EMERGING CAPITAL MARKETS

Lecture 17: Hedging Foreign Exchange Exposure

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Organized Derivative Exchange Markets exist in a number of Emerging Markets, including:

Mexico :

- Mexican Derivatives Exchange (MexDer)

Argentina

- Mercado de Futuros y Opciones (MERFOX)
- Mercado a Término de Rosario S.A. (ROFEX)

Brazil

- Brazilian Mercantile and Futures Exchange (BM&F)
- Maringá Mercantile and Futures Exchange

Romania

- Bursa Romana de Marfuri (BRM)
- Sibiu`s Monetary Financial an Commodity Exchange (BMFMS)

Russia

- Moscow Interbank Currency Exchange (MICEX)

Turkey

- Turkish Derivatives Exchange

China

- Dalian Commodity Exchange (DCE)
- Shanghai Futures Exchange (SHFE)
- Zhengzhou Commodity Exchange (ZCE)
- China Financial Futures Exchange (CFFEX)

India

- National Stock Exchange of India (NSE)
- Bombay Stock Exchange (BSE)
- Multi Commodity Exchange of India (MCX)
- National Multi Commodity Exchange of India (NMCE)
- National Commodity and Derivatives Exchange (NCDEX)

Indonesia

- Jakarta Futures Exchange (JFX) [

Iran

- International Oil Bourse

Hong Kong

- Hong Kong Futures Exchange (HKFE), precursor to Hong Kong Exchanges and Clearing
- Hong Kong Exchanges and Clearing (HKEx)

Korea

– Korea Exchange (KRX), formed from merger of KSE, KOFEX and KOSDAQ exchanges.

Malaysia

– Bursa Malaysia Derivatives (Behad)

Singapore

– Singapore Commodity Exchange (SICOM)

– Singapore International Monetary Exchange (SIMEX) precursor to Singapore Exchange (SGX)

– Singapore Exchange (SGX)

Taiwan

– Taiwan Futures Exchange (TAIFEX)

United Arab Emirates

– Dubai International Financial Exchange (DIFX)

– Dubai Gold & Commodities Exchange (DGCX)

South Africa

– South African Futures Exchange (SAFEX)

Reuters Coverage of Forward Rates in EMs

- Bulgarian Lev BGN
- Croatian Kuna HRK
- Czech Koruna CZK
- Estonian Kroon EEK
- Hungarian Forint HUF
- Latvian Lat LVL
- Lithuanian Litas LTL
- Polish Zloty PLN
- Romanian Leu RON
- Russian Rouble RUB
- Slovakian Koruna SKK
- Slovenian Tolar SIT
- New Turkish Lira TRY
- **Ukraine Hryvnia UAH**

- Egyptian Pound EGP
- Jordanian Dinar JOD
- Kenyan Schilling KES
- Moroccan Dirham MAD
- South African Rand ZAR
- Tunisian Dinar TND

- Chinese R. Yuan CNY
- Hong Kong Dollar HKD
- Indian Rupee INR
- Indonesian Rupiah IDR
- Kazakhstan Tenge KZT
- Malaysian Ringgit MYR
- Pakistani Rupee PKR
- Philippine Peso PHP
- S. Korean Won KRW
- Taiwanese Dollar TWD
- Thai Baht THB

- Argentine Peso ARS
- Brazilian Dollar BRL
- Chilean Peso CLP
- Colombian Peso COP
- Mexican Peso MXN
- Peru New Sol PEN
- Venezuelan Bolivar VEB

Outline

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I. Reducing Risks with Diversification and Hedging

- The large variability of FX rates (volatility) since the breakdown of the Bretton Woods fixed exchange rate system has increased significantly the risk for those that operates with foreign currencies.
- Currency risks can be reduced by having a **diversified** portfolio of currencies that are ***not closely*** correlated.
- The idea of **hedging** is different: It is to find two instruments whose ***future*** cash flows are ***perfectly (or closely)*** correlated:

  then, you ***buy*** one and ***sell*** the other- or if one is a liability, the other is an asset - so that the net position is safe.
- The purpose of hedging is to eliminate/reduce the uncertainty of your ***net*** position.
- In order to set a hedge:
  - If you have a ***liability*** **X,** you can offset it by buying an ***asset*** **Y**.
  - The question is: How many units of Y should you buy?
  - It depends on how X and Y are correlated.
  - They could correlate as follows: $dX = a + b\,(dY)$
  - "b" measures the sensitivity of X to changes in Y.
  - "b" is called the ***Hedge Ratio***: "b" is the units of Y which should be purchased to hedge (offset) the liability of X.

Hedging & Spot Transactions

- A "spot" foreign currency transaction requires almost ***immediate*** delivery of foreign exchange.
  - –Delivery is normally on the second following business day (T+2).
  - –The date of settlement is referred to as the "***value date***".
  - –On the value date, most transactions are settled through the computerized Clearing House Interbank Payment Systems ***(CHIPS)*** in New York, which provides for calculations of net balances owned by any bank to another and for payment by 6:00 pm that same day.
- A 'hedging" transaction requires delivery at some ***future date***, either on a mandatory basis (forwards, futures, swaps), or on a optional basis (options). They are called *"**Derivatives**"* because their values are "derived" from the values of other assets.
- "Short selling" means selling an asset that you do not own, but you borrowed (paying a fee), with the expectation that you can buy it cheaper later on when you have to return it to the original owner. The buyer and original owner of the asset had "long positions" expecting prices to go up.
- When one party goes long (buys) a futures contract, another goes short. When a new contract is introduced, the total position in the contract is zero. Therefore, the sum of all the long positions must be equal to the sum of all the short positions. In other words, risk is transferred from one party to another.

Short Definitions for Derivatives:

- A **Currency Forward or Future** is a firm agreement to buy or to sell foreign currency in the future at a pre-established foreign exchange rate (the forward/future rate).
- A **Foreign Exchange Swap** is a contract under which two currencies are exchanged at a moment of time, with a subsequent exchange in the reverse direction at an agreed upon later date.
- A **Currency Swap** is a contract to exchange "streams" of future periodic cash flows denominated in two different currencies. It can be seen as a succession of foreign exchange swaps.
- An **Interest Rate Swap** is a contract to exchange streams of cash flows (interest payments) under two securities denominated in the same currency, but based on different interest rate bases, such as fixed interest rate versus floating interest rate.

- An **Interest Rate (Bond) Future** is a contract to buy/sell an interest-rate bearing security (US T-bills, T-bonds) at a specified time in the future at an interest rate (price) agreed now.
- **A Forward Rate Agreement (FRA)** is similar to an interest rate future, but negotiated in the OTC. At maturity, only the profit or loss is settled, representing the difference between the agreed upon interest rate and the rate prevailing at the time.
- **An Interest Rate Option** gives the buyer the option (but not the obligation) to buy/sell an interest-rate bearing security in the future at the interest rate agreed now.
- A **Currency Option** is a contract that gives the right (but not the obligation) to buy/sell a currency in the future at a pre-established foreign exchange rate.
- **An Option on Futures** is an option in which the instrument to be delivered at maturity is not the currency itself, but a futures contract on the currency.

- The evolution of the **principal amounts outstanding** of derivatives has been as follows (in US$ billions)– source: *Bank of Int. Settlements*:

Derivative	1987	1998	2000	2002	2004	2007	2008
Exchange-Traded							
Currency Futures	15	49	74	47	103	158	95
Currency Options	60	67	21	37	61	133	125
Interest Rate Futures	488	8031	7892	9956	18165	26770	18733
Interest Rate Options	123	4623	4734	11759	24604	44282	33978
Over-the-Counter-Traded							
Currency forw/FX swaps	-	12063	10134	10427	14951	29144	24562
Currency Options	-	3695	2338	3427	6115	12748	10466
Currency Swaps	183	2253	3194	4220	8223	14347	14725
Interest Rate Swaps	683	36262	48768	68274	150637	309588	328114
Interest Rate Options	-	7997	9476	12575	27082	56951	51301
Forward Rate Agreements	-	5756	6423	9146	12788	26599	39262

Currencies and Maturities for OTC Currency Derivatives:

Maturities: Less of 1 year: 76%; 1-5 years: 17%; + 5 years: 7%

Currencies: US$: 41%; Euro: 20%; Yen: 11%; Pound:8%; others:20%

Notes:

- The **annual turnover** of currency and interest rate derivatives in exchange traded markets reached US$1,632 trillion in 2006. This is a size several times larger than world merchandise exports of $8.5 trillion in 2006.

- The growth of derivatives has been fueled by:
  - The large fluctuations in foreign exchange rates experienced since the breakdown of the Bretton Woods exchange rate system, with many countries under floating exchange rates. Derivatives provide the ways to hedge, pack, unbundle or reallocate risks.
  - Easy of information and computation by new technologies, facilitating the evaluation and pricing of risks.
  - The trend towards securitization, with the need to enhance these agglomeration of obligations with “inducements”
- The Over-the-Counter (OTC) market has grown at a faster pace:
  - They provide with flexibility, customization and less regulations.
  - Counterpart risks have been minimized by trade consolidation: in the US, 8 banks account for 94% of principal outstanding.
  - Standardization of terms, with derivatives being commoditized.
  - Improved management of risks.
  - Improved clearing and settlements.

II. Currency Forwards & Futures

- A currency forward or future contract is a firm agreement to buy or to sell foreign currency in the future at a pre-established foreign exchange rate (the forward (future) rate).

Determination of the Forward (Future) Rate.

- According to the Covered Interest Rate Parity condition, the forward premium (F/S) for one currency relative to another should be equal to the ratio of nominal interest rates (i, i*) on securities of equal risk denominated in the two currencies in question.
- Therefore, the forward rate (F) will be: **$F = S(1+i)/(1+i^*)$.**
- If this condition does not hold, then it will be possible to engaged in covered interest arbitrage that will provide a riskless profit.
- In the period between the initial settlement and the value date, the value of the forward/future contract will vary depending on whether at that time the actual FX spot rate (S_1) is above or below the contract forward rate (F).

- To enter a contract to ***buy*** FX forward is called to "***go long***".

  If the domestic currency ***depreciates*** over and above the forward rate, you make a **profit**. Otherwise, you loose.

- To enter a contract to ***sell*** FX forward is called to "***go short***".

  If the domestic currency ***appreciates*** below the forward rate, you make a profit. Otherwise, you loose.

- Example: Assume that : i = 12%; i* = 5%; S = 5.0 UAH/$

  F = S (1+i)/(1+i*) = 5.0 (1.12)/(1.05) = 5.9 UAH/$ (18% UAH depreciation).

- At maturity in one year, you will need $100,000 in dollars. You can buy dollars now and pay 5UAH/$, but loose the interest rate "i" on UAH. Or you could wait one year, but then have the risk that the UAH may have depreciated a lot.
- If you want to remove the risk that the UAH may depreciate more than today's expectations, then you buy a Forward Contract to get dollars --> At the terminal date, you will pay UAH590,000 and get $100,000 (590,000/5.9).
- If you had not hedged:
  - At maturity, the foreign exchange rate could be equal to the forward rate of 5.9 UAH/$ (e.g., there was a UAH depreciation of 18%). You will to pay UAH590,000 to get the $100,000 you need. You have no profit or loss compared to the hedged position.
  - But if at maturity, the UAH "***depreciates***" over and above the forward rate, you will have to pay more UAH to get the $100,000 (e.g., at 6.2 UAH/$, you will have to pay UAH620,000).
  - With a hedged (forward contract) you would have bought the dollars cheaper. You will have made a "profit" of UAH30,000.

Hedging your Portfolio with Forward Contracts

To hedge a portfolio throughout an entire period of time, you take a position with a forward contract that is the reverse of the principal being hedged.

- A US investor invested £1 million ($2.0 million) in UK bonds.
- At maturity he will get Pounds, but he wants dollars at maturity: he could sell a forward contract to sell £1 million and receive dollars.
- If the spot exchange rate is 2 $/£ and the forward rate is 1.95 $/£, at maturity he will give £1 million & get $1.95 million.
- This forward contract will also hedge the portfolio in the interim:
- If in a few weeks the exchange rate is 1.90, most likely the forward rate is 1.85. Then the value of the portfolio is $1.9 million, a loss of $100,000. On the other hand, your forward contract (at 1.95 $/£) is more valuable now: the realized gain on the forward contract is: (1.95 - 1.85)$/£ x £1.0 million = $100,000. The net position is neutral.
- But if the exchange rate were 2.10 and the forward rate 2.05, the value of the portfolio would be $2.1 million, a gain of $100,000. But the realized loss on the forward contract is (1.95 -2.05)$/£ x £1 million or $100,000. The net position is also neutral.

- Currency forwards are quite old and were tailor-made to suit the needs of the two parties. They are still customized, but have developed principles of operation. In a forwards transaction:
  - The forward rate is established at the time of the agreement.
  - Forward rates are normally quoted for ***value dates*** of one, two, three, six, and twelve months, but could you up to ten years.
  - Payment is normally made at T+2 after the anniversary of the trade.
- There are over 200 large banks in the world that quote rates for buying and selling a given currency. They trade heavily with each other.
- Only very creditworthy institutions participate in this market, given a possible risk of non-delivery at maturity.
- Prior to trading, the bank must enter an agreement, such as the International Foreign Exchange Master Agreement, which sets the relationships between traders, including procedures for delivery and netting.

Forward vs. Future Transactions

- In forward transactions, the risk of non-delivery at maturity (counterpart risk) is serious.
- Therefore, forward transactions are carried out among large, solvent institutions (such as large banks), where the risk of default and non-delivery is more under control.
- Because of this, not everybody can participate in the forward market:
  - In 1967, Milton Friedman anticipated a major devaluation of the Pound: since the end of the war, for 20 years the foreign exchange rate had been 2.8 US$/P and the 3-month forward rate was 2.75 US$/P. But UK's fundamentals were weak in 1967.
  - Friedman expected the exchange rate to be lower that 2.75 US$/P in three months; it could be as low as 2.4 US$/P.
  - Friedman wanted to sell Pounds forward (at 2.75 US$/P) and profit from the expected devaluation (which went to 2.4 US$/P).

- But Chicago and NY banks refused to enter a forward contract with him, even after he agreed to deposit a significant "margin" for the operation.
- Since then, for five years, he published widely encouraging the development of a currency forward market for smaller investors through exchanges, based on standardized contracts and other safeguards.
- In May 1972, the International Monetary Market of the Chicago Mercantile Exchange (CME) was the first exchange to introduced trading in FX futures. It was an instant success, particularly since the Pound started its floating a few months later.

- Future Contracts are devised to eliminate many of the risks of forward contracts, such as default and non-delivery at maturity.

– The differences between Forward and Future Contracts are:

Forward Contracts	Future Contracts
1. Customized contract on size and delivery dates.	1. Standardized contract on size and delivery time.
2. Private contract between two parties.	2. Standardized contract between *one* customer and a clearinghouse.
3. Contract is not reversible.	3. Contract may be freely traded.
4. Profit or loss in a position is realized only on the delivery date.	4. Profit or loss is realized immediately, contracts are marked-to-market daily.
5. Margins are set once, on the day of the initial transaction.	5. Margins must be maintained daily to reflect price movements.
6. Trading is dispersed.	6. Trading centralized in exchanges.

In the 1970s, future markets were developed for other financial assets, including GNMA contracts, US T-bills/bonds, and Eurodollar notes.

Non-Deliverable Forwards (NDF).

In emerging markets with currencies that are not international traded, in forward contracts the currencies are not physically exchanged at the time of settlement. Only the profit or loss at the time of settlement is paid in an international currency, normally US dollars.

III. Foreign Exchange Swaps

- Transactions between a bank and a corporate client normally takes the form of an "outright forward", as described before.
- Most forward transactions between banks, however, are carried out as "foreign exchange swaps", in which two currencies are exchanged at a time, with a subsequent exchange in the reverse direction at an agreed upon later date.
- Therefore, a "forex swap" transaction involves the simultaneous purchase and sale of foreign currency for two different value dates.
- Both purchase and sale are carried out by the same counterparts.
- Since the agreement is executed as a single transaction, the banks incur no "unexpected" foreign exchange risk.
- Normally only the resulting gain or loss from a foreign exchange transaction is settled. That is, the current practice is that no accounts are credited or debited until the maturity date and only the difference is credited or debited.

- Typically, positions are established in the spot market and continuously prolonged by foreign exchange swaps.
- Foreign exchange swaps are often initiated to move the delivery date of foreign currency, originated from spot or forward transactions, to a more optimal point of time.
- By keeping maturities to less than a week and renewing swaps continuously, market participants maximize their flexibility in reacting to market events.
- This explains why the volume of forex swaps has risen so much in recent years and replaced the spot market as the biggest foreign exchange market segment.

Non-Deliverable Swaps - NDS

- A non-deliverable swap is similar to a foreign exchange swap, with the only difference being that settlement for both parties is done only through a major currency such as the US dollar.
- Non-deliverable swaps are used when the swap includes a major currency, such as the U.S. dollar, and a restricted currency from an Emerging Market, such as the Turkish Lira.

Typical forex swaps are:

- **Spot-against-forward swap**:
  - A bank buys a currency in the spot market now and simultaneously sells forward the same amount back.
  - The difference between the sell and buying prices is equivalent to the interest rate differential between the two currencies.
- **Forward-forward swap**:
  - A bank buys a currency forward for delivery in one month and simultaneously sells the same currency forward for delivery in three months.
- A forex swap is similar to borrowing a currency fully collateralized: it can be described as an agreement between two parties to exchange a given amount of one currency for another, and, after a period of time, to give back the original amounts swapped.

IV. Currency Swaps

- A Currency Swap is a contract to exchange "streams" of future periodic cash flows denominated in two different currencies.
- A currency swap can be seen as a succession of foreign exchange swaps.
- It involves a series of currency exchanges over time -- such as interest payments of two debt obligations denominated in two different currencies.
- A typical case is as follows:
  - Two firms in different countries require foreign currencies.
  - The two firms borrow funds in their own currency and market in which they are best known and have a "comparative" advantage (not necessarily an absolute advantage).
  - They "swap" future debt service obligations of the loans.
  - They may also "swap" the initial proceeds of the loans at the current FX rate (which they could do anyway in the market).

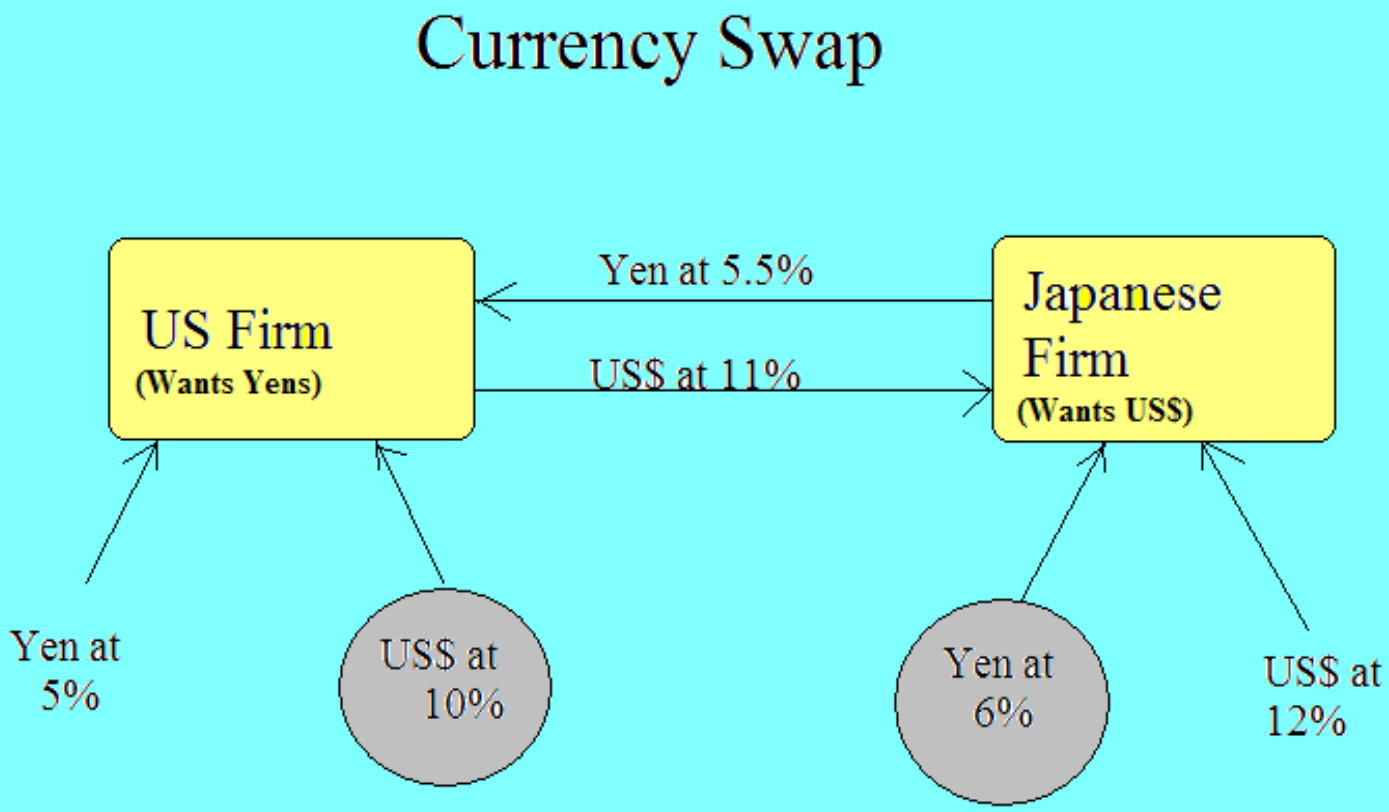
Example of a currency swap:

- An US firm wants Yens and can borrow them at 5% pa. It can borrow US$ at 10%.
- A Japanese firm wants US$ and can borrow them at 12%. It can borrow Yens at 6%.
- Though firm A enjoys an "absolute" advantage in both markets, the borrowing differences are 2% for US$, but only 1% for Yens. Therefore, the Japanese firm has a comparative advantage in Yens.
- The US firm borrows in US$ at 10% and lends it to the Japanese firm with a positive spread of 1%, at 11%.
- The Japanese firm borrows in Yens at 6%, and lends it to the US firm with a negative spread of 0.5%, at 5.5%.
- The borrowing cost to the US firm is: 10% + 5.5% - 11% = 4.5%

  It is ahead by 0.5%, compared to its own yen cost of 5%.
- The borrowing cost for the Japanese is: 6% + 11% - 5.5% = 11.5%

  It is ahead by 0.5%, compared to its own $ cost of 12%.
- Together they save 1% [which is also (12-10)-(6-5)], thanks to market segmentation, which generated comparative advantages.

Example of a currency swap:



Cost to US Firm: $10\% + 5.5\% - 11\% = 4.5\% < 5\%$

Cost to Japanese Firm: $6\% + 11\% - 5.5\% = 11.5\% < 12\%$

- The two firms will lower borrowing costs with a swap, compared to cost if they were to borrow in a foreign market, due to the comparative advantage of each party.
- The firm entering into a currency swap retains ultimate responsibility for the timely service of the initial debt obligation.
- In order to minimize default/counterpart risk, both parties should normally have similar "investment grade rating - over BBB" .
- These risks are minimized if the transaction is carried out through a large bank or an exchange.
- The first Currency Swap was carried out between IBM and the World Bank in 1981 (both AAA).
- If funds are more expensive in one country that another, a fee may be required to compensate for the interest differential.
- The total Currency Swap activity outstanding in 2007 was about US$12,300 billion.

V. Interest Rate Swaps

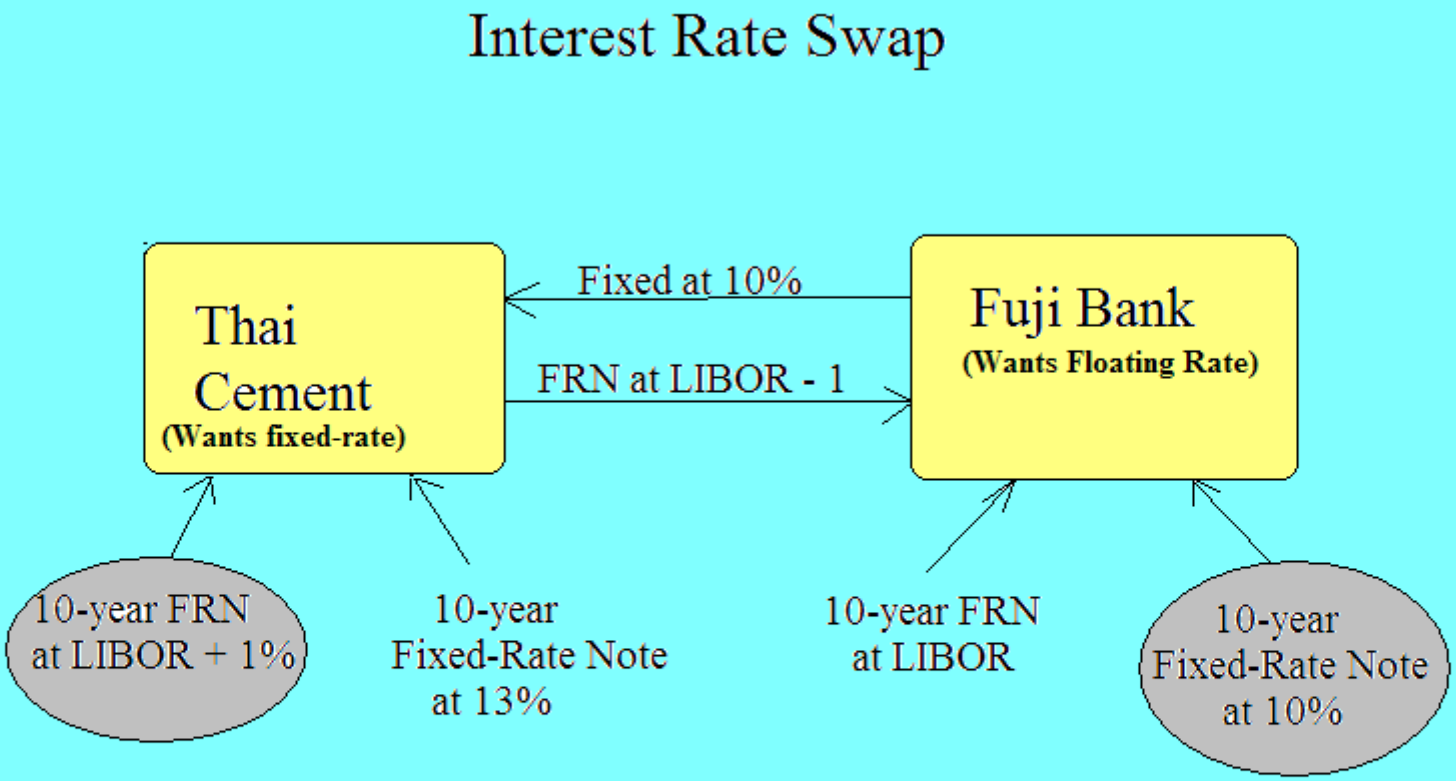
- An ***Interest Rate Swap*** is a contract to exchange streams of cash flows in the same currency, but based on different interest rates.
- The most common interest rate swaps are US dollar swaps involving a **fixed interest rate and a floating interest rate** (normally the 6-month LIBOR).
- Interest rate swaps were invented in a swap deal put together by Salomon Brothers (now part of Citigroup) and Bankers Trust (now part of Deutsche Bank) for IBM in 1984.
- Interest rate swaps do not involve exchange of principal, since the same amount and currency are involved on both legs of the swaps.
- Interest rate swaps are used to alter the exposure of debt assets or obligations to interest rate movements: For example:
  - Financial firms use the swap market intensively to hedge the difference in the interest rate exposure of their assets and liabilities (e.g., to hedge their fixed-rate real estate loans if their liabilities are short-term).
  - A European company borrowed one year ago at a fixed rate of 9.5%. But it now expects US interest rates to drop. To take advantage of this, it swaps its debt with an equal floating rate LIBOR note. A Reverse Swap would be arrange if it believed interest rates were to rise.

- Interest Rates Swaps are also used to exploit "competitive advantages" of two parties. For example:
  - Thai Cement could issue 10-year FRNs at LIBOR +1%; or fixed-rate notes at 13% pa. It wanted fixed rates.
  - Fuji Bank could issue 10-year FRN at LIBOR; or fixed rate notes at 10% pa. It wanted floating rates.
  - Thai Cement issued FRNs at LIBOR+1% and swapped for fixed rate notes at 10% pa issued by Fuji Bank.
  - The deal was that Thai Cement paid to Fuji Bank 10% pa for the Fixed rate and was paid by Fuji LIBOR ***minus*** 1%.
  - The cost to Thai Cement is:

    (Libor+1%) - (Libor-1%) + 10% = 12% pa.

    Thai Cement saves 1% pa.
  - The cost to Fuji Bank is LIBOR - 1%. Fuji Bank saves 1% pa .

Example of Interest Rate Swap



Cost to Thai Cement: (LIBOR + 1) - (LIBOR - 1) + 10% = 12% < 13%

Cost to Fuji Bank: (LIBOR - 1) < LIBOR

Pricing Interest Rate Swaps.

- The fixed-floating interest rate swap is priced using arbitrage to equate the expected net present value (NPV) of the cash inflows and outflows of the two legs.
- The NPV of the floating rate leg is calculated using forward rates from the forward yield curve (i.e., ${}_0R_6$, ${}_6R_{12}$, ${}_{12}R_{18}$, etc), or from interest rate futures prices, and discounting them at spot rates (${}_0R_6$, ${}_0R_{12}$, ${}_0R_{18}$, etc.). Note that: $(1+{}_0R_{12}) = (1+{}_0R_6)^{0.5}\,(1+{}_6R_{12})^{0.5}$
- Given this calculated NPV for the floating rate leg, the **fixed rate** (or spread over USTreasury) is determined as the internal rate of return that renders the expected present value of the floating rate cash flows equal to the expected present value of the fixed rate cash flows.

Interest Rate Swap Quotations

- US dollar swaps have become commodities, widely quoted by banks, as follows:
- The floating side of the swap is ***set*** as the three-month LIBOR.
- The fixed side is usually quoted as follows (Financial Times):

Year	Bid	Ask
1	2.29	2.62
2	3.56	3.59
5	3.11	4.88

- A dealer would be prepared to sell a 5-year swap under which it receives Libor and pays 3.11% fixed rate. *Bid is to receive Libor*.
- He would also be prepared to sell a 5-year swap whereby it pays LIBOR and receives 4.88% fixed. *Ask is to pay Libor*.
- The positive spread of the Ask rate minus the Bid rate means that the dealer expects interest rates to increase.
- Some dealers quote the fix side as US Treasury yield for the corresponding maturity plus a "Swap Spread" that may change over time. This swap spread represents the credit risk of the swap relative to the risk-free US Treasury note.

Trading on Interest Rate Swaps

- The most typical trade on derivatives is "**convergence trading**".
- Traders tries to arbitrage and profit from abnormal differences of values between two assets such as between a risky security -- such a interest rate swap -- and a US treasury (the swap spread) with the expectation that this abnormal spread will dissipate.
- The interest rate swap spread is determined by fundamental economic and financial variables which can be estimated.
- Based on this, the convergence trader forms an expectation of the fundamental level of the spread and trades in an attempt to profit from the expectation that the spread will converge to this level.
- If the spread is above its expected fundamental level, a trader anticipating that the spread will fall toward that level, will put in place a position that will gain if the expectation materializes.
- In terms of the instruments used in a convergence trade, if the swap spread is above its fundamental level, a trader who expects the spread to fall would take a long position in an interest rate swap (he buys it and own it – becoming an asset) and a short position in a Treasury security (he sells it without owning it, by borrowing and agreeing to repay it later on – becoming a liability.).

….Trading on Interest Rate Swaps

- Such a combination of long and short positions is insulated from parallel changes in the level of swap and Treasury interest rates (it is hedged against this risk), but it would gain if the rates moved relative to each other as expected.
- If the spread between the rates fell, with the swap rate falling relative to the Treasury rate, the long swap position would gain value relative to the short Treasury position and the trader would earn the difference by closing out the position.
- A fall in the swap rate would cause the present value of the swap to increase, while a rise in the Treasury rate would cause the price of the Treasury security to fall.
- Thus, the asset (the long position in a swap) gains value while the value of the liability (the short position in a Treasury security) falls.
- But he will incur large losses if the interest rate spread widen dramatically.
- This can occur during extreme market conditions when there is a *flight to quality* pushing up prices of treasuries while depressing credit sensitive securities at the same time.

Other Types of Interest Rate Swaps:

Banks quote swap rates for generic, plain-vanilla swaps, but swaps are often customized products:

Currency-Interest rate Swap: The cash flow streams are in two different currencies, one on floating and the other on fixed interest rates.

Basis Swap: Involves two floating rates, such as one on LIBOR, and the other on T-bills -- This is a TED swap (Treasury Eurodollar).

Differential Swap: Involves LIBOR rates in two different currencies, but with both streams denominated in the same currency.

Forward Swap: It begins at some specified future date, but with the binding terms set in advance.

Zero Swap: No payments are exchanged until maturity, with interest rates being capitalized.

Callable Swap: It gives the fixed-rate payer the option of canceling the swap before maturity, against up-front payment of a premium.

Putable Swap: Gives the fixed-rate receiver an option of canceling the swap before maturity, against up-front payment of a premium.

Swaption: It is an option on a swap, such as the option to enter a swap at a specified future date, against up-front payment of a premium.

Delayed Libor Reset Swap: The reference Libor is the one at the end of the 6-month period.

VI. Interest Rate Futures, Bond Futures, Forward Rate Agreements and Interest Rate Options

An **Interest Rate Future** is a contract to buy/sell an interest-rate bearing short-term instrument (such as a US Treasury bill or CDs) at a specified time in the future at an interest rate agreed now.

They are called **Bond Futures** for longer term securities.

- Short-term debt instruments, such as US Treasury bills and CDs are quoted at a discount from 100. At delivery, the contract price equals 100% minus the discount. For example in March, a June interest rate future contract for 3-month T-bills can be quoted at 97% (which is the settlement price). This represents a yield of 3%. If at delivery in June, the 3-month yield on T-bills is less than 3% (say, 2%), the buyer agreed to pay in March $97 for a security whose price is now in June is $98. He made a profit of $1
- For long term instruments, the process is similar. The price quoted for the bond (the settlement price) reflects the coupon payments and the principal, discounted at the agreed yield to maturity of the bond.

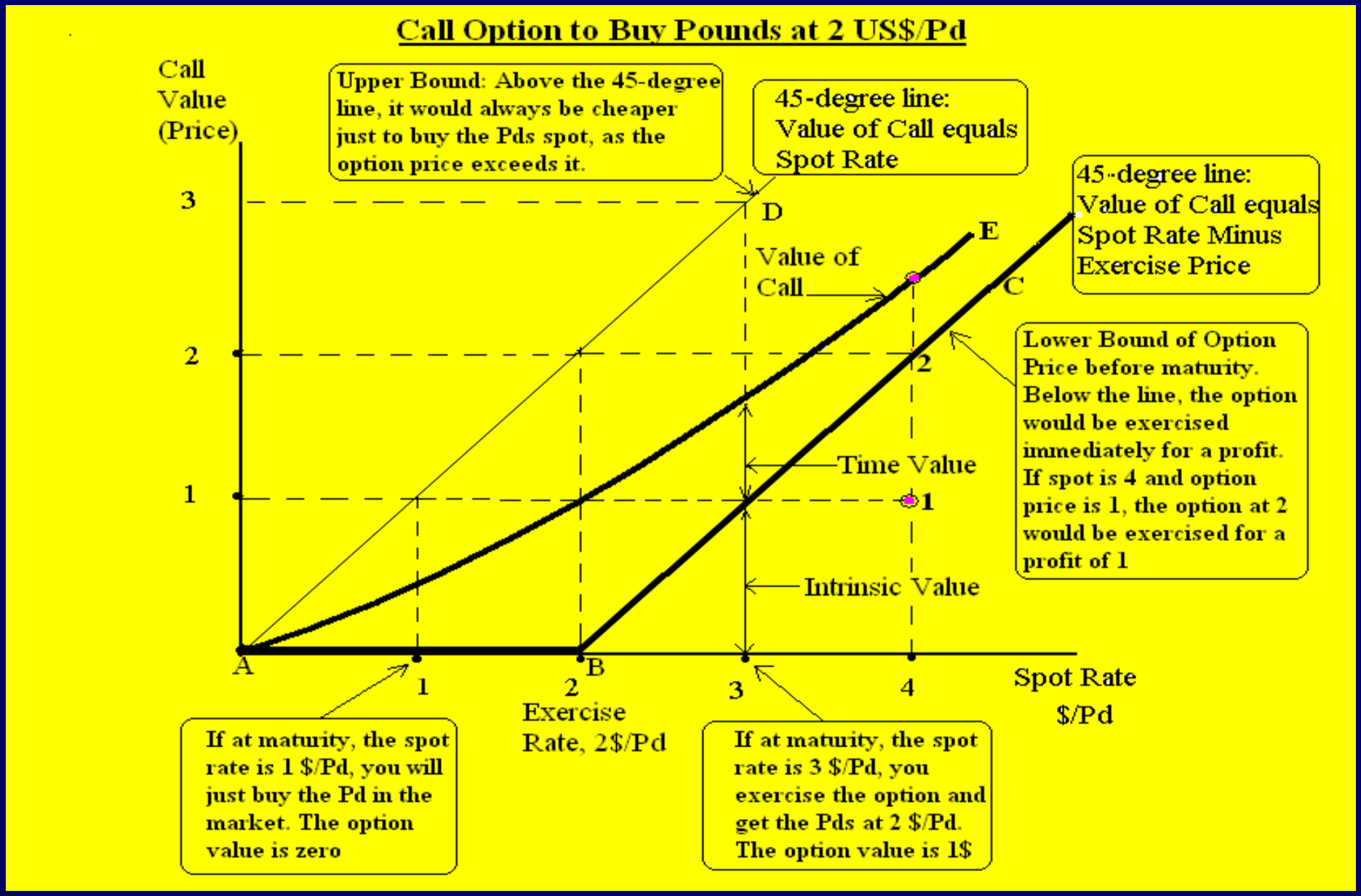
- For example, in March, you may buy a US T-bond, with a face value of US$100,000, a coupon of 6% and 5-year maturity, for delivery in June, at an agreed price of 108.90 that will produce a yields 4%. In June, the yield of this 15-year bond may be lower than 4%, yielding a profit (at 4%, he will be getting a higher rate than otherwise), or the yield may be higher, generating a loss.
- The seller of the future may deliver different US Treasury bonds (say with different coupons), but they should produce in NPVs the same yield to maturity based on agreed upon "conversion factors".
- Bond futures are used to hedge interest rate risks: If you own a bond and are concerned that interest rates may decline and produce a principal loss, by can sell a bond future now to offset the loss.
- **A Forward Rate Agreement (FRA)** is similar to an interest rate or bond future, but negotiated in the OTC. At maturity, only the profit or loss is credited or debited.
- **An Interest Rate Option** gives the buyer the option to buy/sell the security in the future at the agreed upon interest rate.

VII. Currency Options

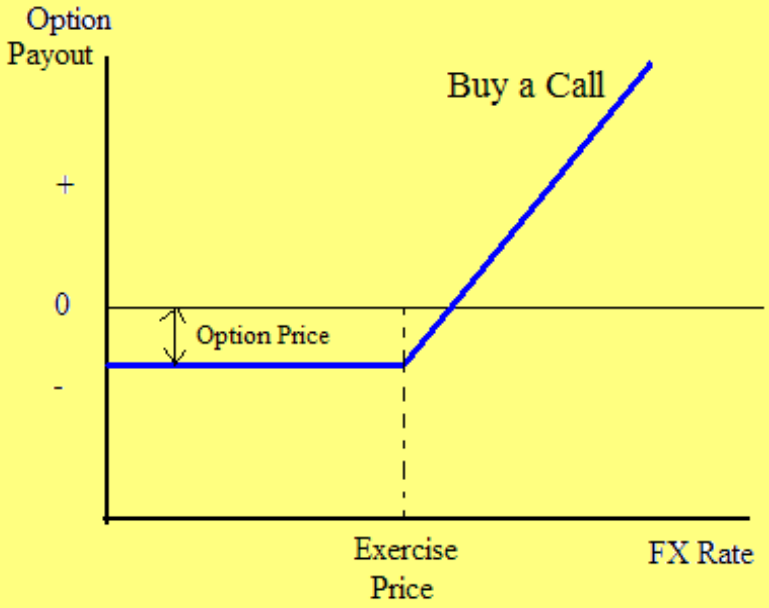
- A **Currency Option** is a contract that, for a fee, gives you the right (but not the obligation) to buy/sell a currency in the future at a pre-established foreign exchange rate (***the strike or exercise rate***).
- A European option can be exercised only at the maturity date, whereas an American option can be exercised at any time before or at maturity.
- An option to buy foreign exchange is a "***Call Option***".
- An option to sell foreign exchange is a "***Put Option***".
- There are two parties to an option contract: the option buyer (the ***holder or owner***), who pays a fee "**premium**" (option value or price) to the option seller (the ***writer***) for the option privilege.
- The holder (buyer) of a **call** option has the right to buy a currency, so the seller of a call option must deliver the currency if asked.
- The holder of a **put** option has the right to sell a currency, so the seller of a put option must accept delivery of the foreign currency at the exercise price if the option is exercised.
- An option whose exercise price is the same as the current spot price is ***at-the-money.*** An option that is profitable if exercised immediately is ***in-the-money***. An option that would **not** be profitable is called ***out-of-the-money.***

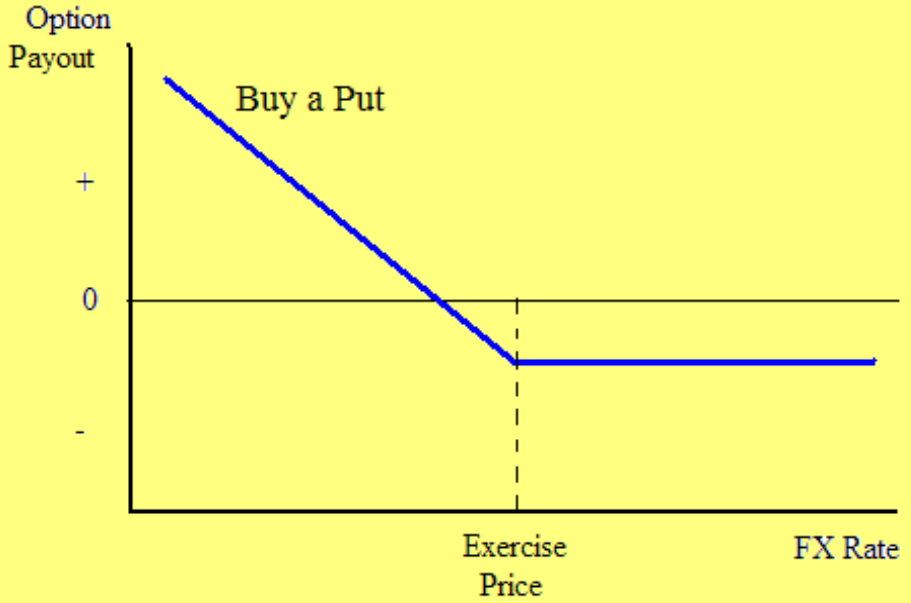
Value of an Call Option - American

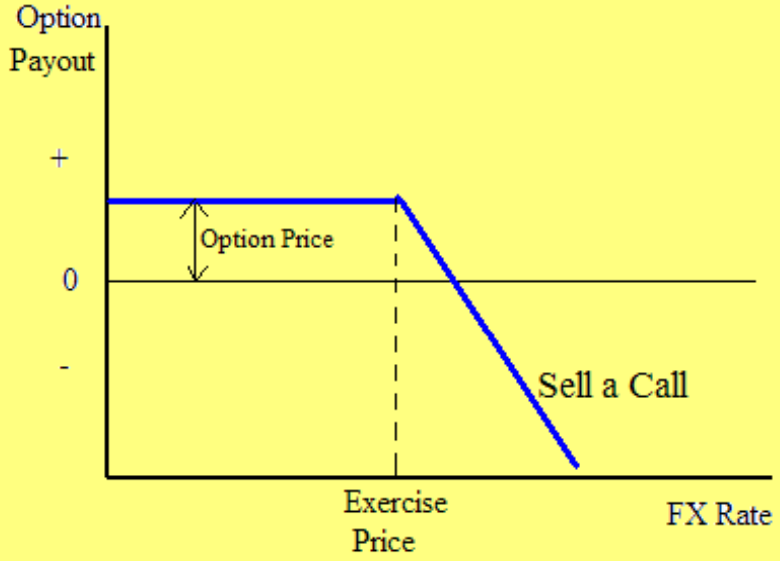
(Call Option to Buy Pounds with Exercise Rate of 2 US$/£)

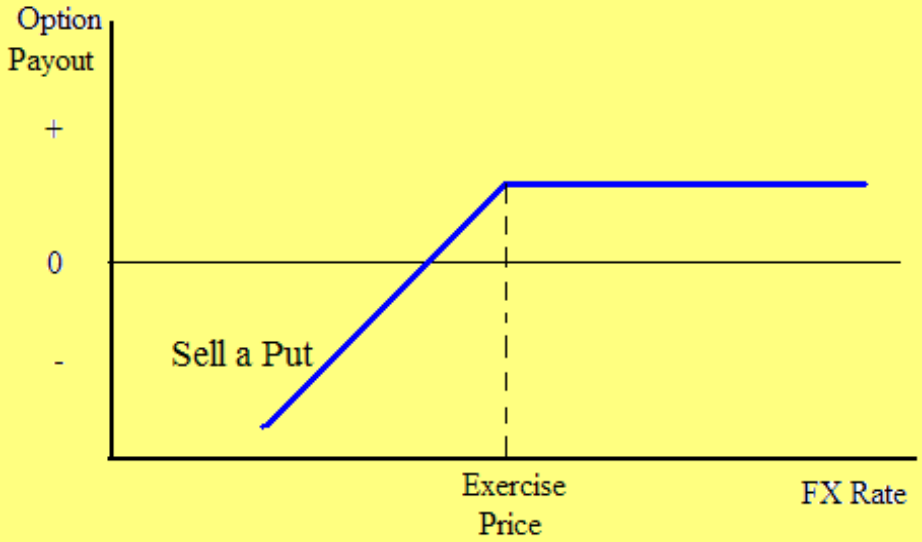


Option Payouts at Maturity









Value of a Call Option (American)

- Just at its maturity, the value of a call option to buy Pounds, with a 2 $/£ exercise rate, is given by line ABC in the previous chart, i.e.:
  - If the spot rate at that time is below 2 $/£ (say 1 $/£), the option has zero value (line AB). You will just buy Pounds at the cheaper spot rate of 1 $/£ and ignore the option of buying at 2 $/£.
  - But if the spot rate is above 2 $/£ (say 3 $/£), it is profitable to exercise the option at 2 $/£. The value of the option is $1: the spot rate (3) minus the exercise rate (2). (Line BC, 45 degrees).
- Before maturity, the option value will not be below ABC. If it were below this line, the option could be exercised immediately for a profit: if the spot is 3 and the option value is only 0.5 $/Pd, I will exercise the option (at a total cost of 2.5 $/£) and sell it for 3 $/£.
- Therefore, Line ABC provides the lower bound of an option value.
- The upper bound of an option is given by the 45 degree line AD. Above this line, buying the foreign currency now (say at 1 $/£ will always be cheaper than buying the option (at a price above 1 $/£).
- Therefore, over time, the value of the option must fall in between these bound area, and follow a curve such as AE.

- The value of the option before maturity can be broken down into two elements:
  - ***Intrinsic Value*** (value if exercised immediately: spot price minus exercise price - Line BC); and
  - ***Time Value*** (value due to potential increase in spot prices during the time before maturity, which depends on the probability of depreciation of the FX rate).
- Therefore, the value of the option is critically dependent on the future variability of FX rates: This is called **Volatility (σ)**
- Volatility is normally calculated by the standard deviation of historical FX rates over the maturity time of the option, with adjustments for future events.
- As volatility is normally available on an annualized basis (σ_a), for maturity periods other that 1 year (such as t expressed in years), it is calculated by the formula: $\sigma_t = \sigma_a \sqrt{t}$ (e.g., for 1 month, t is 1/12)
- The breakthrough in valuation of options came in 1973, with the finding of a formula to calculate the value of an option over time (the Black-Scholes Model).
- Currency options began trading in the Philadelphia Stock Exchange in 1982.

- The Black-Scholes option valuation is based on a basic principle:
  - ***“ Any two assets or portfolios which generate identical cash flows, regardless of the future state of the world, must have the same present value. If this were not true, an arbitrage possibility would exist.”***
- Therefore, if we can construct a portfolio consistent of assets and liabilities whose values we know, and which replicate the payoffs on an option, then we can know the value of the option.
- Example:
  - You have a one-year call option to buy an asset whose current price is $100, and with an exercise price of $108.
  - In one year, the asset could be worth either $80 or $120.
  - The two possible payouts for the option are $12 and zero:
    - If the price raises to $120, the option value is 12 (120-108)
    - If the price falls to $80, the option is worthless (80-108)
- What should be the value of this option before maturity? Since the two outcomes are known in advance, it should be between 0 and 12, depending on the probabilities of the two outcomes.

- On the other hand, if you had an alternative portfolio: holding 30% of the $100 asset and borrowing $20 at an interest rate of 20%:
  - The cash outlay to establish this portfolio (its current value) is $10 ($30 to buy 30% of the asset minus the $20 loan proceeds).
  - In one year, the future payoffs would be as follows:
    - If the asset price increases to $120, its value is $12
      ($120x0.3 - $20x1.2) = $12
    - If the asset price falls to 80, the value is 0
      ($80x0.3 - $20x1.2) = 0
- Note that the future values of this alternative portfolio ($12, 0) are identical to the future payoff of the call option.
- Therefore, the current value of the alternative portfolio ($10) and the current value of the call option (unknown) must be the same.
- The value of the call option is therefore $10.
- From this simple example one can generalize to a situation where there are more than two outcomes (i.e., a normal probability distribution of outcomes), and more than one period to maturity.
- This was the basis of the Black-Scholes option valuation model.

- The Black-Scholes model was extended to the valuation of FX Rate options in 1983 by Garman-Kohlhagen (to cope with 2 interest rates), under which the value "C" of an European FX rate call option will be a function of:
  - ***S***, the current spot rate
  - ***K***, the strike (exercise) rate
  - ***r***, the domestic risk free rate
  - ***r****, the foreign risk free rate
  - **σ** , the volatility of the FX rate during the maturity time of the option.
  - ***N***, the cumulative normal distribution function
  - ***t***, the number of periods to maturity.

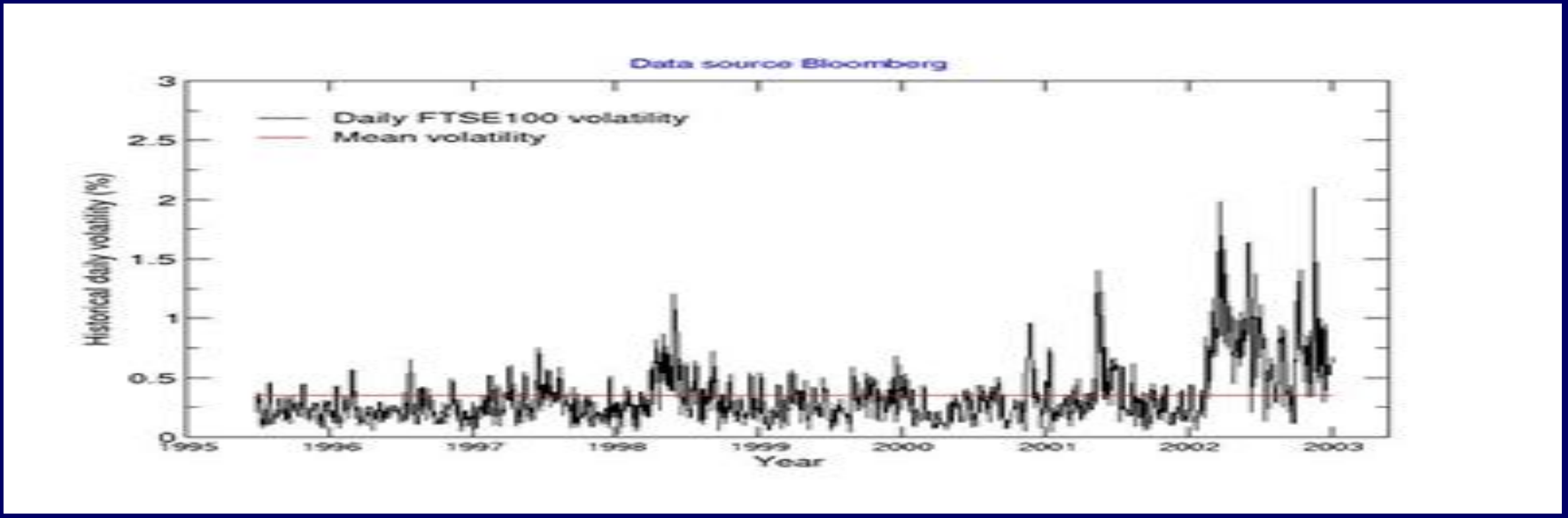
$$C = S\, e^{-r^{*}t}\, N\{d1\} - K\, e^{-rt}\, N\{d2\} \quad \text{where: } d2 = d1 - \sigma\sqrt{t}$$

$$\text{and: } d1 = \frac{\log(S/K) + (r - r^{*} + \sigma^{2}/2)t}{\sigma\sqrt{t}}$$

- The value of the option depends critically on (i) the volatility of the FX rate; and (ii) the probability that the option would be exercised, which depends on how close the spot price is to the exercise price.

- Note that except for **Volatility** σ (i.e., the standard deviation of the foreign exchange rate), all the other determinants of option value can be measured precisely.
- Therefore, the estimation of Foreign Exchange **Volatility** is a key element to estimate the value of an option.
- If rates were not volatile but stable, the spot and exercise prices will be similar, and the price of the option will be small.
- On the other hand, if there is a lot of volatility, the value of the option will increases, since this provides an opportunity for upside profits and options are protected from downside risk.
- Future FX rate volatility can be estimated on the basis of historical data and knowledge of the macroeconomic and markets conditions that could affect future FX rates.
- Another approach to estimate Volatility is to use the Option model in reverse, with Volatility as the dependent variable and the option price as an explanatory variable taken directly from the market option quotes. This is called "**implied volatility**".
- Implied Volatility has the advantage of reflecting the market's view on volatility, but ignores past history of actual market fluctuations.

- The formula for option valuation is not perfect:
  1. A pricing distortion is produced by the use of a normal distribution. The actual distribution is unlikely to be normal.
  2. Also, Future Volatility is not easy to calculate: Volatility in financial instruments is not uniform over time. It tends to have periods/clusters of low volatility followed by episodes of high volatility (estimated since 1982 by Robert Engle's **ARCH** models (Autoregressive Conditional Heteroskedasticity – – Autoregressive: uses previous estimates of volatility to calculate subsequent (future) values; Heteroskedasticity: the probability distributions of the volatility varies with the current value.) Engle's model estimated volatility based on weighted volatility in the past, but giving more weight to most recent volatilities. Engle's work also showed that periods of high volatility tended to coincide with major movements in the price of the instrument, normally down (because of risk aversion) – He won a Nobel Prize.



- These option pricing problems introduce errors in the option price calculations that may lead to ***overprice or underprice*** the option.
- But these imperfections provide opportunities for arbitrage and profitable trading: **you may have a better insight of the real value of an option based on better information on the volatility of future exchange rates.**

Reading Option Quotations (US$/Euro), Financial Times

Contract for 62,500 Euros (Philadelphia SE)

Current Spot Price (April 30) : 0.9160 US$/Euro

Strike Price	*Calls (US Cents/Euro)*			*Puts (US cents/Euro)*		
(US$/Euro)	*May*	*Jun*	*Jul*	*May*	*Jun*	*Jul*
0.8800	**3.54**	**3.58**	**---**	**---**	**0.14**	**0.39**
0.9000	**1.58**	**1.97**	**2.24**	**0.05**	**0.51**	**0.93**
0.9200	**0.28**	**0.84**	**1.17**	**0.77**	**1.39**	**1.93**
0.9400	**0.01**	**0.34**	**0.55**	**2.35**	**2.78**	**---**

My Notes: **Strike Price**: this is the exercise price of the option at maturity

Calls - May: this is the premium, cost or price of the option, last day of May. For the "May 0.8800 call option", the cost is 3.54 US cents/Euro or 0.0354 $/Euro. The contract for 62,500 Euros would cost $2,212.50 (i.e., 62,500 x 0.0354).

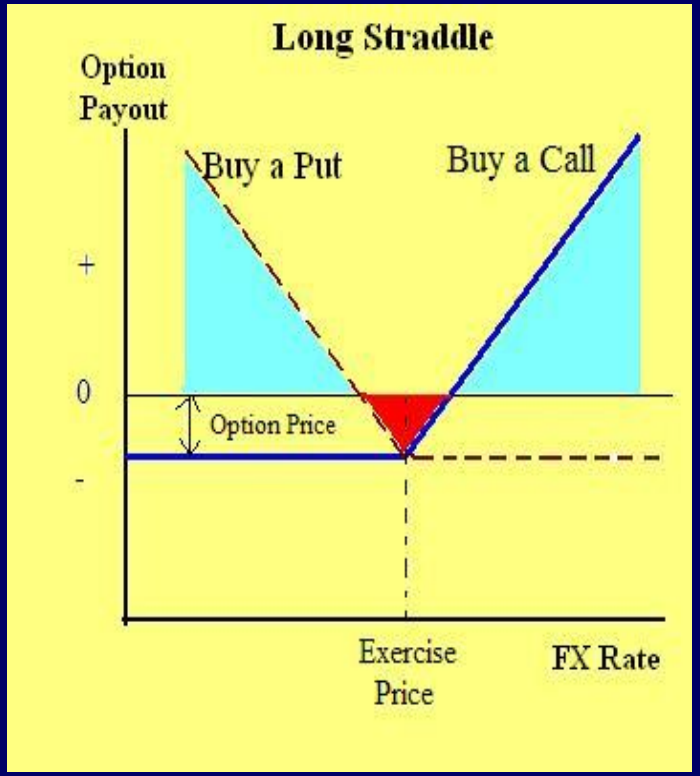
With this option, you will pay for a Euro $0.9154 ($0.8800 + $0.0354), a little bit less than today's spot price of $0.9160/Euro.

Note that with Strike Prices above the Spot Price, the value of the option declines quickly, as it is better to buy the currency directly and ignore the option.

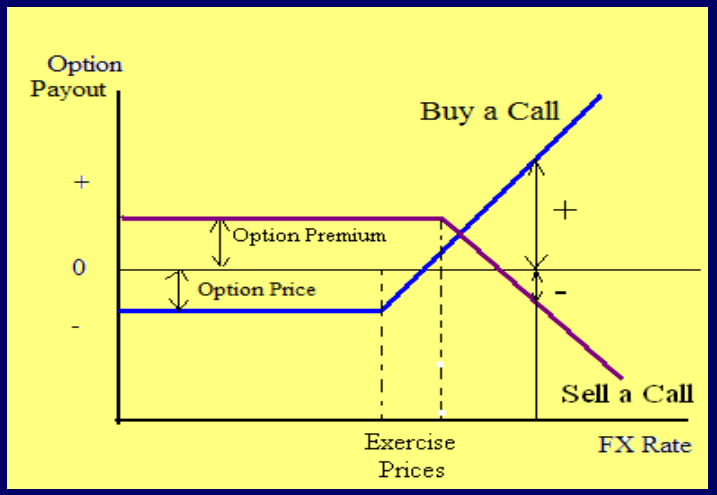
Option Trading – Volatility Arbitrage

- Option traders in banking institutions are not expected to make or loose money from depreciation/appreciation of the currency.
- In fact, if the institution has a view on exchange rates and wishes to use its own funds to take open directional currency positions, it would do it through forwards/futures, which are less expensive than options.
- But hedge funds and speculators do take open positions.
- Option traders in banking institutions made profits by collecting commissions from the transactions or by arbitraging by buying cheap options and selling expensive options under fully hedged positions.
- If the option trader believes that the option price/volatility will increase, he will buy (goes long) a call option, but he would hedge or offset that risk by entering into a transaction that produces an equal and opposite change (needs to be Delta-Neutral) – this is called first-order trade.

- Since offsetting the option position with futures have shortcomings (to fully hedge, the futures positions would need continuous adjustment), for hedging the purchase of the call option, he buys a put option with the same maturity and strike price (creating a long straddle, which is now used widely).
- He will gain if actual volatility is higher than market anticipated volatility, regardless of which of the currencies goes up or down.
- His loss is limited to the sum of the two premiums.



- The trader may also take directional views on a currency, if he anticipate that a currency may move up (or down) – this is called 2nd order trade.
- For this, he goes long (buy) a call option, but he hedges by short sell a similar call option but with different strike price and maturity.



- To make money, in its offsetting operations, the trader must try to buy ***underpriced*** options and to short sell ***overpriced*** options.
- The price of the option and volatility are directly related.
- One is a monotonic transformation of the other. But Volatility is more predictable since it is range bound (+/- 3σ) and mean reverting.
- For this reason, **volatility is a better indicator for trading options than the option price**, since you believe that deviations in volatility will "converge" towards your predicted value.
- To tell which options are overpriced or underpriced, traders use the "***implied volatility***" of the option: that is, the foreign exchange rate volatility that is implied in the actual price of the option, using an option valuation model.
- He then compares this implied volatility with his better views on future FX volatility based on his better analysis of economic fundamentals.
- A cheap, underpriced option is one that has an implied volatility that is lower than the trader's expected future volatility (in other words, the trader believes that market has underestimated volatility in pricing the option; that is, he has better forecasting information on future events).
- Today, options are "quoted" not only on prices but on their volatilities: the trader will buy a quoted "volatility" when he believes it is low and sell a "volatility" when he believes it is high.

- As the option price of low volatility option adjusts upwards, the trader would expect to sell the options at a profit before its maturity (rarely a trader holds an option during its last 30 days).
- In all cases, the option trader is actually arbitraging on volatilities, rather than on the actual prices.
- Option traders trade on implied volatilities because they are more stable and predictable over the long term than option prices.
- For example, a recent statement by JP Morgan's monthly report read:

  "**Sell 3-month PEN volatility** *(on Peru Sol):* Note that 3-month implied vols are 2.5 times above the realized vol. But we believe the PEN will stay in a narrow trade range, with a slightly appreciation bias, as the new BCRP board may not move away from the current interventionist policy right away. Therefore, we recommend to **sell 3-month PEN volatility"**
- An alternative traders twist is to ask: What standard deviation (volatility) would be necessary for the option price that I observe to be consistent with the B-S model? If this implied volatility is below the "real" standard deviation, the option is considered a good buy. The option's observed price is lower than its fair price.
- Typical implied volatilities for various currencies three years ago were as follows: for US$/Yen, 18%; for US$/Euro, 9%; for US$/Pound, 7%

- A trader may have expected that the US$/Yen volatility should converge towards the US$/Euro volatility in the future, as Japan overcome its economic difficulties. Therefore, the US$/Yen option would be overpriced. She would have sold these overpriced US$/Yen options. Indeed, currently the US$/Yen volatility is only 7.5%
- On the other hand, he may have believed that the US$/Pound volatility (7%) and US$/EURO volatility (9%) should converge. He would have bought US/Pound options and sell US$/Euro. Indeed, these volatilities have now converged to around 7.5%
- Even with its imperfections, in theory, option prices should reflect market opinions on future volatility of exchange rates, since options are bets on this market volatility. They may anticipate FX rates more precisely.
- Option-implied volatility are therefore reasonable indicators of market expectations -- or anxieties -- about imminent large exchange rate moves.
- A good example is the behavior of the implied volatility of options on the US dollar/Thai bath exchange rate in the months before the bath peg to the dollar was broken on July 2, 1997.
- The spot rate hardly moved as the exchange rate came under pressure (it was still pegged).

- However, option-implied volatility rose sharply indicating that the market was distinctly aware of the possibility of a bath devaluation.
- From January to March 1997, the spot exchange rate remained at 26 bath/dollar, while implied volatility increased from 4% to 30% during the same period.
- This is actually the results expected from ARCH models.
- In Summary:
  - Currency options are useful for anyone who requires a hedging if the FX rate goes one way, but wants the protection of limited losses, if the rate goes the other way: i.e.,the most to loose is the cost of the option (premium paid for the option).
  - A currency option is also useful to arbitrators if the trader has a better view about volatility of future FX rates than the market: That is, if she believes that the true volatility of the FX rate is higher than the volatility implied in the price of the option.
- Option traders would also re-pack options (into exotic ones) to make them more palatable to clients and enhance their value.

Types of Options.

In a similar way as a "synthetic future" was created, combinations of options or combinations of options with other instruments, can create other hedging alternatives.

Based on this principle (the building-block principle), many options types have been developed. These are called ***Exotic Options***, and includes:

- **All-or-Nothing Option**: an option that pays a fixed sum, or the price of the asset, if the option expires in-the-money.
- **Asian Option**: option with less volatility as is based on an average of rates, rather than on the instantaneous spot rate.
- **As-You-Like-It Option**: at a certain point before expiration, holder can choose whether it is a put or a call.
- **Barrier Option**: the payoff is determined by whether the FX rate breaches a predetermined barrier level.

- **Collar.** An investor who owns an asset simultaneously buys a put option and sells a call option on the same asset. The strike price on the call needs to be above the strike price for the put, and the expiration dates should be the same. The market value of the portfolio will be between the strike price on the call and the strike price on the put, thus limiting possible gains and losses.
- **Digital Options**. Options with only two payoffs at maturity.
- **Down-and-Out Option**: an option that protects within a price range.
- **Pay-Later Option**: buyer pays if and only if the option expires in-the-money.
- **Quanto Option**: the underlying asset and the option payoff are based on different currencies.
- **Ladder Option.** Options specifying lock-in levels that guarantee a minimum price at time of exercise, even if the price drops later on.
- **Straddle.** Combination of put and call options having the same strike price, usually at or near the money.
- **Rainbow Option**: buyer has the right to receive a payoff based on the best performer of a number of assets.
- **Zero-cost Collars**: package of options so that the net premium is nil.

VIII. Options on Futures

- An option on futures is an option in which the instrument to be delivered at maturity is not the currency itself, but a futures contract on the currency. In most cases, the futures has the same maturity as the option.
- They are now the most actively traded currency option in the organized markets.
- With a currency option, if exercised, cash transfers in two currencies actually takes place to and from the bank accounts in the two countries whose currency is involved.
- With an option on futures, two-currency cash delivery is not necessary: since a futures option is marked-to-market, only the difference can be settled, yielding a profit or loss.

IX. Hedging Strategies

- As noted, hedging involves acquiring a financial instrument whose future payout would be able to offset a possible future loss in another instrument. Example:
- Assume the exchange rate is now 5 H/$, you expect to receive $100 in 6 months, and will need to pay a debt of H 480 in six months.
- You want to protect from the risk that the exchange rate may go down below 4.8 H/$ (since you may not be able to repay your debt of H 480).
- You buy a Put Option which gives you the right to sell $100 in six months at a rate of 4.8 H/$ and you pay $1 for this privilege (the writer of the put option believed that there was little risk of this happening and was glad to take the $1 premium).
- In six months, if the exchange rate moved to 4.6 H/$, the put option, which cost you $1, would be worth H 20 (100x4.8 – 100x4.6). The writer of the put option will have to pay you this amount.
- This gain of H 20 plus the proceeds of H 460 (from the sale of your $100) will enable you to pay your debt of H 480.
- But if the FX rate goes above 4.8 H/$, your lose will be limited to $1.

Selecting Alternative Hedgings

- Pertamina (the Indonesian oil company) receives its income in US$.
- Pertamina needs to pay £10 million in 6 months and wants to hedge against pound appreciation (which would require more $ in the future to repay the £10 million.)
- The exchange rate is 1.65 $/£ and Pertamina wants to buy instruments that would generate profits if the exchange rate goes up to 1.66 $/£ or higher.
- Pertamina has three hedging alternatives that would generate profits if the pound appreciates:
  (a) In futures market, buy £10 million of 6-month futures.
  (b) In options market, buy £10 million of 6-month call options.
  (c) In options market, sell £10 million of 6-month put options.
- If:
  - A 6-month future is 1.65 $/£
  - A 6-month option exercise price (call or put) is 1.65 $/£
  - The option premium is 1 $cent/£
- The potential profit (+) or loss (-) under these three alternatives are: (in US$, ignoring transaction costs).

POTENTIAL PROFIT (+) OR LOSS (-)

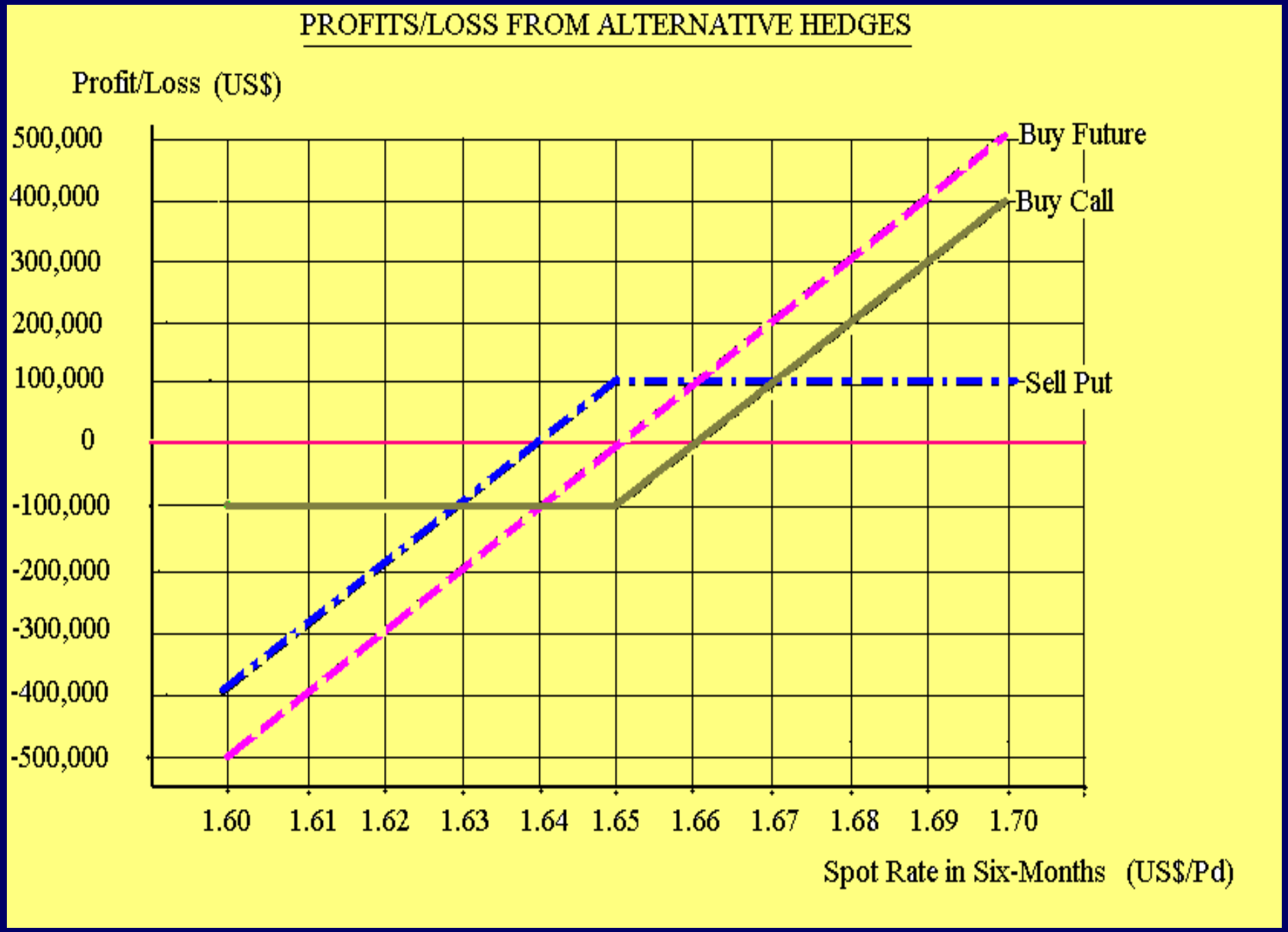
Actual Spot Price in 6-Mo	Buy Future	Buy Call Option	Sell Put Option (d/)
1.70 $/£	+500,000	+400,000	+100,000
1.67 $/£	+200,000	+100,000	+100,000
1.66 $/£	+100,000 a/	**0 b/**	+100,000 c/
1.65 $/£	**0**	-100,000	+100,000
1.64 $/£	-100,000	-100,000	**0**
1.63 $/£	-200,000	-100,000	-100,000
1.60 $/£	-500,000	-100,000	-400,000

a/ If the pound appreciates to 1.66 $/£, Pertamina bought the Pound cheap at 1.65 $/£ and gained 1 cent/£ or +$100,000 on the £10 million.

b/ The appreciation of the pound to 1.66 $/£ generated a $100,000 profit, which is offset by the cost of the option ($100,000).

c/ Here, by selling the put option, Pertamina will get only the $0.01 premium.

d/ With the sale of a put, Pertamina must accept Pounds at 1.65 $/£, if asked so.


PROFITS/LOSS FROM ALTERNATIVE HEDGES
Profit/Loss (US$)
500,000
400,000
300,000
200,000
100,000
0
-100,000
-200,000
-300,000
-400,000
-500,000
Buy Future
Buy Call
Sell Put
1.60
1.61
1.62
1.63
1.64
1.65
1.66
1.67
1.68
1.69
1.70
Spot Rate in Six-Months (US$/Pd)

From the table/chart, we can conclude the following:

- If the Pound appreciates over 1.65 $/£, all the three alternatives can generate “economic” profits, but in different amounts:
- With high appreciation, buying a future will generate the highest profits, followed by buying a call option (lower profit due to the option cost). The profits from selling a put is limited to collecting the premium.
- On the other hand, if the currency depreciates, buying a future or selling a put can generate significant, unlimited losses.
- By buying a call (or buying a put, not shown in the table), you limit the maximum loss you could have.
- Note that the second column equals the third plus the fourth (buying a call and selling a put is creating a synthetic future, at zero cost).
- From this example, we can construct some strategies as to which hedging is best, as noted next:

- If the exchange rate has limited variability (from 1.64 $/£ to 1.66 $/£), selling a put option will give Pertamina the highest profits, though limited to $100,000.
- If the exchange rate appreciates significantly (beyond 1.66 $/£), buying futures will give Pertamina the highest profits. But buying a future will also give Pertamina the highest unlimited losses if the exchange rate were to depreciate.
- If the exchange rate were to depreciate below 1.63 $/£, buying a call option will limit Pertamina's losses to a maximum of $100,000. If the exchange rate appreciates, Pertamina will also get high profits, though less than with futures.

These results will lead to the following hedging strategies, depending on:

(i) the ability to predict whether FX rates will depreciate or appreciate, and

(ii) the degree of variability of FX rates.

Ability to Forecast FX Rates		
High	(A) Buy or Sell FUTURES, depending on prediction.	(B) Sell Options, Puts or Calls, depending on prediction.
Low	(C) Buy Options, Puts or Calls	(D) Sell Options, Puts or Calls
	High	Low

Degree of Variabilty in FX Rates

In (A), if ability to predict is high (you know whether the exchange rate will appreciate or depreciate), and there is high FX volatility, use futures: buy futures if you expect Pound appreciation, or sell futures if you expect Pound depreciation.

In (B), if ability to predict is high, and there is low volatility, then sell options (sell puts if appreciation is expected, or sell calls if depreciation is expected). You will collect the premium.

In (C) with low forecast ability, but high volatility, buy options to protect from losses: buy calls to minimize losses from pound depreciation or buy puts to protect from appreciation. Normally option buying is best when contingent liabilities are high.

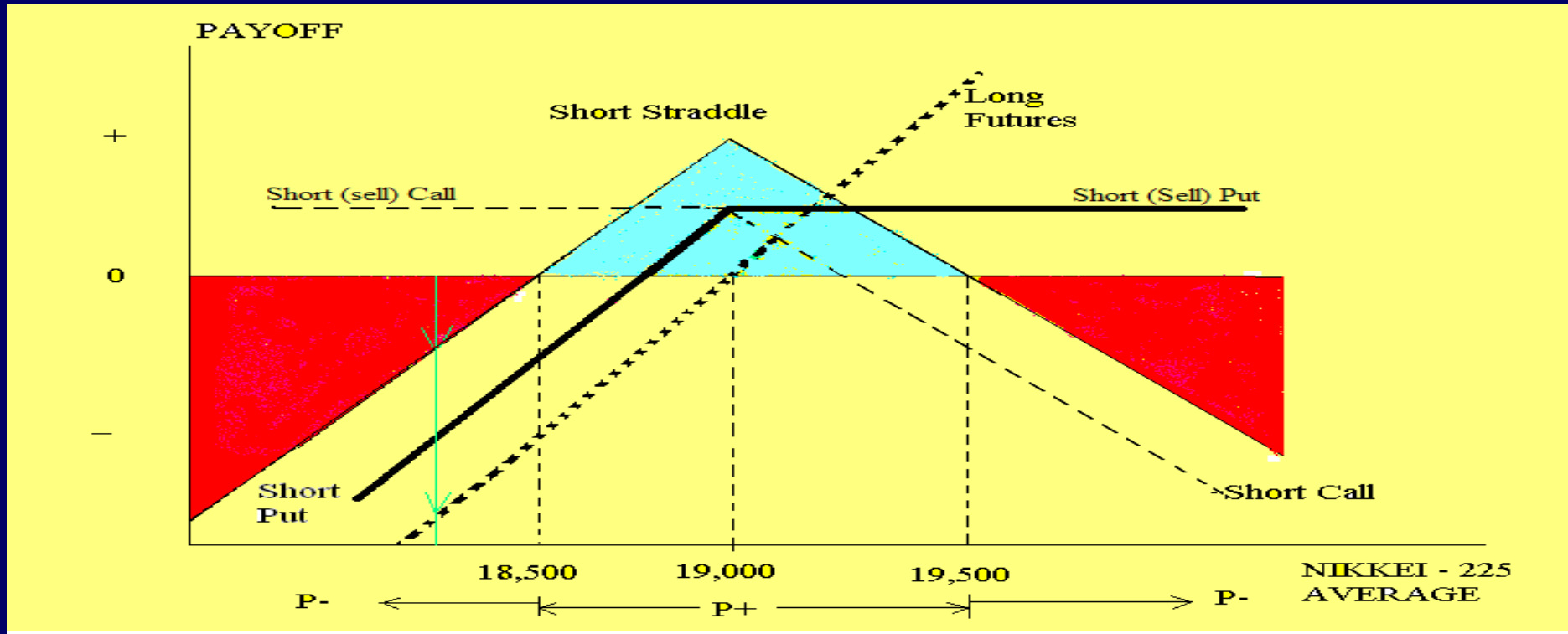
In (D) with low forecast ability and low volatility, sell options to collect the premium.

X. HEDGING RISKS

The Barings Collapse

- On February 1995, Barings, a 233 year-old UK merchant bank, was placed under special administration after one of its derivatives traders in Singapore, Nick Leeson, had bought derivative contracts on Japan's Nikkei average that lost £860 million for the Bank, an amount exceeding the Banks' capital.
- Leeson was supposed to be "arbitraging" seeking to profit from differences in the prices of Nikkei **futures** contracts on the Osaka and Singapore exchanges, buying in one and simultaneously selling in the other. The margins are small, but the risks are minimum.
- Leeson however started making risky one-sided bets using short straddles: simultaneously selling put and call options on the Nikkei.
- He bet that the markets will be less volatile than the option prices predict -- staying in the range 18,500-19,500 -- in which case he would make profits.

- Using this strategy, he earned $150 million in 1994 for Barings, which asked few questions (Leeson falsified records and invented fictitious customers to go ahead with his illegal bets.)
- When the Nikkei collapsed in January 1995 due to the Kobe earthquake, losses amounted to £100 million.
- Leeson attempted to push the Nikkei up by buying huge amounts of futures, in a futile attempt to corner the stockmarket.
- When the Nikkei plunged under 17,800, Leeson bought even more futures, leading the firm to sank. It was purchased by ING for £1.



The Collapse of Enron

- The collapse of Enron, the seventh largest US company at the time, is due in part to the misuse of derivatives.
- By the mid-1990s, Enron had become a successful natural gas pipeline company, having built one of the few nationwide pipeline networks (60,000 km, with revenues of $13 billion and assets of $16 billion).
- It diversified, first, by providing gas storage and other services.
- Later on, it diversified into energy trading, by arranging energy sales (often short sells) based on its purchases of electricity and oil.
- Then, it went into derivative trading of other utilities, such as water and broadband. It also invested in other new more risky ventures.
- To finance these ventures, Enron created about 3,000 special-purpose partnerships. The partnerships were designed to enter into derivatives (swaps and call/put options) with Enron to provide an inflow of cash from outside investors.

- To enhance the creditworthiness of the partnerships and raise money, Enron pledged its assets, giving options on its own common stock and other assets, such as foreign power plants – without fully disclosing it.
- That is, to induced investors to invest in the partnership's securities, Enron entered into "derivatives" with the partnerships, under which Enron committed to give its own stock to the partnership **if** the partnership assets (i.e., speculative technology stocks) declined in value below a certain point.
- Enron also exchanged with a partnership its shares in new ventures (such as technology companies) for a loan from a partnership. Based on these assets, the partnership issued its own securities to investors, both as equity and debt.
- Enron committed $3.7 billion of its own stocks in these partnerships.
- Enron also gave debt repayments guarantees to the partnerships in which it owned 50% or less that 50%.

- In mid-1999, Enron executives began “illicit” deals that doomed the company: The partnerships were used to conceal huge losses suffered in technology stocks, to move off balance sheet Enron’s debt incurred to finance unprofitable new businesses, and to inflate the price of troubled assets.
- To inflate the value of troubled assets, Enron sold a small portion of the assets to a partnership at an inflated price and then revalued all the assets in its balance sheet at this new high price. The investors in the partnership agreed to the purchase of inflated assets thanks to more equity pledged by Enron in case the troubled asset were to decline in price (which they did).
- Enron had not disclosed any of these losses in its quarterly financial statements.
- The Collapse of Enron:
- The decline in technology stocks in 2000 led to the need to Enron to provided significant amounts of its own stock to the partnerships.

- Furthermore, the decline in the value of Enron's own common stock –due to the general economic slowdown in 2000– led to a reduction in the value of the collateral in many partnerships.
- When the price of Enron's stock dropped below the trigger point, the investors in the partnership could and did demand payments in cash from Enron. These payments amounted to billions of dollars in 2000.
- Other Enron investments such as those in water, broadband and electricity generated further losses of $600 million.
- In August 2001, the CEO of Enron resigned.
- By November 2001, Enron's stock had fallen to $7, from a high of $91 in August 2000.
- Enron file for bankruptcy under Chapter 11 on December 2, 2001.
- Both the President and Financial Director of Enron were convicted in 2006 of fraud. The President died before final sentence and the Financial Director is now in jail.
- Financial "engineering" can be useful, but can be misused.

The Current International Liquidity Crisis

- Inappropriate uses of derivatives were major causes of the current international liquidity crisis, as we will see in a future class.
- The tranching of securitized toxic mortgages (CDO -Colaterazided Debt Obligations) gave the illusion that portions of these securities were of high credit quality, which they were not.
- Also, these “toxic” securities were “insured” by Credit Default Swaps to increase the credit quality of these securities and secure a AAA grading from rating agencies, which were easily sold.
- Also, commercial and investment banks were able to reduce their Capital Requirements substantially by reducing the risk of their assets by “insuring” these securities with Credit Default Swaps.
- Unfortunately, the CDOs turned out to be quite “toxic” and the institutions that “insured” them did not have the capital to cover insured losses.

Other Examples of Poor Practices on Derivative Trading

- In January 2008, the bank Societe Generale of France discovered that a trader, Jerome Kerviel, had concealed massive losses from trading futures over 2007-2008 through a scheme of elaborate fictitious transactions (he had worked before in the back-office and knew the administrative control procedures to conceal this information). These illegal positions caused losses of US$7.1 billion, becoming the biggest fraud case in banking history. SG is now raising funds to cover this hole.
- In 2002, US currency trader John Rusnak at All First Financial Bank was charged with covering up $691million of trading losses so that he could boost his own earnings. He was indicted by a federal grand jury on charges of bank fraud, false entry in bank records and aiding and abetting.
- In early 2000, an employee of Electrolux lost US$12 million from unauthorized currency trading.
- In 1997, Kyriacos Papouis, an options trader at NatWest Capital Markets, the investment banking arm of National Westminster Bank, lost US$150 million by mispricing derivatives.
- In 1995, Peter Young, a fund manager with Deutsche Morgan Grenfell lost more than one billion dollars in unauthorized dealings he concealed.

- These cases have led to a demand for better regulations of these markets.
- The industry is rejecting Government regulations and is pushing for better internal controls of hedging risk, as will be discussed later on.

XI. Managing Hedging Risk

Hedging instruments were developed to offset or minimize currency and other risks.

Through derivatives, these risks are “transferred” to a counterpart, normally a financial institution, such as a bank.

Therefore, these financial institutions have the problem of determining the degree of exposure that they are facing and setting limits to the risk that they will tolerate.

A typical example is a large NY bank, which uses its “Greek fraternity row” or “the Greeks” to control its daily exposure.

The bank’s back-office calculates daily the effect of changes in key economic fundamental -- such as spot prices, interest rates, times to expiration, etc. -- on the value of its derivative portfolio.

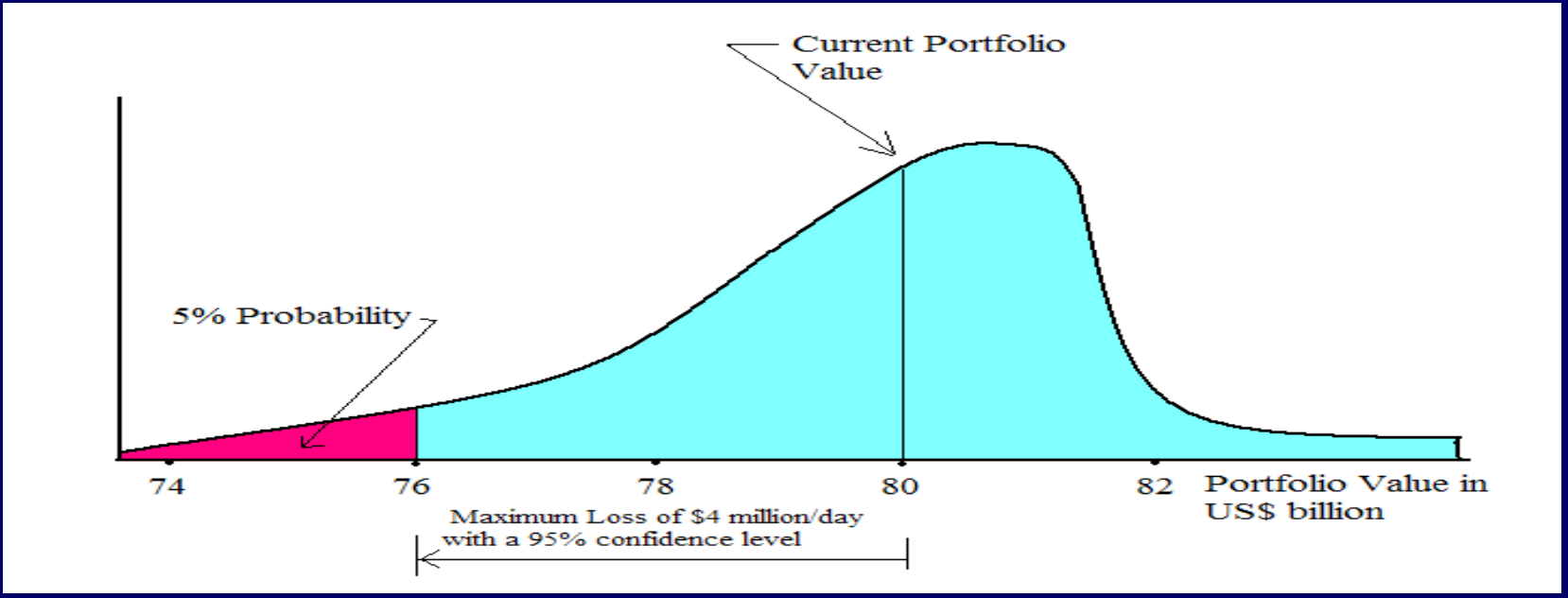
Each of these calculations provides an indicator of risk.

- The Bank's main indicators are (Greek fraternity row):
  1. **DELTA**: Vulnerability of derivative value to spot prices:
     - First derivative of portfolio value to spot prices: d(v)/d(s)
  2. **GAMMA**: Vulnerability of derivative value to *changes* in spot prices. It is the delta of the delta:
     - Second derivative of portfolio value to spot prices: d(delta)/d(s)
  3. **THETA**: Vulnerability of derivative value to time:
     - First derivative of portfolio value to time to maturity: d(v)/d(t)
  4. **VEGA**: Vulnerability of derivative value to portfolio volatility:
     - First derivative of portfolio value to portfolio standard deviation: d(v)/d(st)
  5. **RHO**: Vulnerability of derivative value to interest rates:
     - First derivative of portfolio value to interest rates: d(v)/d(i)
- The bank sets overall limits for each of the above five indicators, limits that individual Units should respect.

- For each derivative, the Unit's back-office calculates the values of its Greek fraternity row. Each of the individual indicators are added up to get an indicator for the overall portfolio risk of the Unit.
- If the portfolio risk exceed the limit, the Unit Manager must ask traders to enter into offsetting derivative transactions to reduce the risk.
- The results for each Unit are forward daily to Senior Management. A Unit Manager is assessed on her ability to maintain her Greek fraternity row to the limits set by the bank, while operating profitably.
- A problem with this approach is that the Greek values of different instruments are not always additive. By adding them one may be over-estimating the risks involved: i.e., the sum of the risks is higher that the risk of the sum.
- A more sophisticated risk evaluation should consider the covariance between the values of different instruments.
- This was done with the Value-at-Risk approach.

Value-at-Risk Approach.

- In the early 1990s, this approach for measuring risk exposure of financial assets was made popular by JP Morgan and is now widely used.
- Value-at-Risk (VAR) is the monetary loss that is expected in a portfolio, over a period of time (normally 1 to 10 days), with a given confidence level (normally 95% or 99%): e.g., "maximum potential loss of $4 million per day with a 95% confidence level" or "with a probability of 95%, the value of its portfolio will decrease by at most $4 million during 1 day"
- This means that the portfolio can be expected to have a decline in value of $4 million during 5 days out of 100 days.



- VAR is used to determine how much hedging is needed.
- To obtain the VAR, three approached are used:

(1) Historical Data:

- Identify the Portfolio Drivers or variables that can affect portfolio value (interest rates, exchange rates, inflation, stock prices, etc)
- Collect data for the % changes in these variables for each of the last 101 days.
- Based on these 100 percentage changes in the past, in chronological order from oldest to newest change make projections from today on for 100 values for the variable.
- Use the projected values for each variable for each day to value each derivative, and then obtain an aggregate portfolio value for each day.
- Sort out the 100 portfolio values from highest to lowest.
- The losses implied in the fifth lowest portfolio is the VAR.

(2) Montecarlo Simulation:

- Calculate the probability distribution of each variable that can affect the portfolio and through Montecarlo simulations obtain the probability distribution of the portfolio.

(3) Variance-Covariance Analysis (VCV) or Delta-Normal

- Calculate the average return and standard deviation of the portfolio based on the returns of invididual assets and the covariance among these returns.
- It assumes that risk factor returns are always (jointly) normally distributed and that the change in portfolio value is linearly dependent on all risk factor returns.

VII. Derivatives for Emerging Markets

- Emerging Markets make up one of the fastest-growing sectors for derivatives.
- The Chicago Mercantile Exchange (CME) has been especially aggressive in developing EM products, including futures and options.
- For this purpose, the CME has created its Growth and Emerging Markets Division. It offers currency options on a number of currencies of emerging markets.
- Mexico (launched in 1995) and Brazil are quite active and have become the fastest growing contracts in CME history.
- In the over-the-counter market, J.P. Morgan, Merrill Lynch, ING Bank, and Salomon Brothers have been most active in EMs, creating "custom" hedges for specific clients.
- Today, in the over-the-counter market, it is possible to create hedging positions in more than 130 currencies.

- Also, many EM countries peg their currencies to a major currency (e.g., Estonia's to the Euro). Here, you can just hedge against this major currency (Cross-hedging).
- Cross-hedging techniques are used for minor currencies that have no direct hedging instruments, but which are closely correlated to others.
- Using mathematical models (OLS and Markov Switching Models), the correlation between this minor currency and established futures is calculated.
- This information provides the basis for hedging using the currency futures that are best related to the minor currency.
- (see Emerging Market Portfolios, By Michael Papaioannou, Irwin, 1997, for an application of this technique for Taiwan versus Japan, Germany, Canada and the UK).