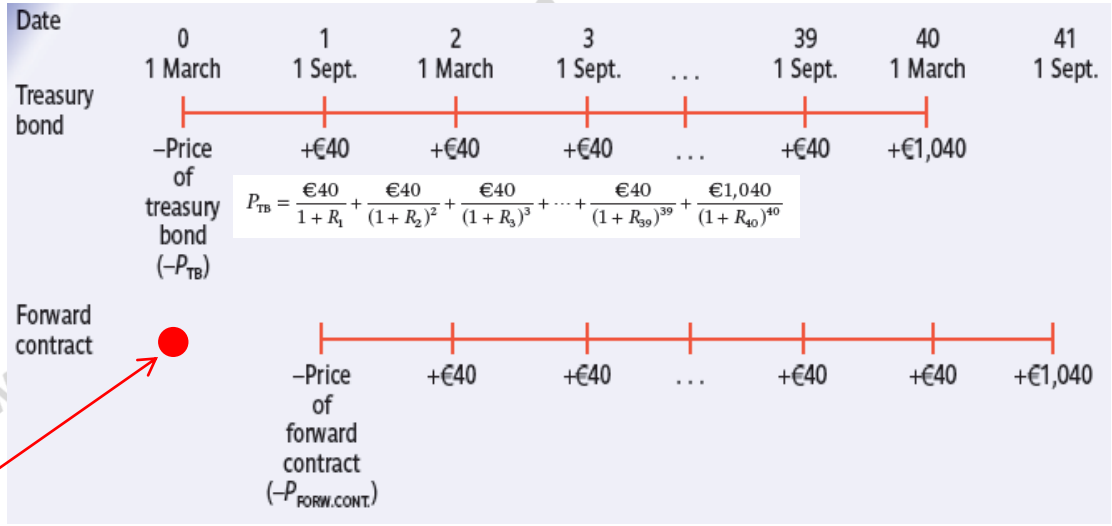


1a 1b Buyer and seller instruct their respective brokers to conduct a futures transaction.
2a 2b Buyer's and seller's brokers request their firm's commission brokers execute the transaction.
3 Both floor brokers meet in the pit on the floor of the futures exchange and agree on a price.
4 Information on the trade is reported to the clearinghouse.
5a 5b Both commission brokers report the price obtained to the buyer's and seller's brokers.
6a 6b Buyer's and seller's brokers report the price obtained to the buyer and seller.
7a 7b Buyer and seller deposit margin with their brokers.
8a 8b Buyer's and seller's brokers deposit margin with their clearing firms.
9a 9b Buyer's and seller's brokers' clearing firms deposit premium and margin with clearinghouse.

Note: Either buyer or seller (or both) could be a floor trader, eliminating the broker and commission broker.

Pricing a Forward

- Consider a 20-year, 8 per cent coupon bond that was issued on 1 March
- The first payment is to occur in six months – that is, on 1 September
- Then, imagine a ***forward*** contract where, on 1 March, you **agree to buy** a new **20-year**, **8 per cent coupon** Treasury bond **in six months** (on 1 September)



Value of the 1 Sept Forward as of 1 March

$$\frac{P_{FORW.CONT.}}{1+R_1} = \frac{€40}{(1+R_2)^2} + \frac{€40}{(1+R_3)^3} + \frac{€40}{(1+R_4)^4} + \cdots + \frac{€40}{(1+R_{40})^{40}} + \frac{€1,040}{(1+R_{41})^{41}}$$

Pricing a Forward

$$\frac{P_{\text{FORW.CONT.}}}{1+R_1} = \frac{€40}{(1+R_2)^2} + \frac{€40}{(1+R_3)^3} + \frac{€40}{(1+R_4)^4} + \cdots + \frac{€40}{(1+R_{40})^{40}} + \frac{€1,040}{(1+R_{41})^{41}}$$

- Forward contracts are similar to the underlying bonds themselves
  - If the entire term structure of **interest** rates unexpectedly shifts **upwards** on 2 March, the Treasury **bond** issued the previous day should **fall** in value

$$P_{\text{FORW.CONT.}} = \frac{€40 \times (1+R_1)}{(1+R_2)^2} + \frac{€40 \times (1+R_1)}{(1+R_3)^3} + \frac{€40 \times (1+R_1)}{(1+R_4)^4} + \cdots + \frac{€40 \times (1+R_1)}{(1+R_{40})^{40}} + \frac{€1,040 \times (1+R_1)}{(1+R_{41})^{41}}$$

  - **For forwards**, if the entire term structure of interest rates unexpectedly shifts upwards on 2 March, the *first* term should fall in value
  - That is, both ***R*1 and *R*2 will rise by an equal amount**
  - **However**, ***R*2 enters as a *squared* term**, so an **increase in *R*2 more than offsets the increase in *R*1**
  - **Thus**, as long as the entire term structure shifts upwards by an equal amount on 2 March, the **value of a forward contract must fall** on that date

Hedging with Forwards and Futures

Speculation vs Hedging

A futures contract makes unfavourable price movements less unfavourable and a favourable price movements less favourable …

General Rules for Hedgers

- If you are going to **sell** something in the near future but want to **lock in** a secured price …
- … you take a **short** position

- If you are going to receive / **buy** something in the future but want to **lock in** a secured price …
- … you take a **long** position

The Role of Speculators

- Speculators are involved in price **betting** and take the risk of price movements against them

Hedging in Commodities - Example

- In January, Simon Agyei-Ampomah, a Ghanaian **farmer**, **anticipates a harvest** of 5,000 tonnes of cocoa at the end of September
- The September cocoa contract on Euronext Liffe is trading at £1,735/per 10 tonnes on 9 January

- **What can / shall Simon Agyei-Ampomah do?**

Hedging in Commodities – Example (cont´d)

- **Short Hedge**
  - Reduces his risk by *selling* a futures contract
  - Occurs whenever someone either anticipates receiving inventory or is holding inventory
- **No Hedge**
  - May simply be uninformed about hedging
  - May have a special insight or some special information that commodity prices will rise

- In January, Simon Agyei-Ampomah, a Ghanaian farmer, anticipates a harvest of 5,000 tonnes of cocoa at the end of September
- The September cocoa contract on Euronext Liffe is trading at £1,735/per 10 tonnes on 9 January

Write futures contracts against his anticipated harvest

- He executes the following transaction:

Date of transaction	Transaction	Price per 10 tonnes
9 January	Write 500 September futures contracts	£1,735

- He notes that transportation costs to the designated delivery point in London are £10 per 10 tonnes. -- Thus his net price per contract is £1,725 = £1,735 − £10.

Harvest the cocoa without writing a futures contract

- Alternatively, Mr Agyei-Ampomah could harvest the cocoa without the benefit of a futures contract
- The risk would be quite great here, because no one knows what the cash price in September will be
- If prices rise, he will profit. Conversely, he will lose if prices fall

More Hedging in Commodities – Example

- On 1 April, Maan Chemical **agreed to sell petrochemicals** (in US dollars) to the Dutch government in the future
- The **delivery dates and prices** have been **determined**
- Because oil is a basic ingredient of the production process, Maan Chemical will need to have large quantities of oil on hand

- **What can / shall Maan Chemical do?**

More Hedging in Commodities – Example (cont´d)

- **No Hedge**
  - If selling to private individuals, because cost increases are likely to be passed on to the consumer …
- **Long Hedge**
  - Takes a long position in the futures market
  - In general, a firm institutes a long hedge when it is committed to a fixed sales price

- On 1 April, Maan Chemical agreed to sell petrochemicals (in US dollars) to the Dutch government in the future
- The delivery dates and prices have been determined
- Because oil is a basic ingredient of the production process, Maan Chemical will need to have large quantities of oil on hand

Buy the oil as the firm needs it

- This is an **unhedged** position because, as of 1 April, the firm does not know the prices it will later have to pay for the oil
- The key to this risk bearing is that the sales price to the Dutch government has already been fixed, thus **increased costs cannot be passed on** to the consumer

Buy futures contracts

- The firm can buy futures contracts with expiration months corresponding to the dates when the firm needs inventory
- The futures contracts **lock in the purchase price** to Maan Chemical
- Because **there is a crude oil futures contract for every month**, selecting the correct futures contract is not difficult
  - Many other commodities have only five contracts per year, frequently necessitating buying contracts one month away from the month of production

Interest Rate Hedging - Example

- Erik Werenskiold owns a **mortgage banking company**
- **On 1 March** he made a **commitment to lend** a total of $1 million to various homeowners **on 1 May**
- The loans are 20-year mortgages carrying a 12 per cent coupon, the going interest rate on mortgages at the time
  - Thus the mortgages are made at par

What is Erik´s position in regards to Derivatives?

Interest Rate Hedging – Example (cont´d)

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- **On 1 March** he made a **commitment to lend** a total of $1 million to various homeowners **on 1 May**
- The loans are 20-year mortgages carrying a 12 per cent coupon, the going interest rate on mortgages at the time
  - Thus the mortgages are made at par
- Though homeowners would not use the term, we could say that Erik is "**buying a *forward contract* on a mortgage"**
  - That is, he **agrees** on 1 March **to give (alas: pay) $1 million** to his borrowers on 1 May in exchange **for (receiving) principal and interest** from them every month for the next 20 years.

But Erik has a plan …

- Like many mortgage bankers, he has no intention of paying the $1 million out of his own pocket

Interest Rate Hedging – Example (cont´d)

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  - That is, he **agrees** on 1 March **to give (alas: pay) $1 million** to his borrowers on 1 May in exchange **for (receiving) principal and interest** from them every month for the next 20 years.
- Like many mortgage bankers, he has no intention of paying the $1 million out of his own pocket
- Rather, **Erik intends to sell the mortgages to an insurance company**
  - Thus the insurance company will actually lend the funds, and will receive principal and interest over the next 20 years
- Mr Werenskiold does not currently have an insurance company in mind
- He **plans to visit the mortgage departments of insurance companies over the next 60 days** to sell the mortgages to one or many of them
- He **sets 30 April as a deadline for making the sale**, because the borrowers expect the funds on the following day

Interest Rate Hedging – Example (cont´d)

Erik makes a deal with Superbe Insurance on 15 April

Assume that interest rates have gone up in the meantime, to over 12%

What is Erik´s financial position?

Interest Rate Hedging – Example (cont´d)

	Mortgage interest rate on 15 April	
	Above 12%	Below 12%
Sale price to Superbe Insurance	Below €1 million (we assume €940,000).	Above €1 million (we assume €1.05 million).
Effect on mortgage banker	He loses, because he must lend the full €1 million to borrowers.	He gains because he lends only €1 million to borrowers.
Euro gain or loss	Loss of €60,000 (= €1 million – 940,000).	Gain of €50,000 (= €1.05 million – €1 million).

The interest rate on 1 March, the date when the loan agreement was made with the borrowers, was 12 per cent. 15 April is the date the mortgages were sold to Superbe Insurance.

Interest Rate Hedging – Example (cont´d)

What does the mortgage banker get out of this loan to **offset** his **risk** bearing?

- ***Origination fee***
  - Paid to the mortgage banker by the insurance company on 15 April – that is, on the date the loan is sold
  - An industry standard in certain locales is 1% of the value of the loan, which is $10,000 (= 1% × $1 million)

- ***Collection agent* for the insurance company**
  - Small portion of the outstanding balance of the loan each month
  - For example, if he is paid 0.03% of the loan each month, he will receive $300 (= 0.03% × $1 million) in the first month
  - As the outstanding balance of the loan declines, he will receive less

Though Mr Werenskiold will earn profitable fees on the loan, he bears interest rate risk. He loses money if interest rates rise after 1 March, and he profits if interest rates fall after 1 March. To hedge this risk, he writes June Treasury bond futures contracts on 1 March. As with mortgages, Treasury bond futures contracts fall in value if interest rates rise. Because he *writes* the contract, he makes money on these contracts if they fall in value. Therefore, with an interest rate rise, the loss he endures in the mortgages is offset by the gain he earns in the futures market. Conversely, Treasury bond futures contracts rise in value if interest rates fall. Because he writes the contracts, he suffers losses on them when rates fall. With an interest rate fall, the profit he makes on the mortgages is offset by the loss he suffers in the futures markets.

Interest Rate Hedging – Example (cont´d)

Could Erik hedge his financial position?

Interest Rate Hedging – Example (cont´d)

	Cash markets	Futures markets
1 March	Mortgage banker makes forward contracts to lend €1 million at 12 per cent for 20 years. The loans are to be funded on 1 May. No cash changes hands on 1 March.	Mortgage banker writes 10 June Treasury bond futures contracts.
15 April	Loans are sold to Superbe Insurance. Mortgage banker will receive sale price from Superbe on the 1 May funding date.	Mortgage banker buys back all the futures contracts.
If interest rates rise:	Loans are sold at a price below €1 million. Mortgage banker loses because he receives less than the €1 million he must give to borrowers.	Each futures contract is bought back at a price below the sales price, resulting in *profit*. Mortgage banker's profit in futures market offsets loss in cash market.
If interest rates fall:	Loans are sold at a price above €1 million. Mortgage banker *gains* because he receives more than the €1 million he must give to borrowers.	Each futures contract is bought back at a price above the sales price, resulting in *loss*. Mortgage banker's loss in futures market offsets gain in cash market.

Interest Rate Hedging – Example (cont´d)

Risk would be totally **eliminated if losses in the cash markets were *exactly* offset by gains in the futures markets**, and vice versa.

- But, **mortgages** and **Treasury bonds** are **not identical** instruments
  - Mortgages may have different **maturities** from Treasury bonds
  - Treasury bonds have a different **payment stream** than do mortgages: Principal is paid only at maturity on T-bonds, whereas principal is paid every month on mortgages: Therefore, mortgages have a shorter *effective* time to maturity than do Treasury bonds
  - Mortgages have **default risk** whereas Treasury bonds do not
  - **Mortgages may** be paid off early and hence **have a shorter *expected maturity*** than Treasury bonds of equal maturity

- Because mortgages and Treasury bonds are not identical instruments, they are **not identically affected by interest rates**
  - If **Treasury bonds** are **less volatile** than mortgages, he may write more than 10 T-bond futures contracts
  - An optimal ratio of futures to mortgages will reduce risk as much as possible
  - However, the price movements of mortgages and Treasury bonds are **not *perfectly correlated***

- **Strategy is a *short hedge***, because futures contracts are sold to reduce risk
  - Though it involves an interest rate futures contract, this short hedge also offsets an inventory price fluctuation
  - Contract to lend money to borrowers are effectively inventory

Short versus Long Hedging - Example

- Margareth Boswell is another mortgage banker
- Her strategy is the opposite of Mr Werenskiold's: That is, she **promises to deliver loans to a financial institution *before* she lines up borrowers**
- On 1 March her firm agreed to sell mortgages to No-State Insurance
- The agreement specifies that she must **turn over 12 per cent coupon mortgages with a face value of $1 million to No-State by 1 May**
- **No-State is buying the mortgages at par**, implying that they will pay Ms Boswell $1 million on 1 May
- As of 1 March, Ms Boswell had not signed up any borrowers
- Over the next two months, she **will seek out individuals who want mortgages with a fixed interest** beginning on 1 May

- As with Mr Werenskiold, changing interest rates will affect Ms Boswell
- **If interest rates fall** before she signs up a borrower, the **borrower** will **demand** a **premium** on a 12 per cent coupon loan
  - That is, the borrower will receive more than par on 1 May
  - Because Ms Boswell receives par from the insurance company, she must make up the difference
- Conversely, **if interest rates rise**, a 12 per cent **coupon loan will be made at a discount**
  - That is, the borrower will receive less than par on 1 May
  - Because Ms Boswell receives par from the insurance company, the difference is pure profit to her

Short versus Long Hedging – Example (cont´d)

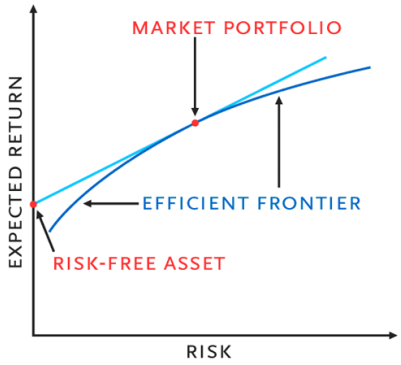
Could Margareth hedge her financial position?

Short versus Long Hedging – Example (cont´d)

	Cash markets	Futures markets
1 March	Mortgage banker makes a forward contract (advance commitment) to deliver €1 million of mortgages to No-State Insurance. The insurance company will pay par to Ms Boswell for the loans on 1 May. The borrowers are to receive their funding from the mortgage banker on 1 May. The mortgages are to be 12 per cent coupon loans for 20 years.	Mortgage banker buys 10 June Treasury bond futures contracts.
15 April	Mortgage banker signs up borrowers to 12 per cent coupon, 20-year mortgages. She promises that the borrowers will receive funds on 1 May.	Mortgage banker sells all futures contracts.
If interest rates rise:	Mortgage banker issues mortgages to borrowers at a discount. Mortgage banker gains because she receives par from the insurance company.	Futures contracts are sold at a price below purchase price, resulting in loss. Mortgage banker's loss in futures market offsets gain in cash market.
If interest rates fall:	Loans to borrowers are issued at a premium. Mortgage banker loses because she receives only par from insurance company.	Futures contracts are sold at a price above purchase price, resulting in gain. Mortgage banker's gain in futures market offsets loss in cash market.

Options

CAPM



- The goal of CAPM is to **determine a required rate of return to justify adding an asset** to an already well-diversified portfolio, considering that asset's non-diversifiable risk
- CAPM takes into account the **non-diversifiable market risks or Beta (β) in addition the expected return of a risk-free asset**
  - While CAPM is accepted academically, there is empirical evidence suggesting that the model is not as profound as it may have first appeared to be

Market Efficiency

- Current price reflects all relevant information
- A market is efficient with respect to a set of information if it is impossible to make a NPV > 0 based upon that information
- Note: Market Efficiency is **only a hypothesis** not a theory
  - Weak form Market Efficiency : Past Information
  - Semi-strong form Market Efficiency: All Public Information
  - Strong form Market Efficiency: All Information

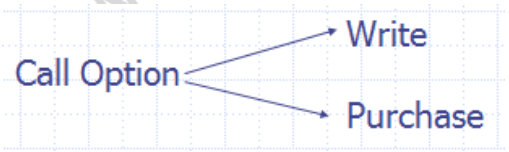
Options

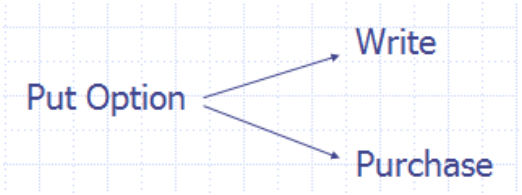
- **The owner of an options has the OPTION to buy or sell something at a predetermined price and is therefore more costly than a futures**

- **Call option**
- **Put option**
- **Excersice price / strike price**
- **Option premium**
- **Moneyness (in-the-money, at-the-money, out-of-money)**
- **European vs. American Options**

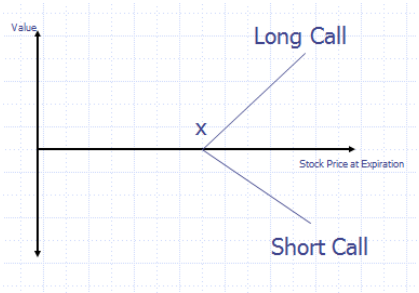
- The purchaser of an Option has rights - but **not obligations** - to buy or sell the asset during a given time for a specified price, the "**Strike**" price
- An Option to buy is known as a "**Call**"
  - An Option to sell is called a "**Put**"
- The seller of a Call Option is obligated to sell the asset to the party that purchased the Option
  - The seller of a Put Option is obligated to buy the asset
- In a "**Covered" Option**, the seller of the Option already owns the asset
  - In a "**Naked" Option**, the seller does *not* own the asset
- Options are traded on organized exchanges and OTC

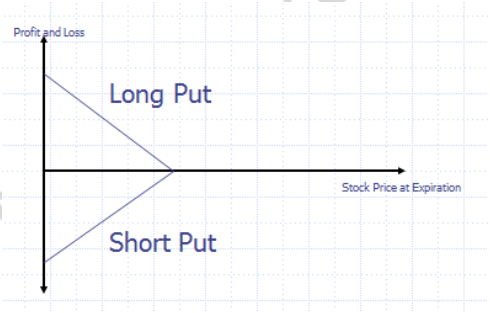
The 4 Basic Option Positions

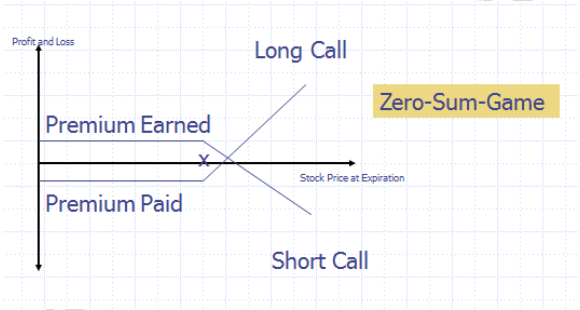


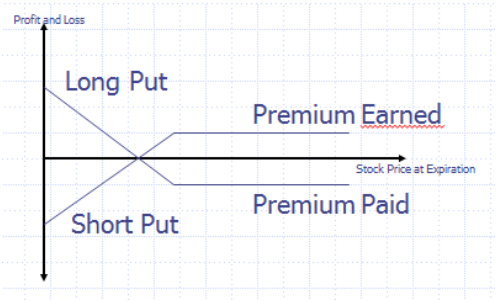


Options (cont´d)









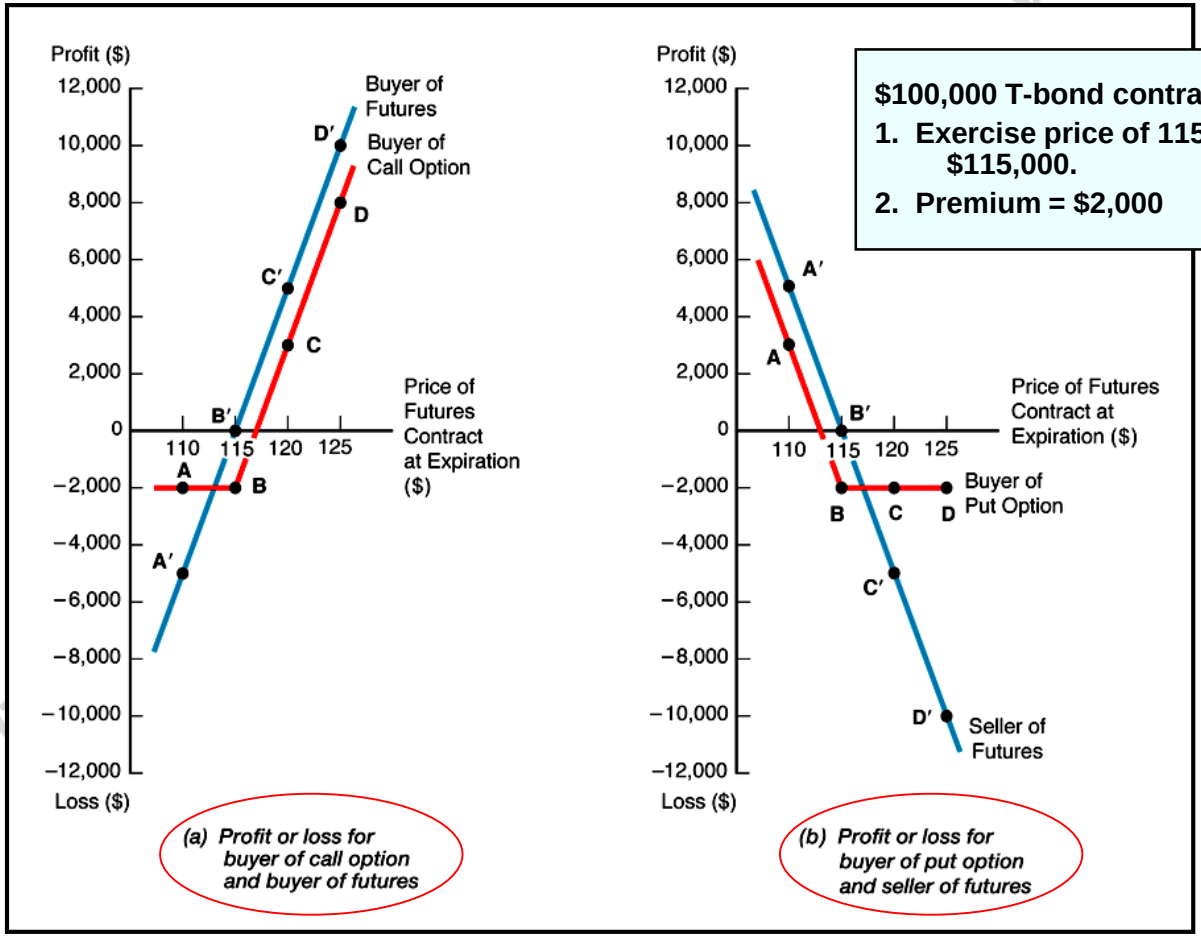
Long Call

- A bullish opinion
- Premium paid in exchange for receipt of potential upside in the market
- *Long* refers to a person's position as the **holder of an option**

Short Call

- A bearish position
- *Short* refers to a person's position as the **writer of an option**

Options vs Futures



Strategic Use of Options

Key Features

- The option can be exercised at the ***strike price***
- The day on which an option can be exercised, or *offset*, is the ***expiration date***
- The ***premium*** is the means by which the buyer compensates the writer for his or her willingness to grant the option and assume the associated risk
  - *Premium* also serves as the payment securing the buyer's claim to the contract
  - There are no margin payments, and the premium paid for the option is the maximum loss to the option holder
- An option is ***exercised*** at the sole discretion of its buyer
  - If an option has not been exercised prior to its expiration, it ceases to exist

Different kinds of Delivery

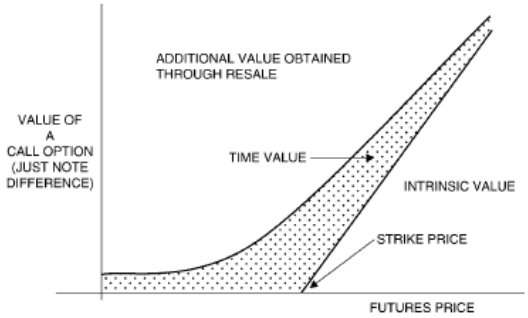
- **Cash settled** based on the difference between:
  - A determined value of the underlying interest at the time the option is exercised, and …
  - …the fixed exercise price of the option
- **Physical**

Intrinsic Value and Time Value

Intrinsic is the value of the option **if** it were to **expire immediately**

- Essentially, this is the amount the **futures price** is **higher than a call**'s exercise price **or** …
- … **lower than a put**'s exercise price

- In the money
- At-the-money
- Out of the money



Extrinsic *value* of an option is its **current price less** its **intrinsic value**

- Extrinsic value is also called ***time value*** because the time remaining for the option to make a move is key to its worth

- Time value **is a risk premium** demanded by the option writer, and it depends on
  - The relationship of the **futures price to the exercise price**,
  - The **volatility** of the futures price, and
  - The amount of **time** remaining until expiration

Styles of Options

An ***American*** *option* may be exercised by the holder at **any time** on or prior to its expiration

A ***European*** *option* may be exercised only during a **specified period before the option**

- Since European-style options may be exercised only during a limited period before expiration, other things being equal, their cost is lower

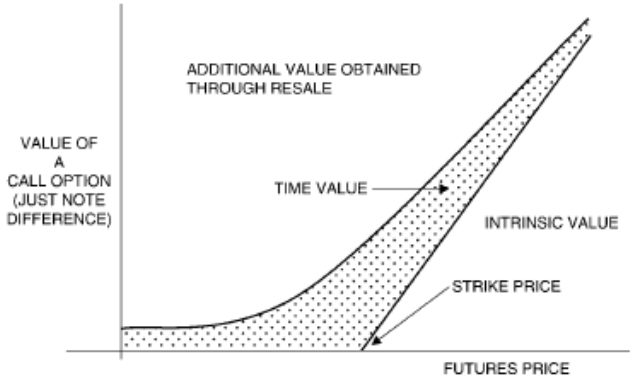
An ***Asian*** *option* (or *average value* option) is a special type of option contract

- For Asian options the payoff is determined by the **average underlying price over some pre-set period of time**
  - Such averages may be arithmetic or geometric.
- One advantage of Asian options is that these reduce the risk of market manipulation of the underlying instrument at maturity
- Another advantage of Asian options involves the relative cost of Asian options compared to European or American options
  - Because of the **averaging feature**, Asian options **reduce the volatility** inherent in the option; therefore, Asian options are **typically cheaper** than European or American options

Pricing of Options

Among key factors that generally affect the pricing of an option are the following

- Style of the option
- Depth of the market for the option
- Effect of supply and demand in the option's market and underlying
- Relationship between an option's value and exercise price
- Current values of related instruments like futures on the underlying
- Critical ratio equal to strike spot price
- Strike price of the option relative to the price of the underlying
- Days remaining before an option contract expires
- Historical volatility of the underlying



The Black-Scholes Model …

$$\text{Theoretical option price} = pN(d_1) - se^{-rt}N(d_2)$$

$$\text{where } d_1 = \frac{\ln\left(\frac{p}{s}\right) + \left(r + \frac{v^2}{2}\right)t}{v\sqrt{t}}$$

$$d_2 = d_1 - v\sqrt{t}$$

The variables are:

- p = stock price
- s = striking price
- t = time remaining until expiration, expressed as a percent of a year
- r = current risk-free interest rate
- v = volatility measured by annual standard deviation
- ln = natural logarithm
- $N(x)$ = cumulative normal density function

… embedded in the Option Calculator

Option Parameters

			Call Option	Put Option
Underlying Price	100	Theoretical Price	2.649	0.329
Exercise Price	98	Delta	0.798	-0.202
Days Until Expiration	30	Gamma	0.098	0.098
Interest Rates	5	Gamma 1%	0.01	0.01
Dividend Yield	1	Vega	0.081	0.081
Volatility	10	Theta	-0.024	-0.011
Rounding	3	Rho		
Graph Increment	1			

Calculate

http://www.option-price.com/

Excursion: Volatility

- **The standard convention is to annualize historical volatility based on 254 trading days**

Date	IBM Close	%Change
7/3/2007	111.99	
7/5/2007	110.66	-1.19
7/6/2007	107.6	-2.77
7/9/2007	109.28	1.56
7/10/2007	108.1	-1.08
7/11/2007	105.63	-2.28
7/12/2007	106.97	1.27
7/13/2007	108.03	0.99
7/16/2007	110.05	1.87
7/17/2008	107.58	-2.24
7/18/2007	104.01	-3.32

Standard Deviation	$\sqrt{254}$	Statistical Volatility
1.97	15.937	31.40%

$$\sigma = \sqrt{\frac{1}{N}\left[(x_1-\mu)^2+(x_2-\mu)^2+\cdots+(x_N-\mu)^2\right]}, \text{ where } \mu = \frac{1}{N}(x_1+\cdots+x_N),$$

Swaps

Swaps

- **A swap is an agreement between two parties to exchange a sequence of cash flows**

- **Counterparties**
- **Interest rate swaps**
- **Currency swaps**
- **Phenomenal growth of the swap market**
- **Future and Option markets only provide for short term investment horizon**
- **Traded in OTC markets with little regulations**
- **No secondary market**
- **Market limited to institutional investors**

- A Swap is a **simultaneous buying and selling** of the same security or obligation
  - Perhaps the best-known swap occurs when two parties exchange interest payments based on an identical principal amount, called the "notional principal amount."

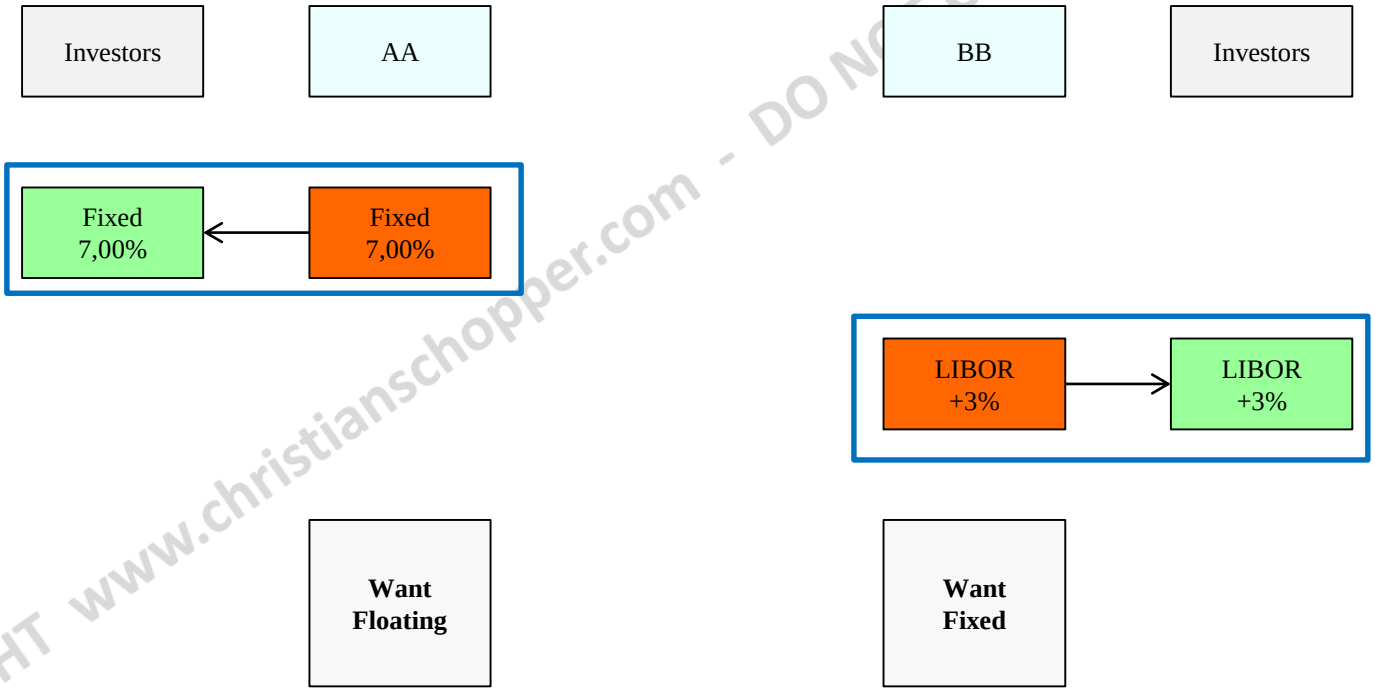
- **Advantages** of swaps
  - Reduce risk, no change in balance-sheet
  - **Longer term** than futures or options

- **Disadvantages** of swaps
  - Lack of **liquidity**
  - Subject to **default** risk
  - … with financial **intermediaries** help reduce disadvantages of swaps …

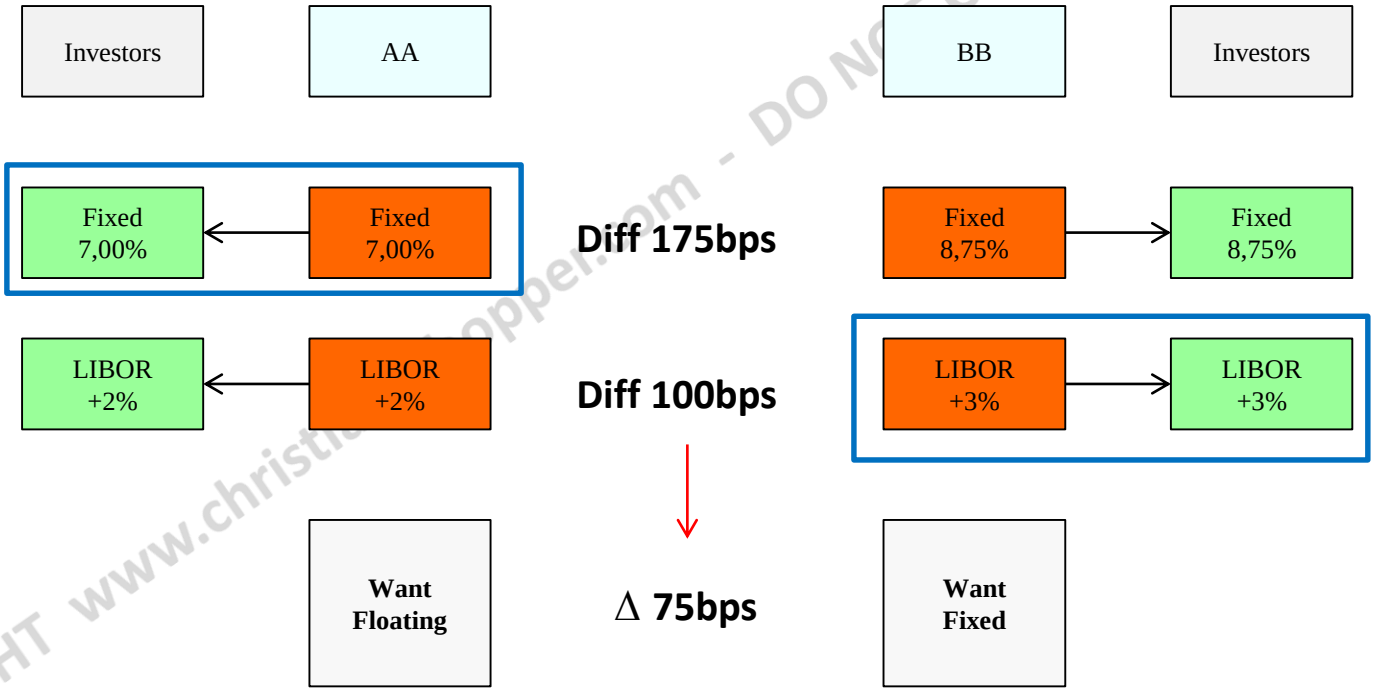
Rationale of Interest Rate Swaps

- Interest rate swaps occur generally in three **scenarios**
  - Fixed rate for a floating rate
  - Floating rate for a fixed rate
  - Floating rate for a floating rate

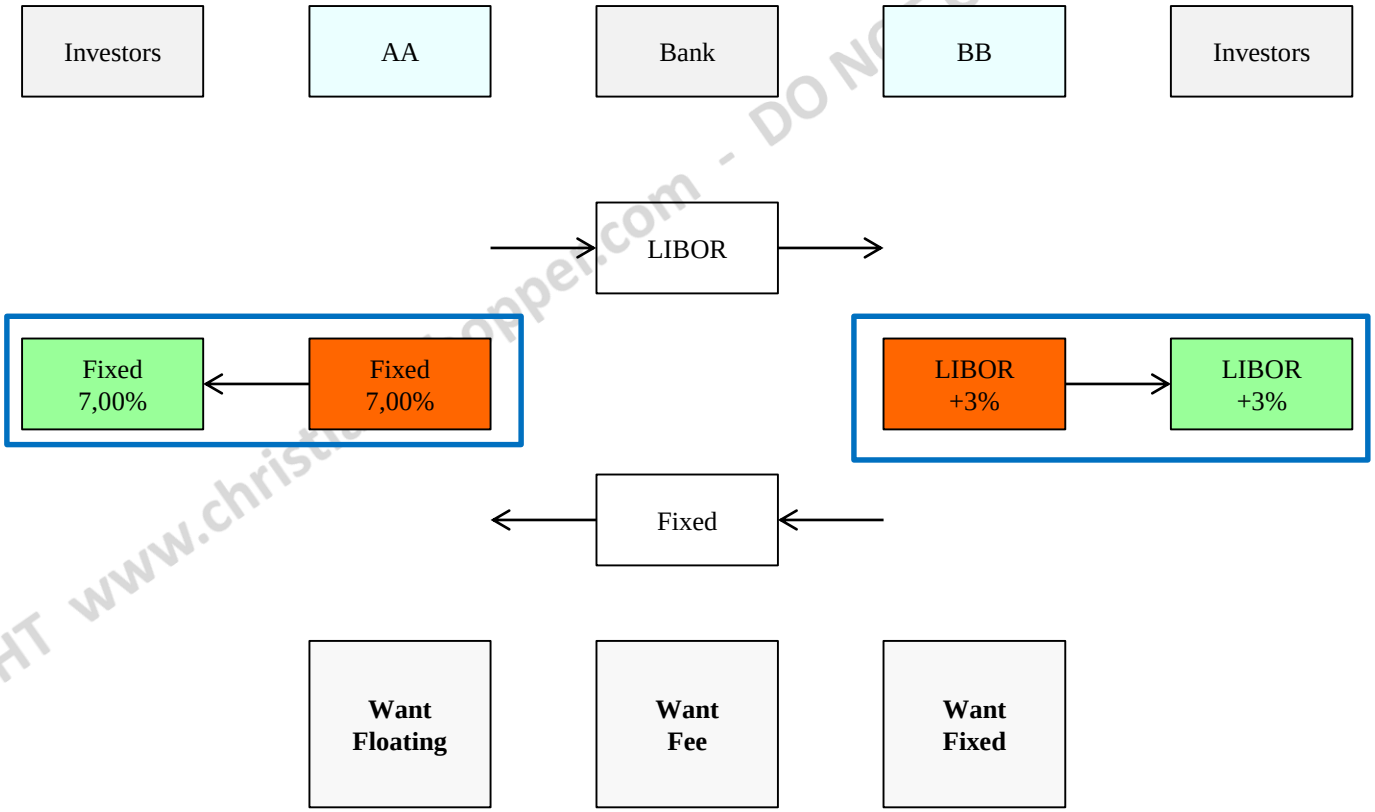
Swap – Example 1



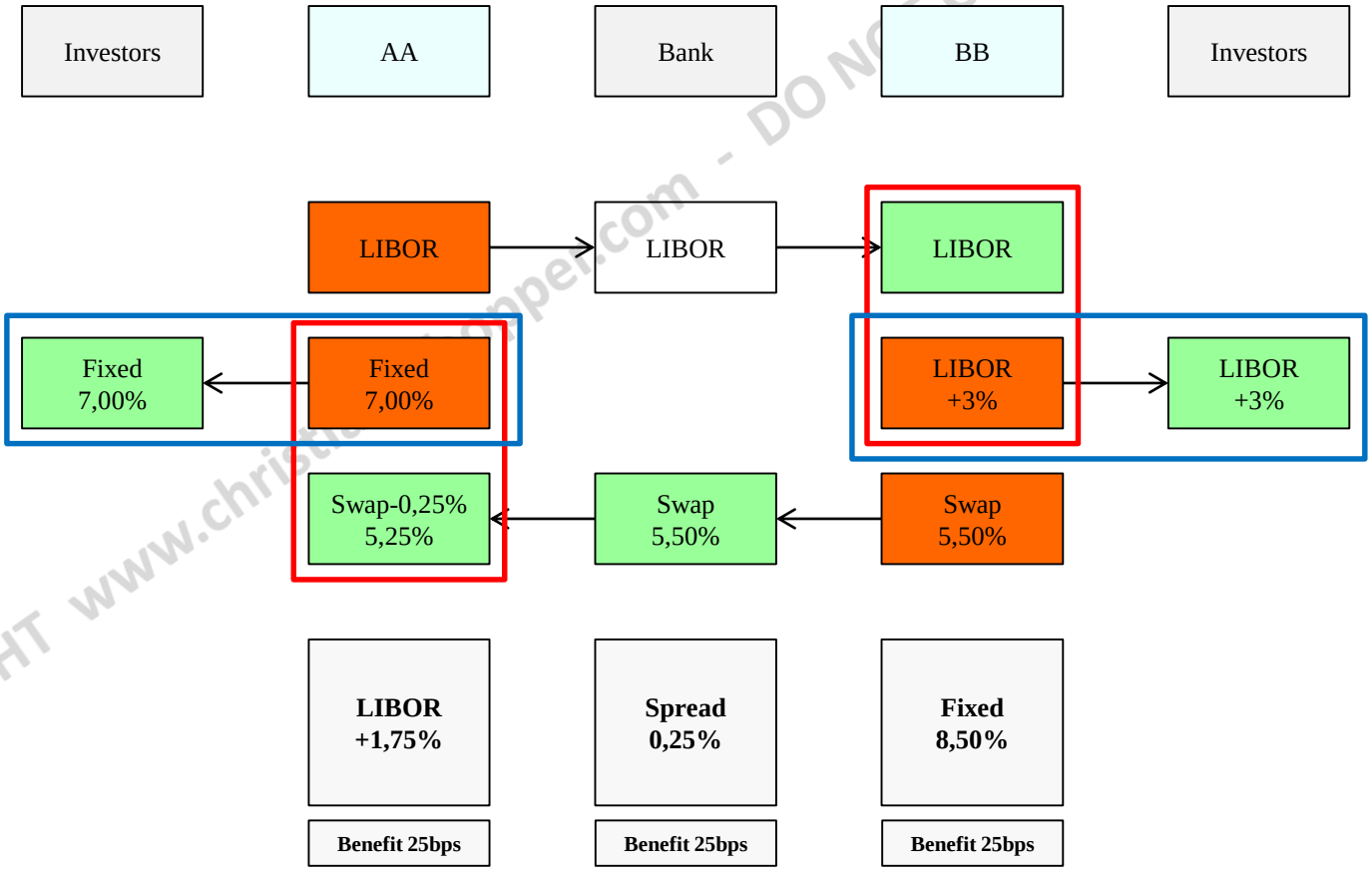
Swap – Example 1 (cont´d)



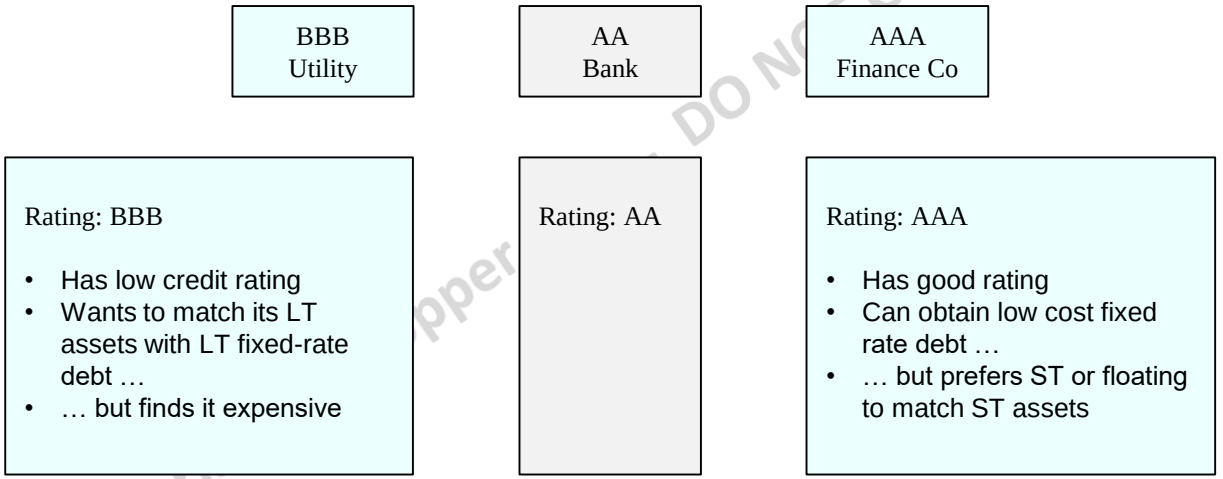
Swap – Example 1 (cont´d)



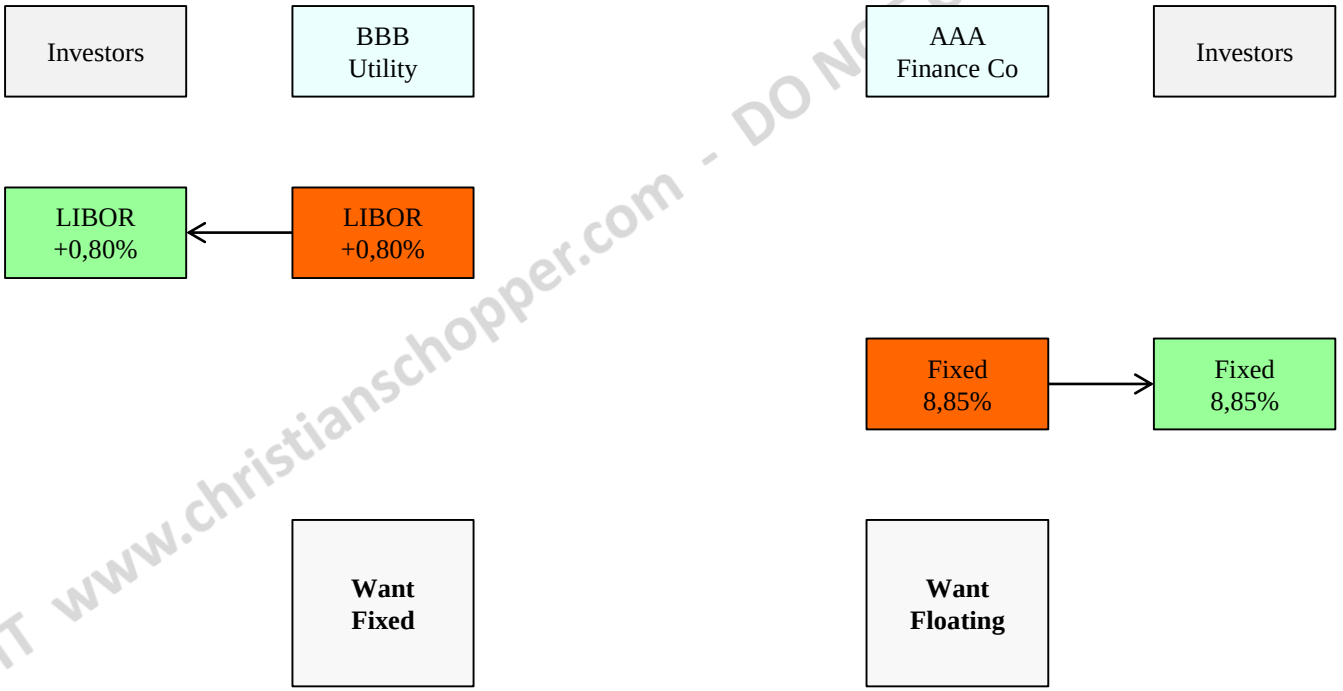
Swap – Example 1 (cont´d)



Swap – Example 2

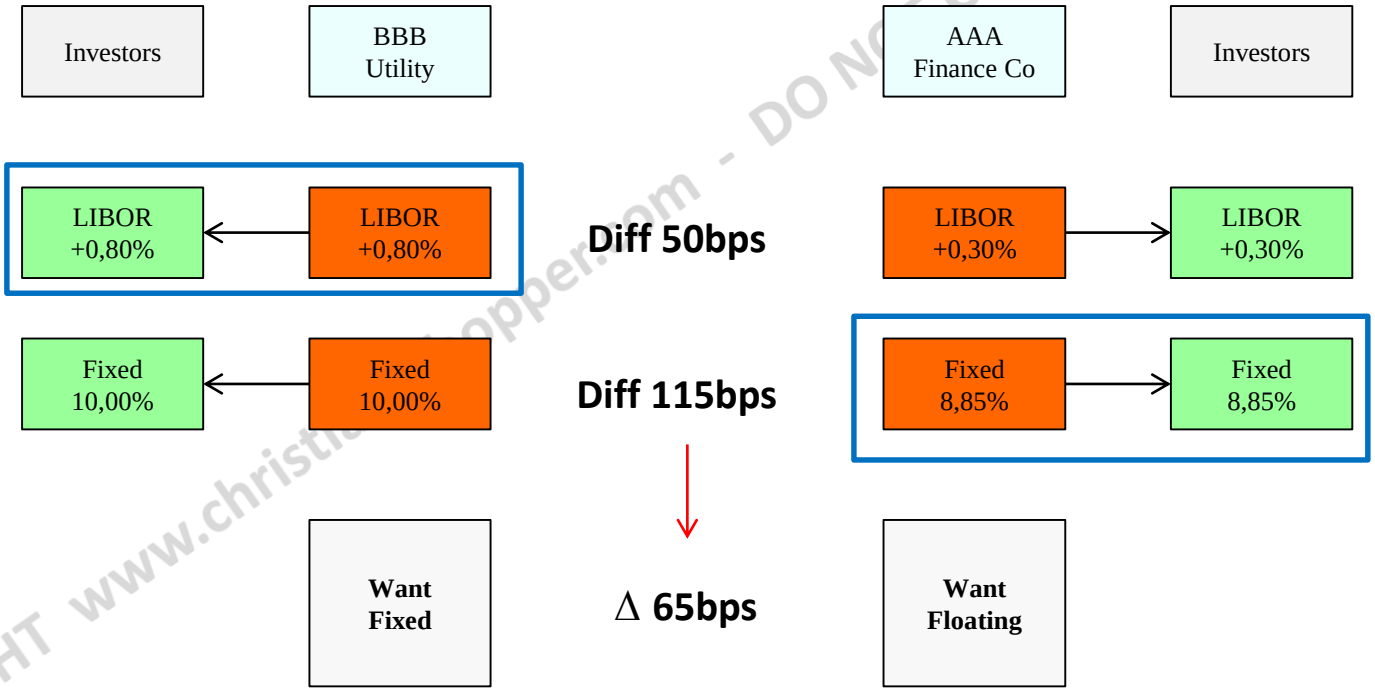


Swap – Example 2 (cont´d)

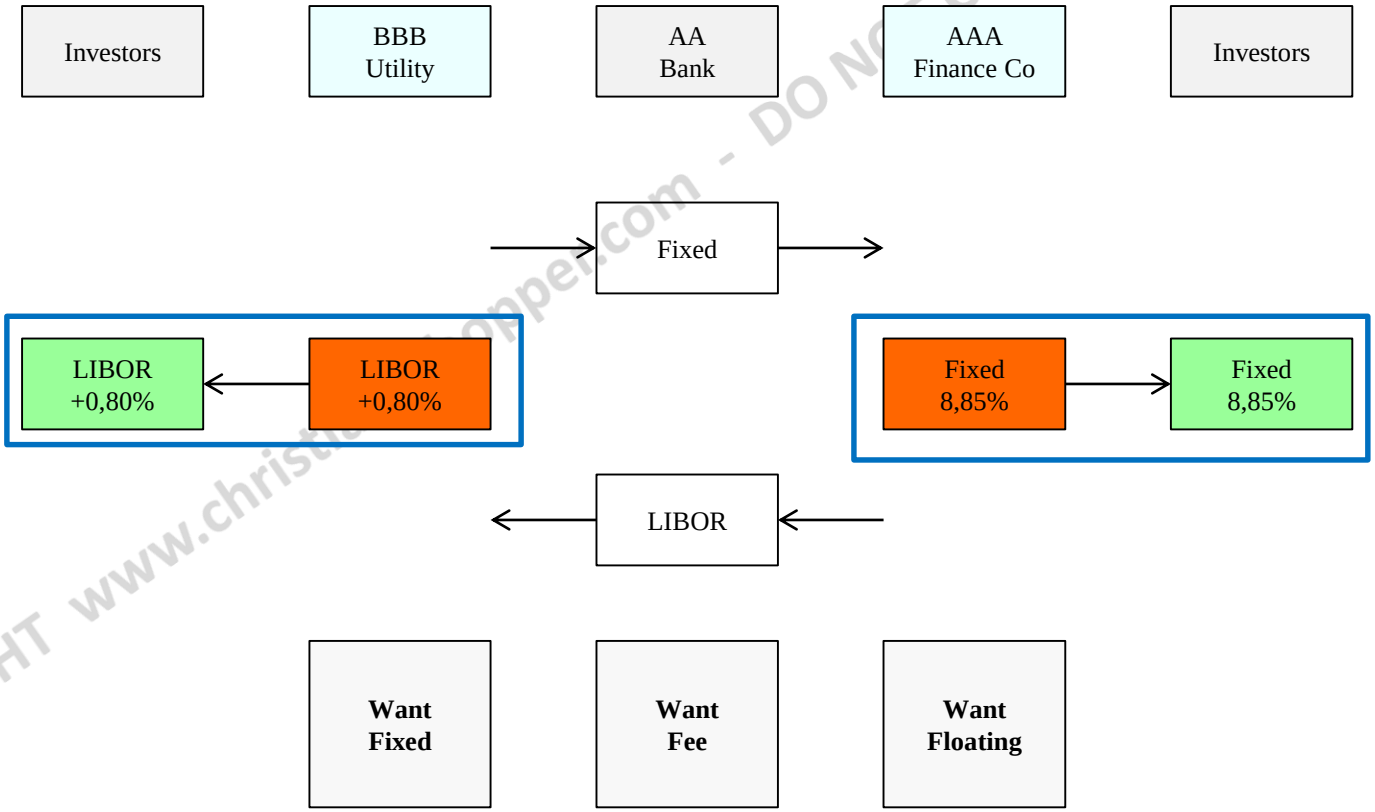


Swap – Example 2 (cont´d)

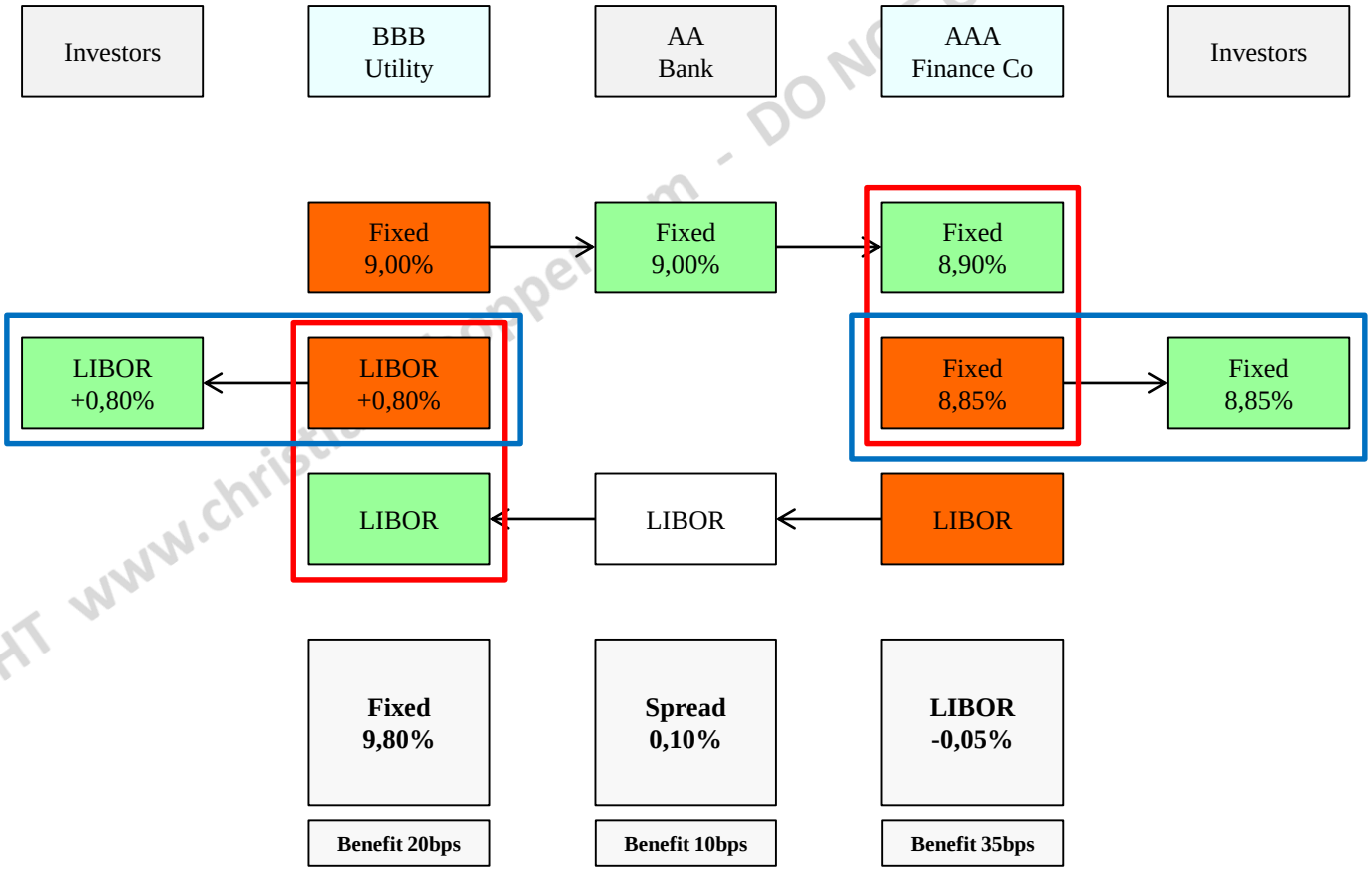
- The finance co. enjoys a lower borrowing cost in <u>both</u> markets
- But, the public utility faces <u>relatively</u> lower costs in floating rate market.
- It has a <u>comparative</u> advantage of 65 bps (115 - 50)
- This 65 bps comparative Advantage is the amount of potential savings from the swap



Swap – Example 2 (cont´d)



Swap – Example 2 (cont´d)



Swap – Example 2 (cont´d)

- Total potential **savings** from swap 65bps

- The bank takes 10bps spread as **compensation** for the swap

- The parties have **not exchanged obligations to make principal payments**, …
- … **only** to make each other's **interest payments**

- Hedges may not be perfect
- This is a simple example to display the mechanics of a swap …
- … and it does not go into risks, and **exposures** to the parties involved
- **Interest rate movements** and **credit risks** are also very important

Terms of Interest Rate Swaps

"Plain vanilla" interest rate swap

- An exchange of interest payments, where one party has fixed interest payments and the other party has variable interest payments
- **No actual transfer of principal**, only interest payments on debt contracts
- Useful in managing interest rate gap problems in banks and nonbank firms

Three types of interest rate swaps:

- Coupon swaps
  - Fixed and floating coupon payments
- Basis swaps
  - Two different floating rates of interest
- Cross-currency swaps (or currency swaps)
  - Swaps involving three counterparties with different currencies on fixed and floating rate debts.
  - A *plain deal* currency swap involves equal interest payments but different currencies

Credit Default Swaps

and Credit Risk Related Instruments

Credit Default Swap

Credit default swaps began as instruments for managing credit risk

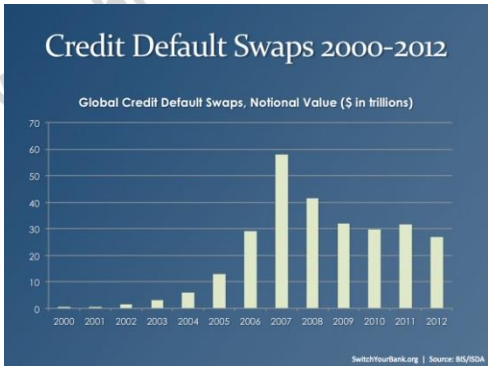
- A single-name CDS is a mutual agreement whereby the **protection buyer** (the credit risk seller), **pays** a **one-time premium to** the **protection seller** (the credit risk buyer)
- If a **credit event** occurs in the reference entity, the protection seller makes periodic **payments** in exchange for all or part of the loss
  - Therefore, a **credit event** plays an important role in the CDS agreement …

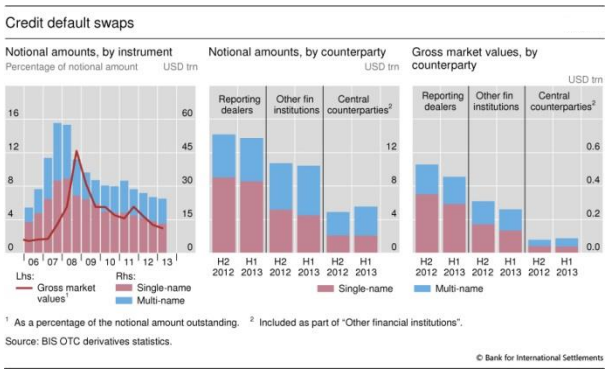
- If an agreed upon credit event such as bankruptcy or default occurs, the protection seller must **compensate** for the **value of the lost reference asset**
  - This can be achieved through the payment of **cash** (i.e., cash settlement), or by purchasing the reference asset at face value, despite the applicable reference asset's decline in value (i.e., physical settlement)

- **Premiums** are **determined** by factors such as the reference entity, the protection seller's **credit risk**, the expected "**recovery rate**" of the principal if a credit event occurs, and conditions in the **financial markets**
  - The protection seller's credit risk refers to the concern that the agreement will not be performed because of bankruptcy or other event
  - This is often referred to as the counterparty risk

Credit Default Swap vs Insurance

- CDS contracts have obvious similarities with insurance, because the buyer pays a premium and, in return, receives a sum of money if an adverse event occurs
- However, the most important difference is that an **insurance contract** provides an indemnity against the **losses *actually suffered*** by the policy holder on an asset in which it holds an insurable interest
  - By **contrast** a **CDS** provides an **equal payout to all holders, calculated using an agreed, market-wide method**
  - The holder does not need to own the underlying security and does not even have to suffer a loss from the default event
- The CDS can therefore be used to **speculate** on debt objects



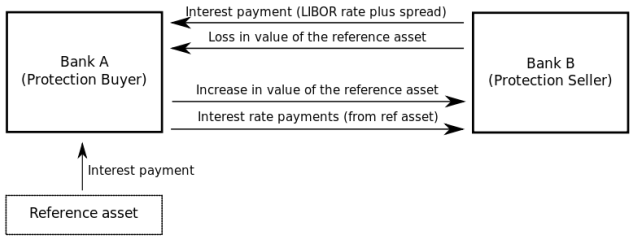


Total Return Swap

- One party makes **payments based on a set rate**, either fixed or variable, …
- … while the other party makes **payments based on the return of an underlying asset**, which includes both the **income** it generates **and** any **capital gains**
  - In total return swaps, the underlying asset, referred to as the reference asset, is usually an **equity index, loans, or bonds**
  - This is owned by the party receiving the set rate payment

- Total return swaps allow the party **receiving the total return** to gain exposure and benefit **from a reference asset without actually having to own it**
  - These swaps are **popular with hedge funds** because they get the benefit of a **large exposure with a minimal cash outlay**

- Therefore, in comparison to a Credit Default Swap market risk - the **price risk of the reference asset** - is **also taken on** in addition to credit risk



Credit Linked Notes

- A Credit Linked Note (CLN) is a form of funded credit derivative. It is structured as a **security with an embedded credit default swap** allowing the issuer to transfer a specific credit risk to credit investors
  - The **issuer is not obligated to repay the debt if** a **specified event** occurs
  - This **eliminates** a third-party **insurance provider**
  - Interest rate is above-market

If no event

- Issuer repays investor scheduled principal + interest (no need for protection any more)

If credit event

- Issuer can withhold interest and if necessary part of principal

- It is issued by a special purpose company or trust, designed to offer investors par value at maturity unless the referenced entity defaults
  - In the case of default, the investors receive a recovery rate

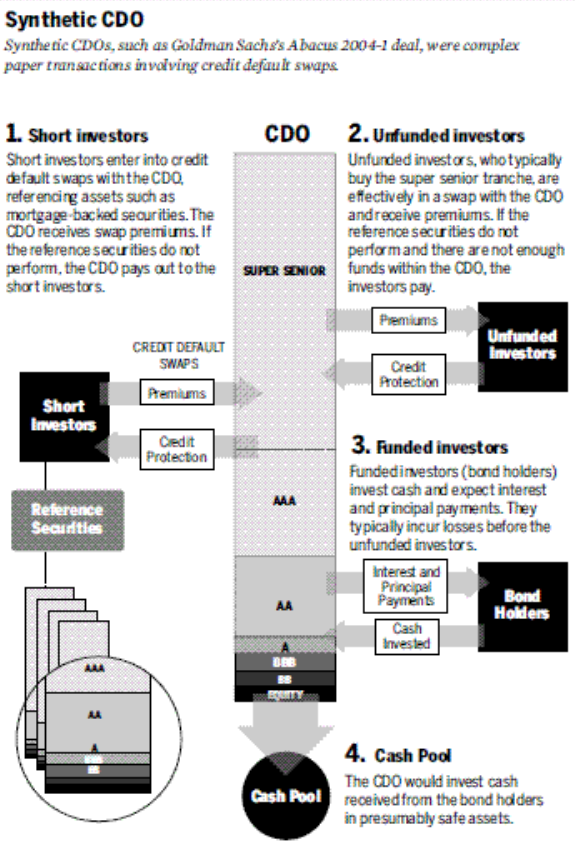
Other Swaps

- Basket Default Sawp
  - Unlike single-name CDS's, the Basket Default Swap is **a form of CDS that creates a pool of many reference assets**
  - According to the likely order in which credit events will occur, these risks are classified into categories such as "first-to-default basket" swaps, "second-to-default basket" swaps, and so on
  - It differs from a CDS, however, in the sense that there is not only one reference entity that issues the reference asset, but rather may include five, ten, twenty or more reference entities

- Portfolio Default Swap
  - The Portfolio Default Swap is a structured financial product **similar to the BDS**
  - The number of institutions that issue reference assets is considerably higher (between forty and one hundred), and the limit for the compensation is not based on the order in which the credit events occur

Synthetic Collateralized Debt Obligation

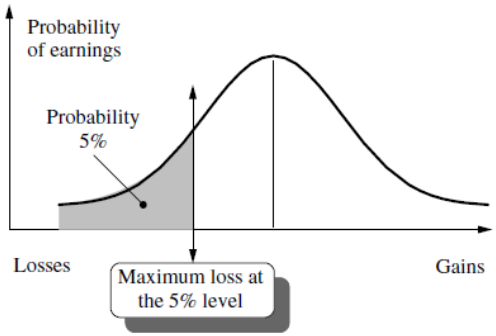
- A Synthetic Collateralized Debt Obligation is a structured financial product which generates cash flow
- It is **similar to the traditional cash CDO** because it uses the transaction of a credit derivative - such as a credit swap - to transfer the credit risk inherent in reference assets - such as a majority of the loan obligations and regular corporate bonds - to the separately established SPV
- The value and **payment stream** of a synthetic CDO is derived **not from cash assets**, like mortgages or credit card payments — as in the case of a regular or "cash" CDO — **but** from **premiums paying for credit default swap "insurance" on the possibility** that some defined set of "**reference**" securities — based on cash assets — will **default**



Value at Risk

The VaR Question

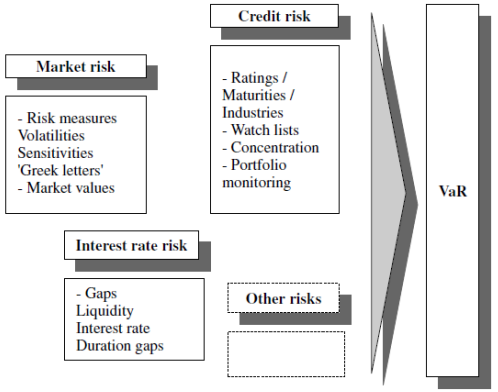
- **Volatility** does **not care about the direction** of an investment's movement …
- … whereby **VaR** focuses on the odds of **losing money**



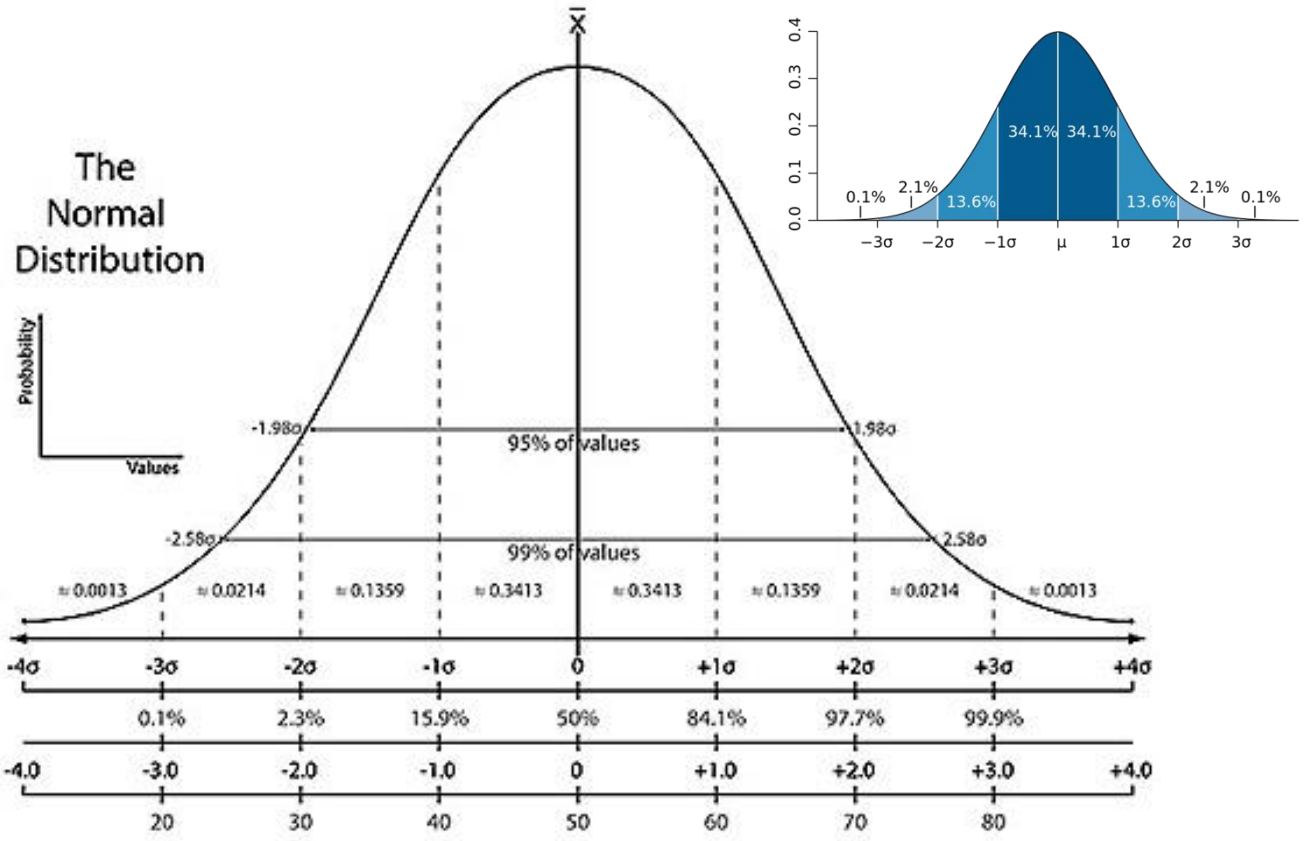
"What **loss level** is such …
… that we are *X*% **confident** …
… it will **not** be **exceeded** …
… in *N* business days?"

Simplified: "**How bad can things get**?"

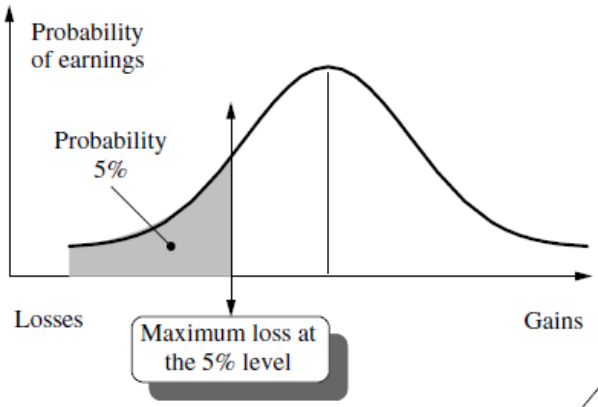
- It captures an important aspect of risk in a **single number**
- It is **easy** to understand
- It can be **applied to both, loan as well as securities portfolios**

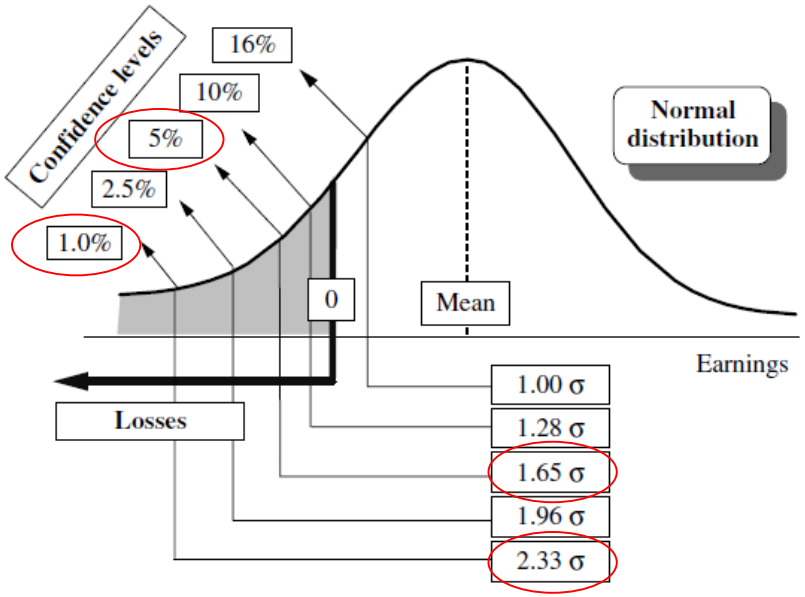


The Normal Distribution



Confidence Levels and Normal Distribution





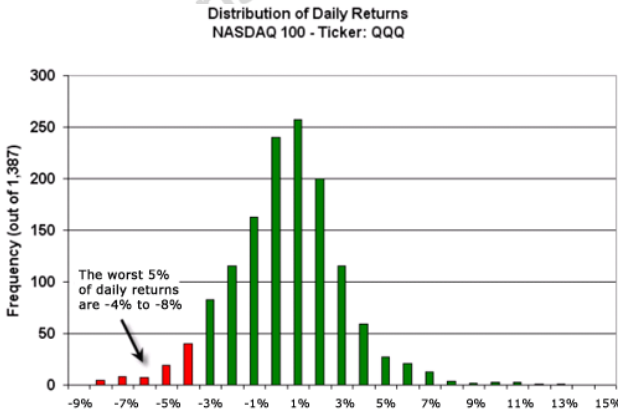
VaR Approach in Measuring Volatility

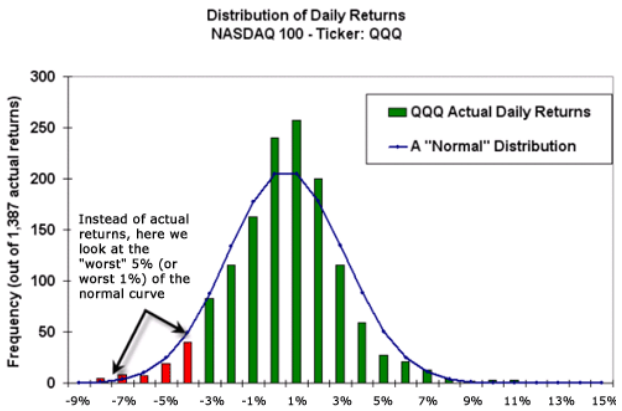
Historical Simulation

- Create a database of the **daily movements** in **all market variables**
  - The historical method **simply re-organizes actual historical returns**, putting them in order from worst to best
  - It then assumes that history will repeat itself, from a risk perspective

Model Building Approach

- **Assuming** that stock returns are **normally distributed**, expected return and a standard deviation are estimated
  - … also called the **variance-covariance approach**
- Advantage: Knowing the σ we know where the worst 5% and 1% lie on the curve



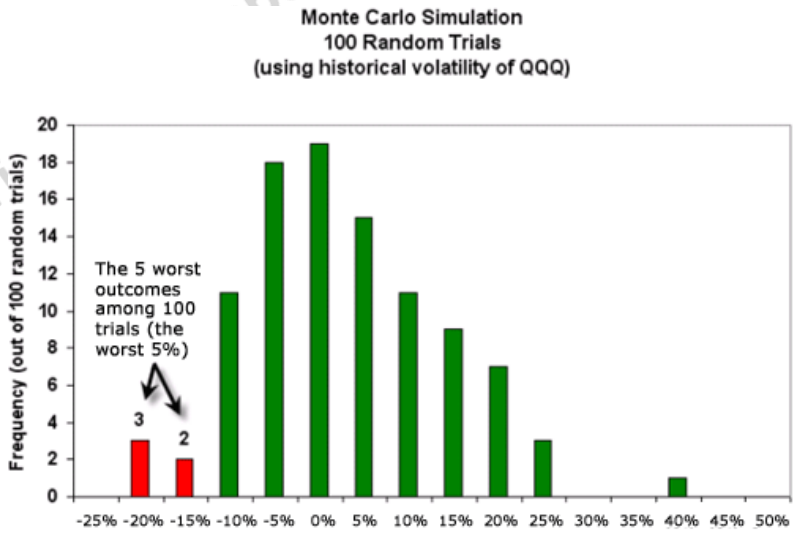


VaR Approach in Measuring Volatility (cont´d)

- **Note: While the previous graphs have shown daily returns, this graph displays monthly returns**

Monte Carlo Simulation

- Involves developing a **model for future stock price returns and running multiple hypothetical trials** through the model
  - A Monte Carlo simulation refers to any method that randomly generates trials, but by itself does not tell us anything about the underlying methodology
  - For most users, a Monte Carlo simulation amounts to a "black box" generator of random outcomes …



VaR and Time Horizon

VaR and Regulatory Capital

- In principle, also regulators base the capital they require banks to keep on VaR, foremost though on risk clusters

- Regulators require calculating the 10-day, 99% VaR …
- … whilst analysts usually calculate a 1-day 99% VaR

- Switch from a 10-day, 99% VaR ⟶ to a 1-day 99% VaR

$$10\text{-day VaR} = \sqrt{10} \times 1\text{-day VaR}$$

- This is exactly true when **portfolio changes** on successive days come from **independent identically distributed normal distributions**

Example: Microsoft / 10-day 99% VaR

- We have a position worth **$10m in Microsoft shares**
- Question: **What is the VaR with a 99% confidence level over a period of 10 days?**

- The **volatility** of a Microsoft share is **2% per day**
  - In **option pricing** we measure volatility "per year"
  - In **VaR** calculations we measure volatility "per day"

$$\sigma_{day} = \frac{\sigma_{year}}{\sqrt{252}}$$

→ Microsoft´s volatility equals about 6.3% over 10 days or 31.7% per year

- Hence, the standard deviation of the change in the $10m Microsoft position with a daily 2% volatility is $200,000

→ The standard deviation of the change of the position in 10 days is

$$200{,}000\sqrt{10} = \$632{,}456$$

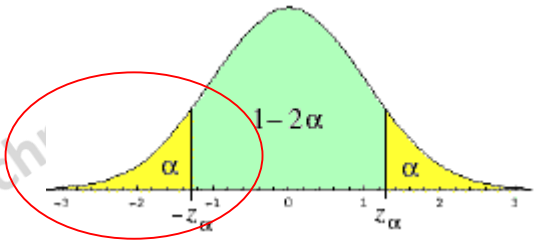
Example: Microsoft / 10-day 99% VaR

- For the calculation of a 10-day 99% VaR we use a **confidence level of 99%** (X=99)
- **Assumptions**:

  Expected **change in the value** of the portfolio is **zero** and …

  This is a fair assumption for short time periods

  … change in the value of the portfolio is **normally distributed**
- In the VaR calculation we are **only interested in the loss**, so on **one side of the tail**



α = tail area	central area = 1 − 2α	z_α
0.10	0.80	$z_{.10}$ = **1.28**
0.05	0.90	$z_{.05}$ = **1.645**
0.025	0.95	$z_{.025}$ = **1.96**
0.01	0.98	$z_{.01}$ = **2.33**
0.005	0.99	$z_{.005}$ = **2.58**

- Since N(–2.33) = 0.01, the 10-day 99% VaR is

$$2.33 \times 632{,}456 = \$1{,}473{,}621$$

Example: AT&T / 10-day 99% VaR

- We have a position worth **$5m in AT&T shares**
- Question: **What is the VaR with a 99% confidence level over a period of 10 days?**

- The **volatility** of an AT&T share is **1% per day**
  → hence approximately 3.2% over 10 days or 15.9% per year

- The standard deviation of the change in the $5m AT&T position with a daily 1% volatility over a 10-day period is $158,144

$$50{,}000\sqrt{10} = \$158{,}144$$

- The 10-day 99% VaR is

$$158{,}114 \times 2.33 = \$368{,}405$$

Example: Portfolio of Microsoft and AT&T / 10-day 99% VaR

- Now consider a **portfolio consisting of $10m Microsoft and $5m AT&T shares**
- Suppose that the **correlation between the returns is 0.3**
- The standard deviation of a portfolio of 2 stock is defined as:

$$\sigma_{X+Y} = \sqrt{\sigma_X^2 + \sigma_Y^2 + 2\rho\sigma_X\sigma_Y}$$

- In this Microsoft / AT&T portfolio case
  - σ X = 200,000
  - σ Y = 50,000
  - r = 0.3
- The standard deviation of the change in the portfolio value in one day is therefore $220,227
- The 10-day 99% VaR for the Microsoft / AT&T portfolio is

$$220{,}227 \times \sqrt{10} \times 2.33 = \$1{,}622{,}657$$

- The **benefits of diversification** are (1,473,621+368,405) –1,622,657 = $219,369
- Therefore, there is an incremental effect of holding AT&T additionally on VaR

Structured Notes

Structured Notes

- Structured Notes are debt instruments where the **principal and/or the interest rate is indexed to an unrelated indicator**
- A bond whose interest rate is decided by interest rates in England or the price of a barrel of **crude oil** would be a Structured Note
- Sometimes the two elements of a Structured Note are inversely related, so as the index goes up, the rate of payment (the "coupon rate") goes down
  - This instrument is known as an "**Inverse Floater**"
- With **leveraging**, Structured Notes may fluctuate to a greater degree than the underlying index
- Therefore, Structured Notes can be an extremely volatile derivative with high risk potential and a need for close monitoring
- Structured Notes generally are traded **OTC**

Structured Notes (cont´d)

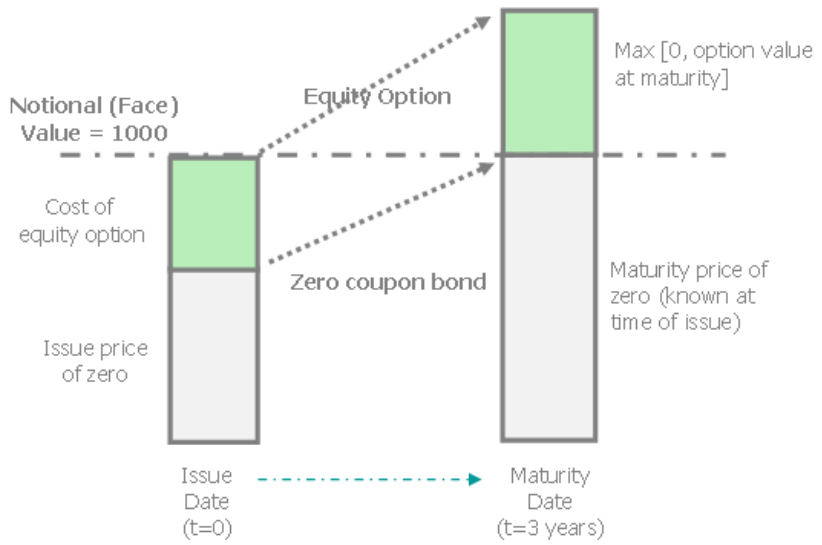
What Are Structured Products?

- Designed to facilitate highly customized risk-return objectives
- Accomplished by taking a traditional security - such as a conventional investment-grade bond - and replacing the usual payment features (e.g. periodic coupons and final principal) with non-traditional payoffs
  - These are derived not from the issuer's own cash flow, but from the performance of one or more underlying assets
- If the underlying assets return "x," then the structured product pays out "y"
  - This means that structured products closely relate to traditional models of option pricing …
  - … though they may also contain other derivative types such as swaps, forwards and futures
- Structured products originally became popular in Europe and have gained currency in the U.S., where they are frequently offered as SEC-registered products, which means they are accessible to retail investors in the same way as stocks, bonds, exchange traded funds (ETFs) and mutual funds
  - Their ability to offer customized exposure, including to otherwise hard-to-reach asset classes and subclasses, makes structured products useful as a complement to these other traditional components of diversified portfolios

Structured Notes (cont´d)

Example – Principal Protection

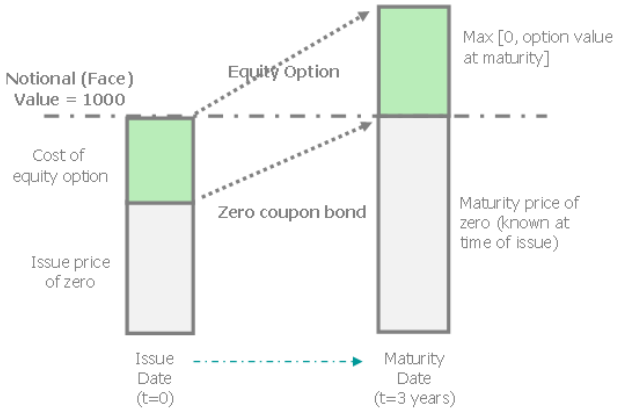
- Structured Notes, each with a notional face value of $1,000
- Each note is a package consisting of a zero-coupon bond and a call option on an underlying equity instrument, such as a common stock
- Maturity is in three years



Structured Notes (cont´d)

Example – Principal Protection (cont´d)

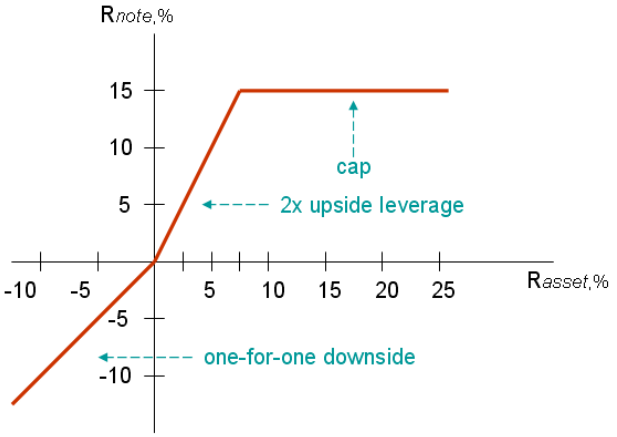
- Although the pricing is complex, the principle is fairly simple
- On the issue date pay the face amount of $1,000
  - This note is fully principal-protected, meaning that you will get your $1,000 back at maturity no matter what happens to the underlying asset
  - This is accomplished via the zero-coupon bond accreting from its original issue discount to face value.
- For the performance component, the underlying asset, priced as a European call option, will have intrinsic value at maturity if its value on that date is higher than its value when issued
  - If not, the option expires worthless and only the $1,000 principal is returned



Structured Notes (cont´d)

Example – Custom Sizing

- An investor is willing to trade off some or all of this protection in favor of more attractive performance features
- If the return on the underlying asset (**R *asset***) is positive - between zero and 7.5% - the investor will earn double the return (e.g. 15% if the asset returns 7.5%)
- If **R *asset*** is greater than 7.5%, the investor's return will be capped at 15%
- If the asset's return is negative, the investor participates one-for-one on the downside (i.e. no negative leverage)
- There is no principal protection



Structured Notes (cont´d)

Risks and Considerations

- Relative lack of liquidity due to the highly customized nature of the investment
- The full extent of returns from the complex performance features is often not realized until maturity
  - Because of this, structured products tend to be more of a buy-and-hold investment decision
- A significant innovation to improve liquidity in certain types of structured products comes in the form of exchange-traded notes (ETNs)
  - These are structured to resemble ETFs, which are fungible instruments traded like regular common stock on a securities exchange
  - ETNs are different from ETFs, however, as they consist of a debt instrument with cash flows derived from the performance of an underlying asset - in other words, a structured product. ETNs can provide access to hard-to-reach exposures, such as commodity futures and the Indian stock market
- Structured products are associated with the issuer's credit quality
  - Although the cash flows are derived from other sources, the products themselves are legally considered to be the issuing financial institution's liabilities
- Another consideration is pricing transparency
  - There is no uniform standard for pricing

General Observations

Risks Linked to Derivatives

The Federal Reserve, Comptroller of the Currency, and FDIC have cited seven key categories of risk associated with derivatives.

- **Counterparty credit risk** is the risk that a counterparty in a financial transaction will default, resulting in a financial loss to the other party
  - Credit exposure is not measured by the notational amount of the contract but by the cost of replacing its cash flows in the market. In an interest rate swap, for example, the present value of expected cash flows on the underlying instruments would need to be calculated

- **Price, or market, risk** is the risk that the market price of the derivative security will change
  - This risk is closely related to the price risk of the underlying instrument
  - Most banks break overall price risk into components, including interest rate risk, exchange rate risk, commodity price risk, and others

- **Settlement risk** occurs when one party in a financial transaction pays out funds to the other party before it receives its own cash or assets
  - Thus, settlement risk is linked to credit risk

- **Liquidity risk** is the risk that a counterparty will default and a liquidity shortfall will occur due to losses

Risks Linked to Derivatives (cont´d)

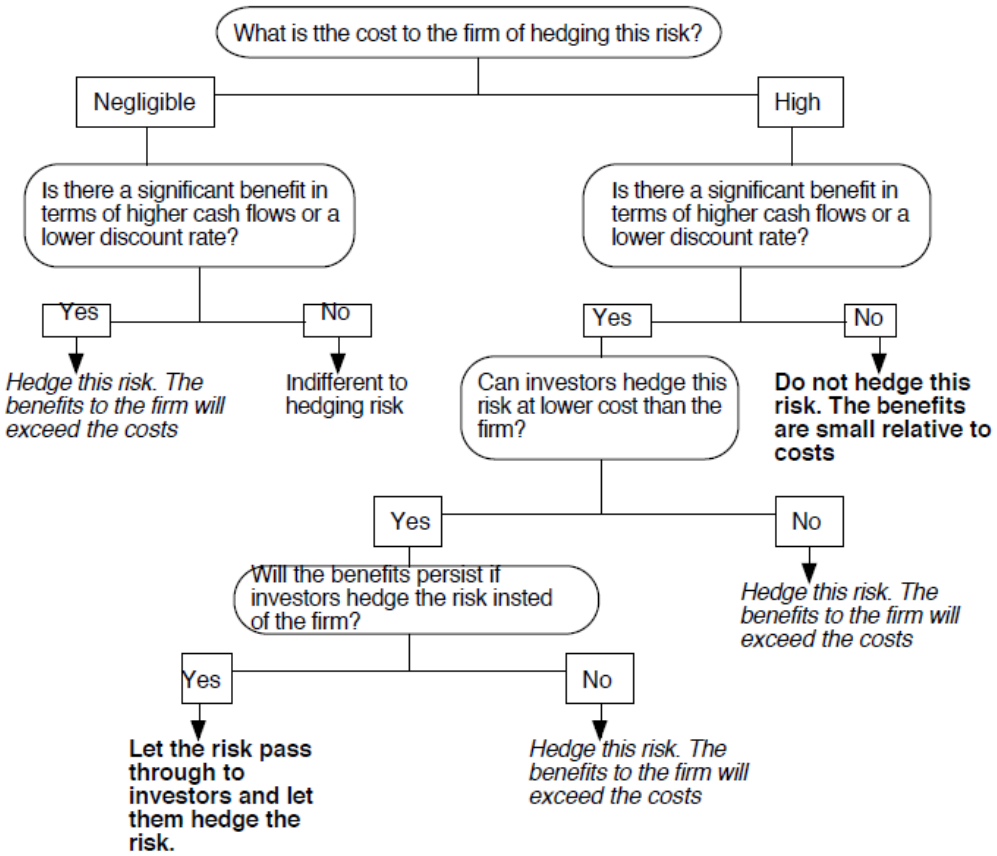
- **Operating risk** due to:
  - *Inadequate internal controls*
    - The complexity of some derivatives, human error, and fraud are all sources of risk that demand internal monitoring and control by management
  - *Valuation risk*
    - The valuation of many derivatives rely on fairly sophisticated mathematical models that are highly dependent on assumptions about market conditions, which together can make valuation a difficult task
  - *Regulatory risk*
    - Regulators are scrutinizing OTC derivatives due to their explosive growth, and this attention could draw changes in accounting procedures, capital adequacy, restrictions on activities, and other banking practices

- **Legal risk**
  - As the OTC market for derivatives is private in nature, fast developing, and innovative in security design, all of which means that disputes within this new market will require a period of legal cases to clearly establish the rights and obligations of all participants
  - The International Swap Dealers Association has established some rules in cooperation with most large industrialized countries, but the differences in national bankruptcy laws raises legal concerns about the risks in international deals.

- **Aggregation risk**
  - Complex interconnections that can occur in derivatives deals which involve a number of markets and instruments

Managing Derivates Risk

To Hedge or Not to Hedge ...



Managing Derivates Risk

Before considering a derivative transaction:

1. FORECAST:

- Have a view on the markets
- Build a credible scenario.
- Compare it with market consensus

2. ANALYSE:

- Work out your cash flows and your risks under various scenarios
- Determine your target cash flows if you are right and how much you are
- willing to lose if you are wrong

Managing Derivates Risk (cont´d)

Reviewing the derivative transaction:

3. REPLICATE:

- Reverse engineer the transaction by decomposing it into its basic building blocks
- De-leverage it if necessary
- Understand its implied trading strategy.
- Understand which variables have the greatest impact on the value of the transaction

4. SIMULATE:

- Compute the transaction's break-even and its evolution with the passage of time and under different scenarios
- Compute the leverage over time and under changing scenarios

5. SCALE:

- Determine the optimal size and leverage of the transaction

6. COMMIT:

- Tie your dealer down to a maximum bid/ask spread, quote frequency and dealing size
- What does his price represent – a dealing price or a theoretical mid-market valuation
- Check his pricing methodology, his credit standing and check price with other market makers

Managing Derivates Risk (cont´d)

Approving the derivative transaction:

7. AUTHORISE:

- Who can commit the firm to a transaction, what and how much can he commit to, and with whom
- Under what conditions can he commit the firm to a transaction especially new structures with which the firm is not familiar

8. LIMIT:

- Determine the acceptable overall risk profiles over time
- For markets risk, this includes risk limits for the “Option Greeks” i.e. separate limits for delta, Gamma Vega
- For credit risk, there should be counterparty and concentration limits, collateral triggers and other sorts of credit enhancements in place

9. ESTABLISH:

- Ensure that the appropriate systems, procedures, accounting, documentation and people are in place and able to keep abreast with the changing dynamics of a derivative transaction

Managing Derivates Risk (cont´d)

Entering into the derivative transaction:

10. MONITOR:

- Set individual adjustment points in advance: for e.g. stop-loss limits or profit lock-ins which trigger an automatic close out of a transaction once they are breached
- Establish procedures and the people who have authority to override these automatic close-out triggers

How Do We Protect Ourselves?

- A common sense approach is to adopt the KISS principle: Keep it Short and Simple
  - If a transaction requires the use of complex formulas, stay away from it
  - The complex maths is there only to confuse the buyer
  - The best solutions can be explained in the simplest of words
- Invest in tools to price structured products if you buy them
- Invest in training the board members and the finance team in understanding derivatives
- When in doubt – either call for reinforcements – use the experts
- And still not clear – walk away

And finally investors (and directors too!) need to ask a few questions:

- Do these transactions help the firm reach its return goals?
- Do these transactions add to the total portfolio risk?
- Is the firm using derivatives to help create a better portfolio, or to concentrate risks because of institutional constraints?
- Does the manager using these techniques, have respect for their power?
- Does the manager use derivatives prudently?

Off Balance Sheet Structures

Off-Balance Sheet Activities

Derivatives

- Currency and interest rate swaps
- Over-the-counter options, futures, and forwards
- Other off-balance sheet activities
- U.S. banks and international expansion

Financial guarantees

- Standby letters of credit
- Bank loan commitments
- Note issuance facilities

- Financial Guarantee: The bank stands behind an obligation of a third party
  - A loan guarantee is a common example

Off-Balance Sheet Activities

- Market risk
  - Wild gyrations in interest rates in the 1980s
  - Turmoil in emerging markets in the 1990s
  - Periodic volatility in global financial markets

- Off-balance sheet activities to deal with market risk
  - Commitments based on a contingent claim -- an obligation by a bank to provide funds (lend funds or buy securities) if a contingency is realized
  - Two broad categories: financial guarantees and derivative instruments
  - Transforming deposit/lending institutions into risk management institutions
  - Tremendous growth of off-balance sheet activities of large banks

Financial Guarantees – Standby Letter of Credit

- Standby Letters of Credit (SLC)
  - SLCs obligate the **bank to pay the beneficiary if the account party defaults** on a financial obligation or performance contract
  - Equivalent to an OTC **put option written by the bank**
    - The firm can "put" the credit obligation back to the bank
  - **Financial SLCs**: Backup lines of credit on bonds, notes, and commercial paper serve as guarantee
  - **Performance SLCs**: Completion of construction contracts guaranteed
  - SLCs are considered loans
    - They may be collateralized
  - Need to diversify, limit credit risk, and increase capital to manage risks
  - Liquidity risk (or funding risk), capital risk, interest rate risk, and legal risk are inherent in these instruments
  - Material adverse change (MAC) clause
    - Enables bank to withdraw its commitment if the risk of the SLC changes substantially

Financial Guarantees – Bank Loan Commitments

- Bank Loan Commitments
  - **Promise by a bank** to a customer to **make a future loan** under certain conditions
  - Most commercial and industrial loans are made under some form of guarantee (informal or formal)

- *Line of credit* -- Informal commitment of a bank to lend funds to a client firm

- *Revolving line of credit* -- Formal agreement by a bank to lend funds on demand to a client firm under the terms of the contract
  - MAC clauses may be used to protect the bank from changing firm risk
  - Protect firms from availability and markup (or premium) risks of credit
  - Bank is exposed to interest rate risk

- *Funding risk* -- Risk that many borrowers will take down commitments at the same time and thereby strain bank liquidity
  - Also known as quantity risk
  - Most likely to occur during periods of tight credit
  - Some commitments are irrevocable (i.e., unconditional and binding)

Financial Guarantees – Note Issuance Facilities

- Note Issuance Facilities (NIF)
  - NIFs are medium-term (2-7 years) agreements in which a **bank guarantees the sale of a firm's short-term debt securities at or below pre-determined interest rates**
  - The bank will step in a timely fashion to buy the securities of the firm
    - Other terms for similar financial guarantees are *revolving underwriting facilities* (RUFs) and *standby note issuance facilities* (SNIFs)
    - Banks that use CDs might seek a *Roly-Poly CD facility*
    - Nonbank borrowers might issue short-term debt securities called *Euronotes* (denominated in dollars but sold outside of the U.S.)
  - Contingent risks to banks here as **underwriters** (i.e., arrangers if a single bank or tender panel if a group of banks) are credit risk and funding risk.

Appendix: Exotic Option Structures

Covered Call

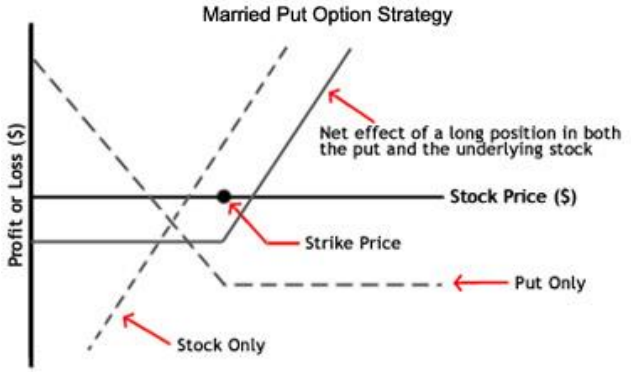
- In this strategy, you would purchase the assets outright, and simultaneously write (or sell) a call option on those same assets. Your volume of assets owned should be equivalent to the number of assets underlying the call option

- Investors will often use this position when they have a short-term position and a neutral opinion on the assets, and are looking to generate additional profits (through receipt of the call premium), or protect against a potential decline in the underlying asset's value

Married Put

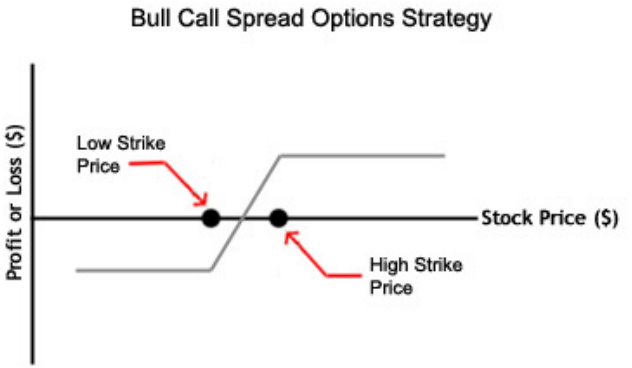
- In a married put strategy, an investor who purchases (or currently owns) a particular asset (such as shares), simultaneously purchases a put option for an equivalent number of shares

- Investors will use this strategy when they are bullish on the asset's price and wish to protect themselves against potential short-term losses. This strategy essentially functions like an insurance policy, and establishes a floor should the asset's price plunge dramatically



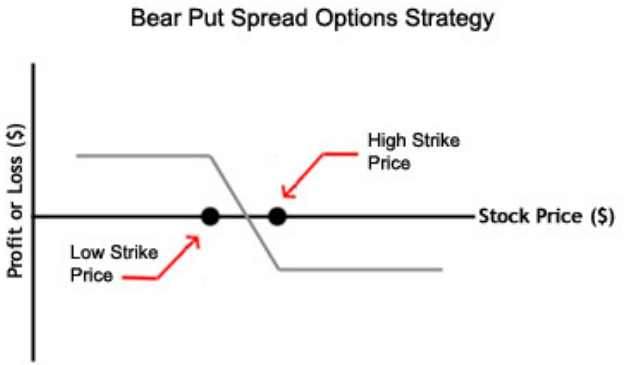
Bull Call Spread

- In a bull call spread strategy, an investor will simultaneously buy call options at a specific strike price and sell the same number of calls at a higher strike price
- Both call options will have the same expiration month and underlying asset
  - This type of vertical spread strategy is often used when an investor is bullish and expects a moderate rise in the price of the underlying asset



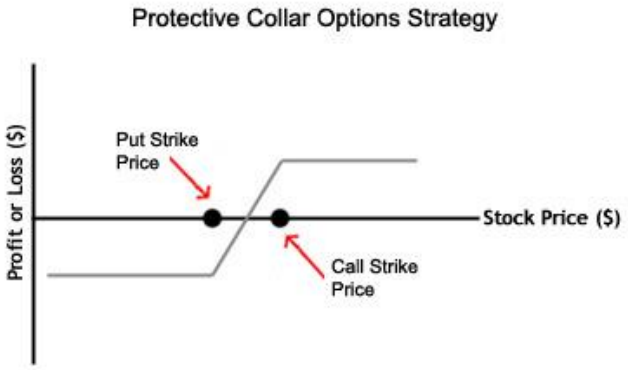
Bear Put Spread

- The bear put spread strategy is another form of vertical spread
- In this strategy, the investor will simultaneously purchase put options as a specific strike price and sell the same number of puts at a lower strike price
- Both options would be for the same underlying asset and have the same expiration date
  - This method is used when the trader is bearish and expects the underlying asset's price to decline
  - It offers both limited gains and limited losses



Protective Collar

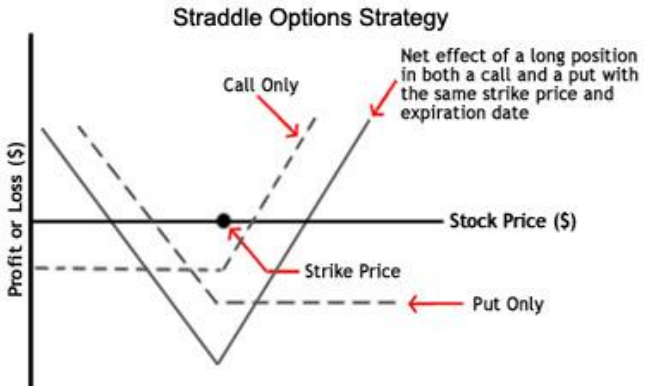
- A protective collar strategy is performed by purchasing an out-of-the-money put option and writing an out-of-the-money call option at the same time, for the same underlying asset (such as shares)
- This strategy is often used by investors after a long position in a stock has experienced substantial gains
  - In this way, investors can lock in profit without selling their shares



Long Straddle

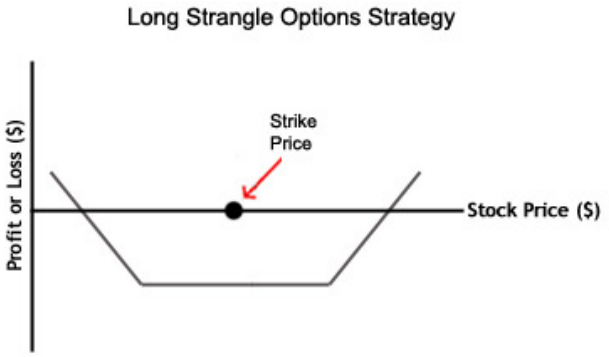
- A long straddle options strategy is when an investor purchases both a call and put option with the same strike price, underlying asset and expiration date simultaneously

- An investor will often use this strategy when he or she believes the price of the underlying asset will move significantly, but is unsure of which direction the move will take
  - This strategy allows the investor to maintain unlimited gains, while the loss is limited to the cost of both options contracts



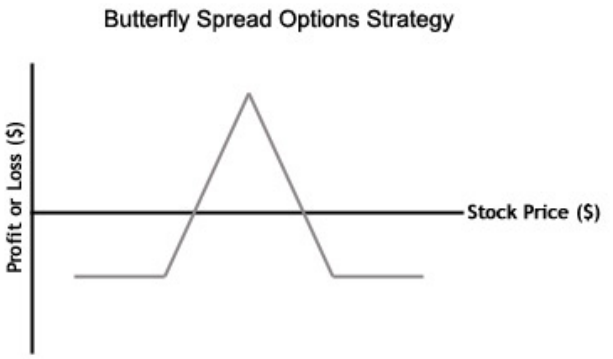
Long Strangle

- In a long strangle options strategy, the investor purchases a call and put option with the same maturity and underlying asset, but with different strike prices
- The put strike price will typically be below the strike price of the call option, and both options will be out of the money
- An investor who uses this strategy believes the underlying asset's price will experience a large movement, but is unsure of which direction the move will take
  - Losses are limited to the costs of both options; strangles will typically be less expensive than straddles because the options are purchased out of the money



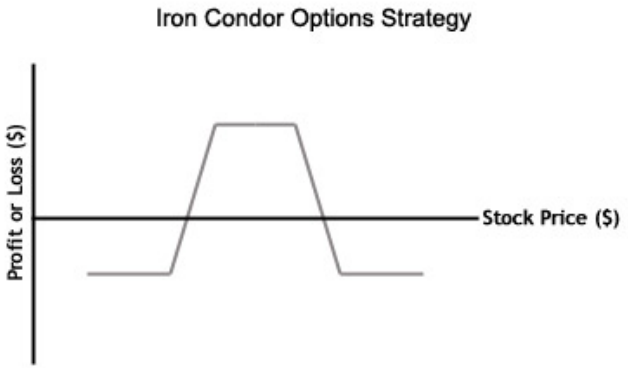
Butterfly Spread

- All the strategies up to this point have required a combination of two different positions or contracts
- In a butterfly spread options strategy, an investor will combine both a bull spread strategy and a bear spread strategy, and use three different strike prices
- For example, one type of butterfly spread involves purchasing one call (put) option at the lowest (highest) strike price, while selling two call (put) options at a higher (lower) strike price, and then one last call (put) option at an even higher (lower) strike price



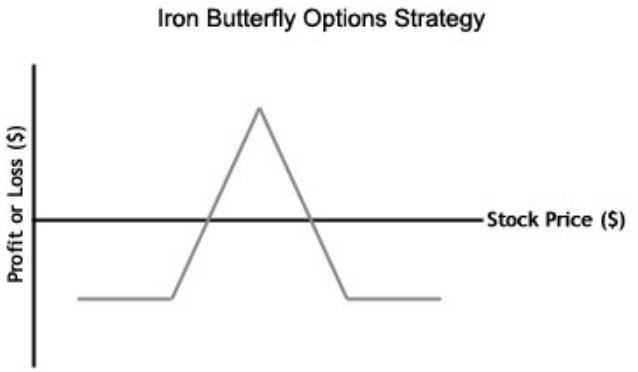
Iron Condor

- An even more interesting strategy is the iron condor. In this strategy, the investor simultaneously holds a long and short position in two different strangle strategies
- The iron condor is a fairly complex strategy that definitely requires time to learn, and practice to master



Iron Butterfly

- In this strategy, an investor will combine either a long or short straddle with the simultaneous purchase or sale of a strangle
- Although similar to a butterfly spread, this strategy differs because it uses both calls and puts, as opposed to one or the other
- Profit and loss are both limited within a specific range, depending on the strike prices of the options used. Investors will often use out-of-the-money options in an effort to cut costs while limiting risk



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