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Financial derivatives market and financial engineering

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Lesson objectives

- Introduce the essence of financial engineering.
- Introduce main aspects of financial derivatives markets.
- Describe main types of financial instruments and positions which can be taken on the market.

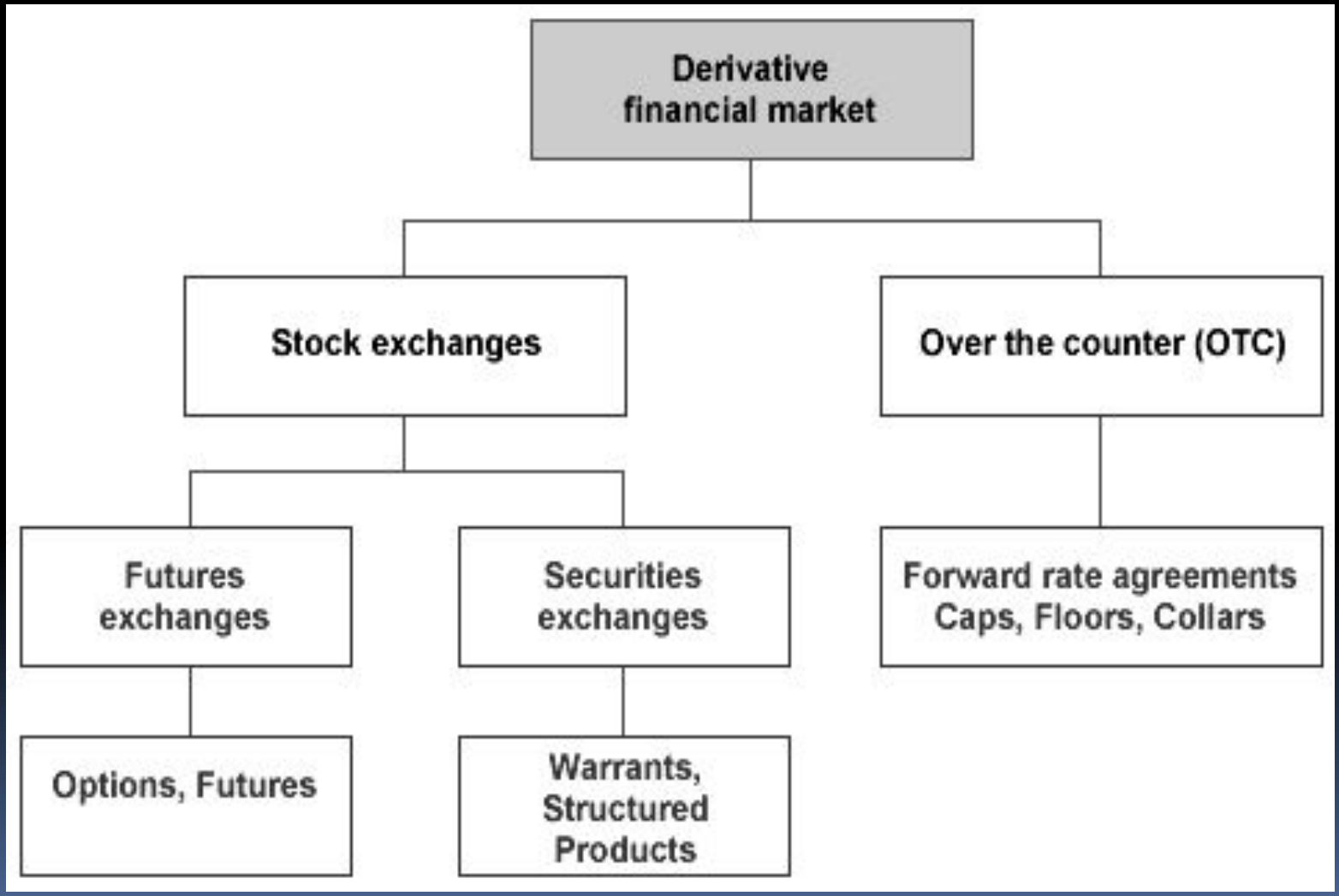
Financial engineering

- Financial engineering involves application of mathematical methods to solve financial problems. It uses methods from computer science, statistics, economics, etc.
- Financial engineering is employed by commercial banks, investment funds, insurance agencies and hedge funds.
- Those institutions can apply its methods for new product development, securities valuation , risk management portfolio optimization and scenario simulation.

Financial engineering 2

- **Securities pricing**: Financial engineering is aimed at pricing derivative securities based on arbitrage arguments.
- **Risk management**: Financial engineering evaluates the risk associated with current portfolio and helps to adjust it in case too high risk.
- **Portfolio optimization:** This implies choosing such trading strategy, which optimizes certain objective function reflecting the portfolio performance.

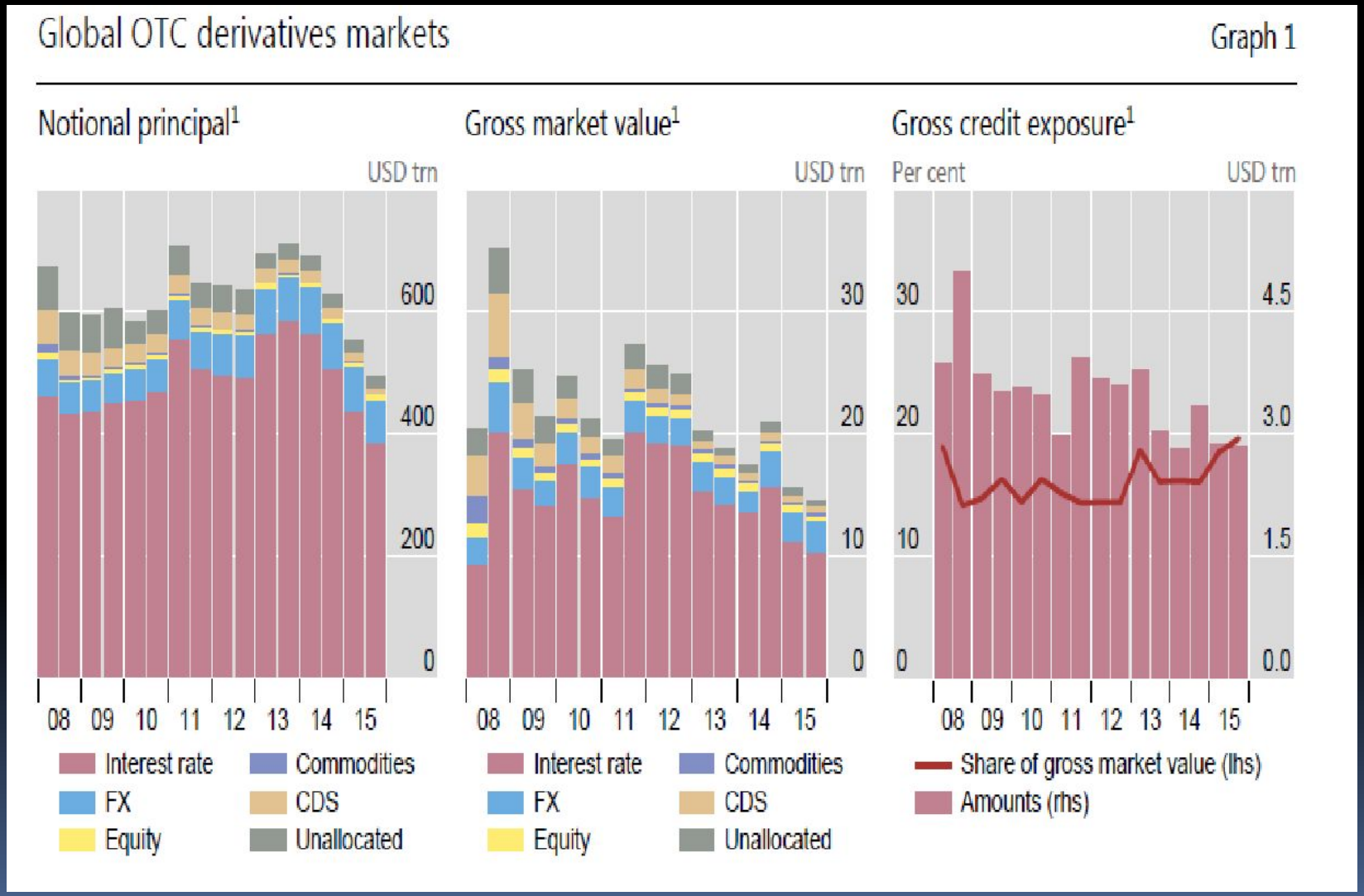
Financial derivatives market structure



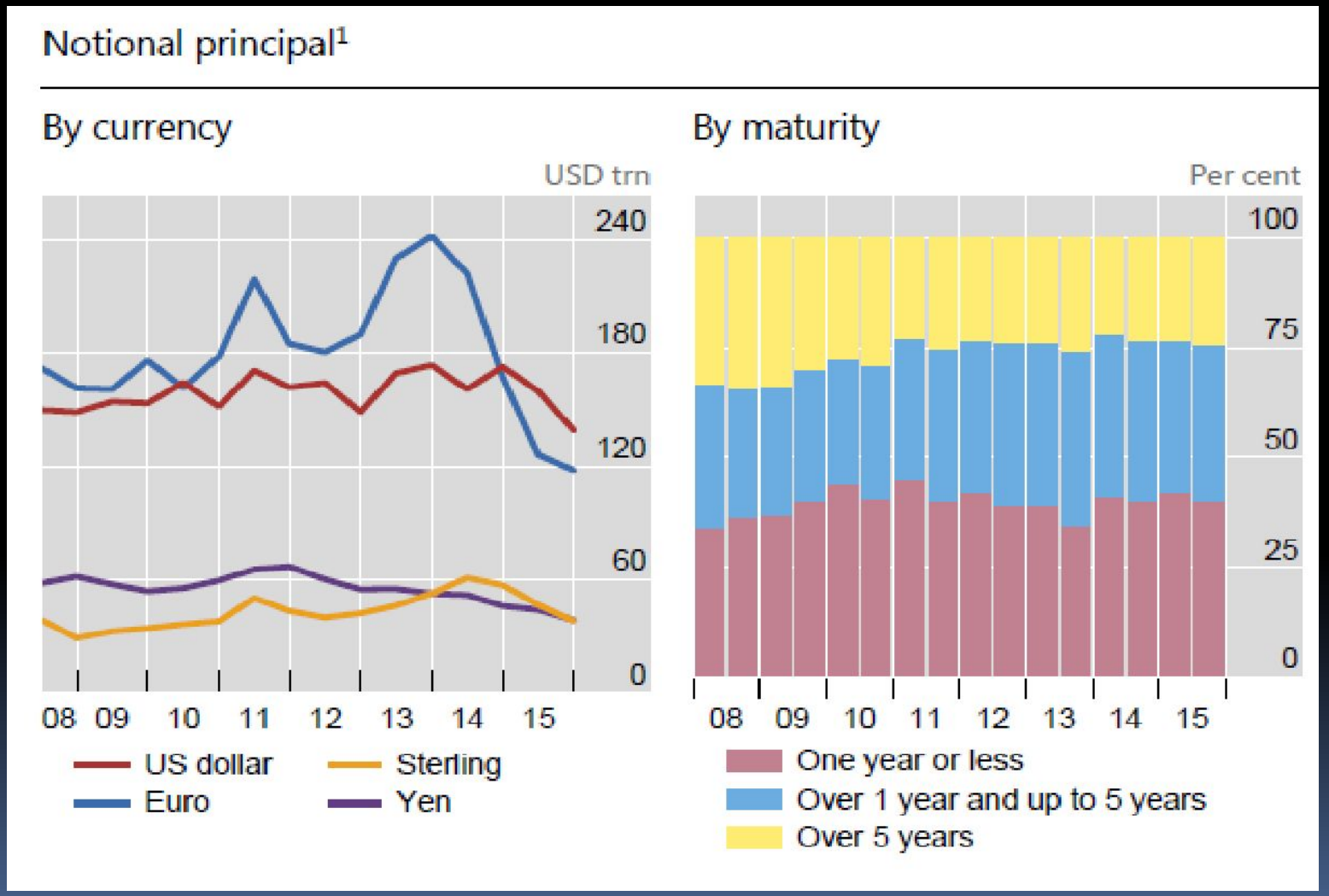
Financial Derivatives Market

- Financial derivatives market demonstrated very impressive growth starting from 1990s up to global financial crisis, being fuelled by financial innovation.
- Between 1998 and 2008 the size of the market grew by approximately 25% per year.
- Financial crisis revealed some deficiencies in the market structure which did not allow to adequately mitigate risks.

Financial Derivatives Market 2



Derivative Financial Market 3



Derivative financial markets 3

- In the derivative financial markets derivatives whose prices are derived from underlying asset are traded.
- Financial derivatives enable the transfer of unwanted risks from risk-averse to more risk-tolerant market participants.
- In case of trading financial derivatives the actual investments are comparatively small compared with the amounts involved .
- Price fluctuations as a share of investment capital are , on the other hand, greater than those in the price of underlying asset. This points to higher potential returns.

Onshore markets; Exchanges vs OTC

- Over-the-counter (OTC) markets evolved due to spontaneous trading activity.
- No formal organization , still closely monitored by regulatory agencies and transaction performed according to documentation.
- In OTC market transactions done electronically or over the phone with instruments having greater flexibility.
- Interest rate swap market is OTC.

Onshore markets; Exchanges vs OTC 2

- Organized exchanges are formal entities . Traded instruments and trading procedures are standardized.
- The specifications of traded contracts are less flexible.
- Examples include stock markets trading equities or futures and options markets processing derivatives with different underlying assets.

Major players on derivatives markets

- ***Market makers:*** Market makers provide liquidity and must buy and sell at their quoted price. For each traded instrument they must quote a bid and an ask price.

- ***Traders :*** They buy and sell securities executing client's orders. Trader can also trade for the company given his her position limits.

- ***Brokers :*** They provide a platform where buyers and sellers can get together. Brokers also do not trade for themselves

Major players on derivatives markets 2

- ***Dealers****:* They quote two-way prices and hold large inventories of particular instruments for longer period of time then market makers.

- ***Risk managers :*** Risk managers asses the trade and give approvals if risks remain within preselected boundaries.

- ***Regulators***

Types of quoted prices

- Bid price

The price at which the market maker is willing to buy the underlying asset

- Ask price

The price at which the market maker is willing to sell the underlying asset

Major instrument classes

- Fixed income instruments – certificates of deposits, deposits , treasury bills .
- Bond market instruments- bonds and floating rate notes
- Equities
- Currencies
- Commodities
- Derivatives
- Credit instruments : corporate bonds , credit default swaps
- Structured products: MBS , ABS

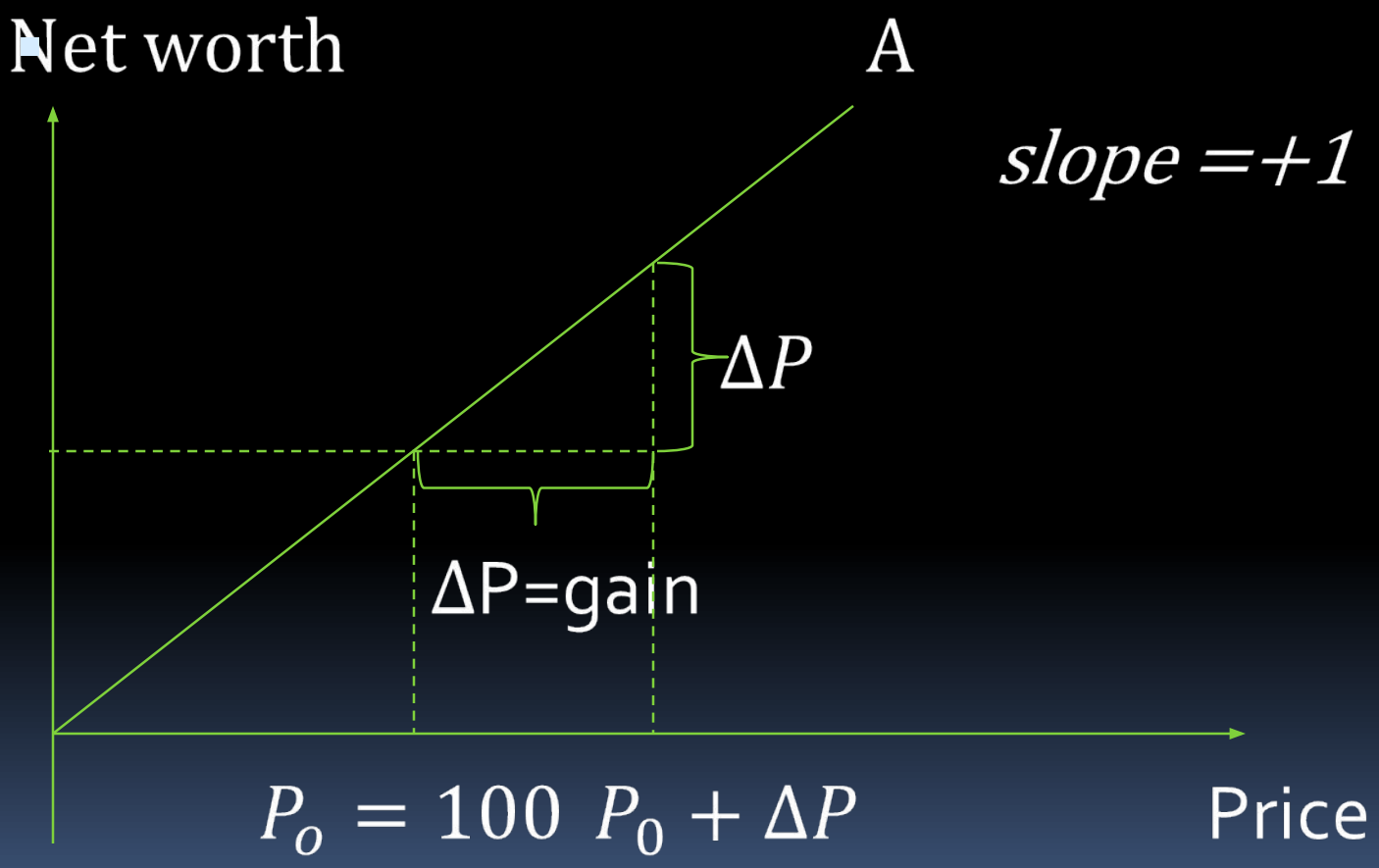
Long vs Short position

- ***Long position*** - buy an item for cash and hold it or sign contract implying obligation to buy something at future date.

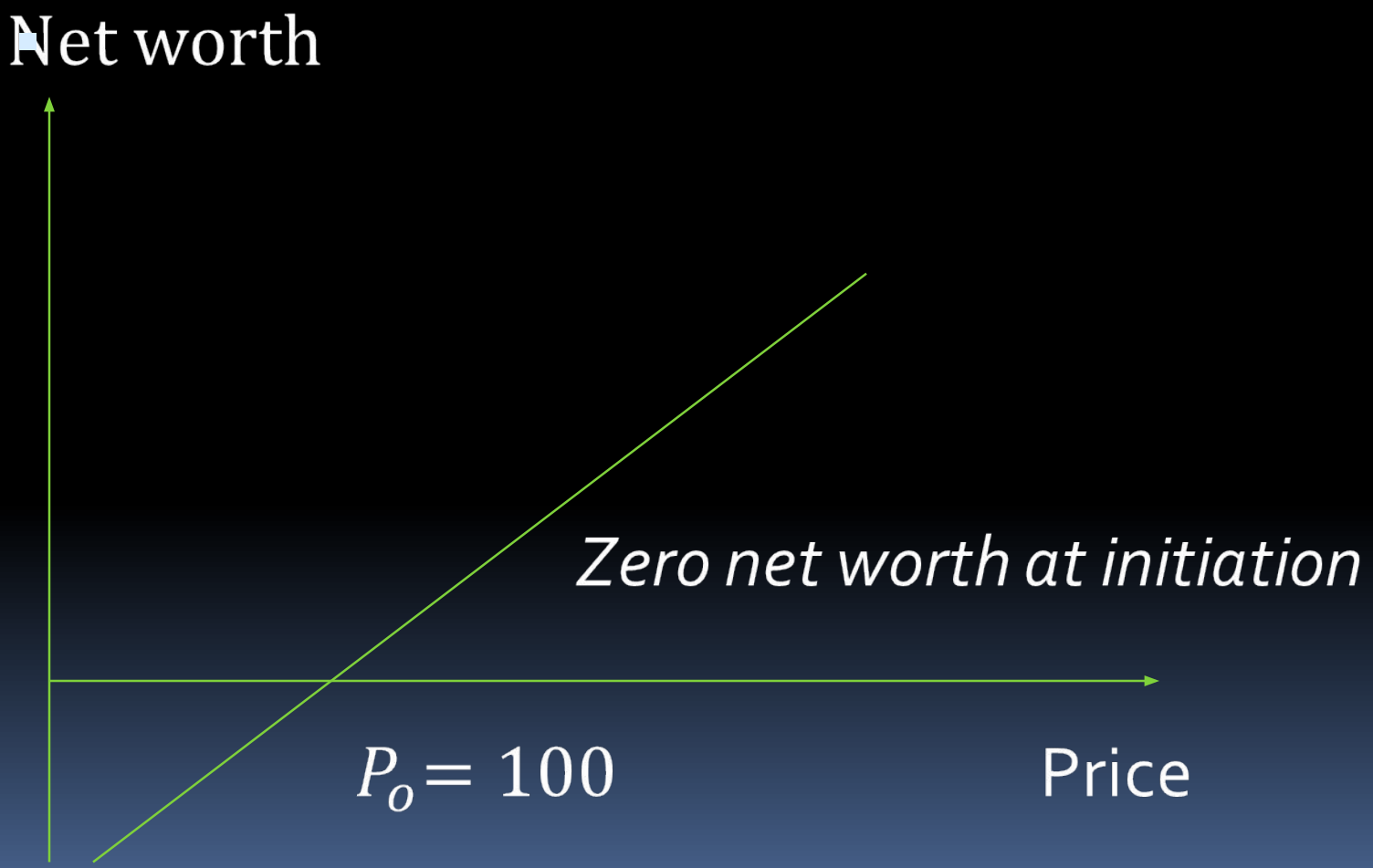
- Long position implies profit if underlying asset price increases.

- *Short position* – market participant has sold an item without actually owning it.

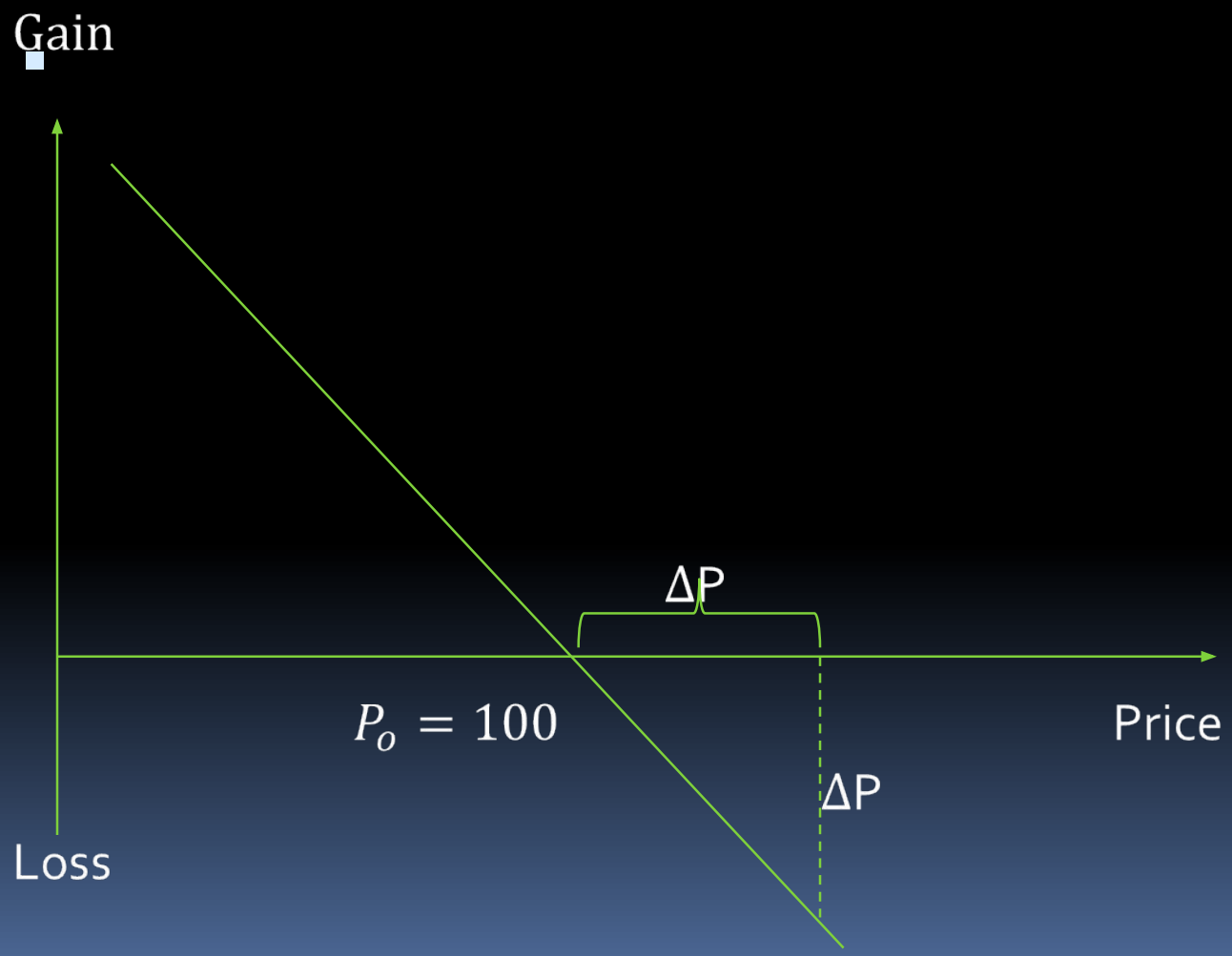
Payoff Diagram: Long position



Payoff Diagram: Funding long position



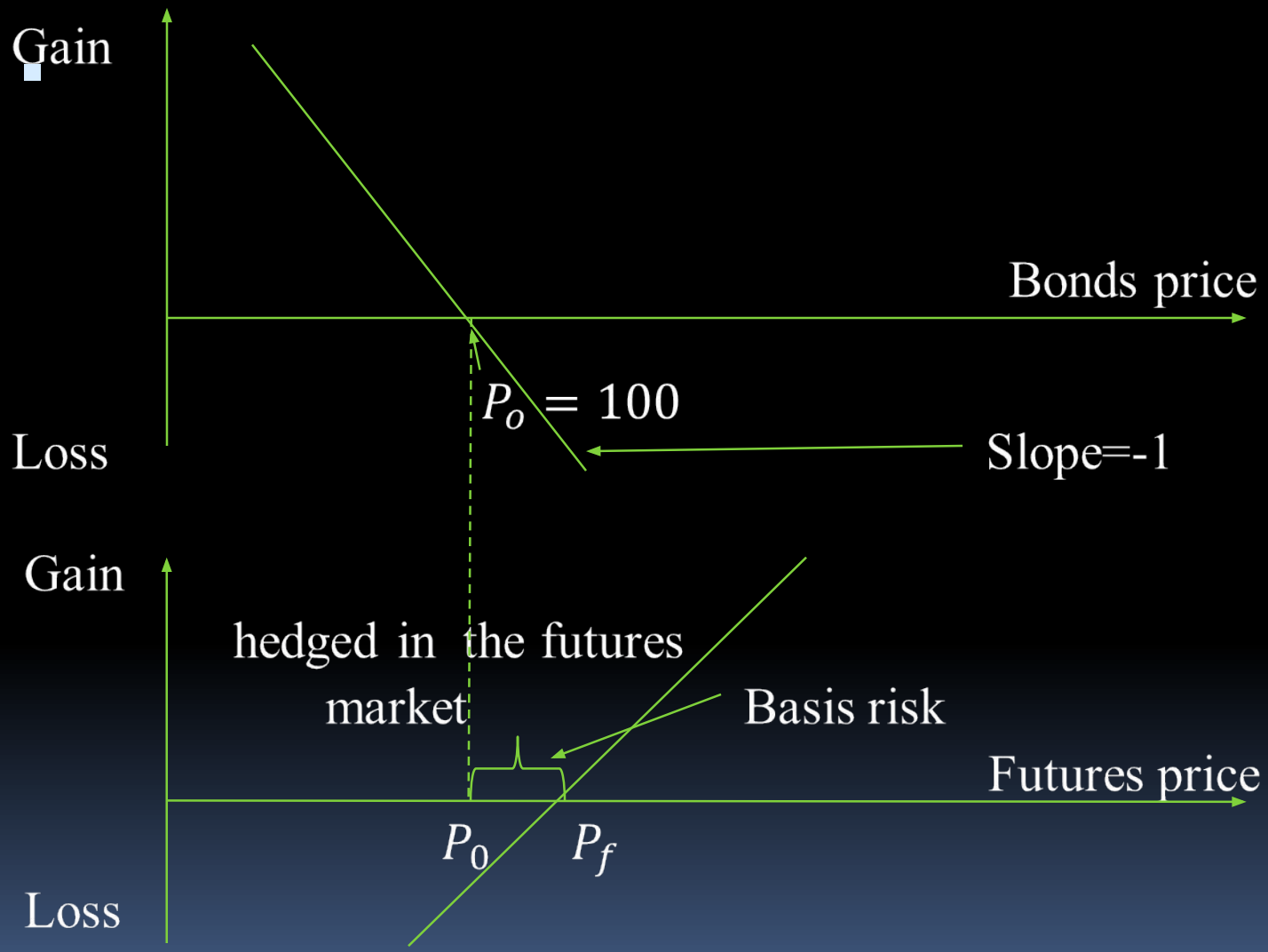
Payoff Diagram: Short position



Purposes of taking positions

- ***Hedging-*** this is done to eliminate the exposures of existing positions without unwinding position itself.
- Say we have short position in a bond. If price of bond goes up market-to-market loss will be registered.
- To hedge we buy a similar bond thus reducing exposure to movements in underlying price. Still some basis risk will remain.
- Alternatively one can take a long position but in futures or forwards market instead of spot market.

Hedging with futures contract



Purposes of taking positions 2

- ***Arbitrage***

Prices of financial instruments are ***arbitrage –free*** (no opportunity for arbitrage) if portfolio with non-negative return in the future, which costs nothing to assemble does not exist .

Arbitrage free prices represent fair market value for underlying instrument.

Equivalent of zero in finance

- Consider initial date t_0 when one concludes the following deal with a bank.
- At t_1 100 USD is borrowed from a bank at a current LIBOR rate L_{t_1}.
- The interest and principal is paid back at time t_2.
- No default risk for the loan which lasts δ units of time.

Equivalent of zero in finance 2

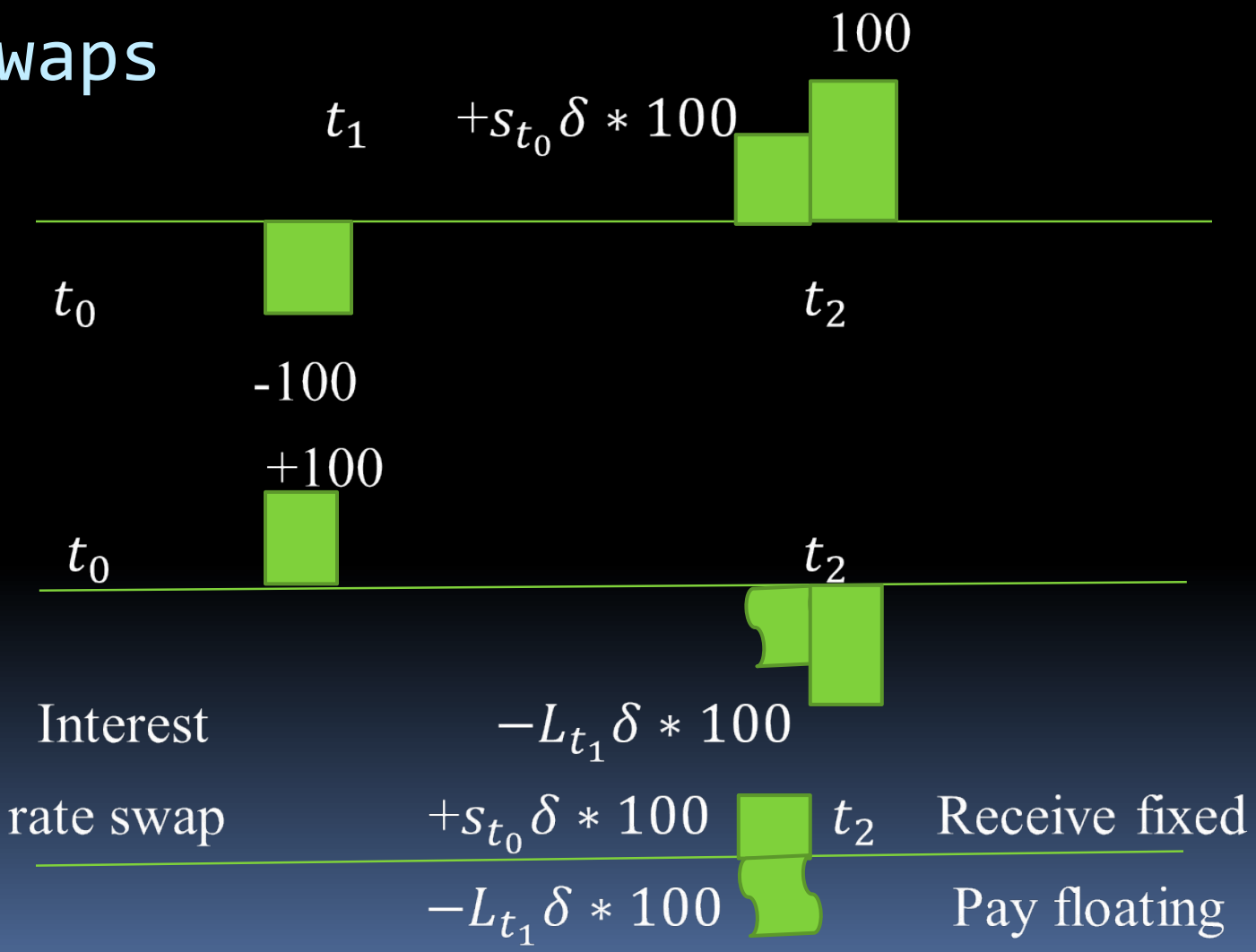
- For any t between t_0 and t_1 value of the described forward contract is zero irrespective of future interest rate.

- Time t_1 value of future cash flows is given by :

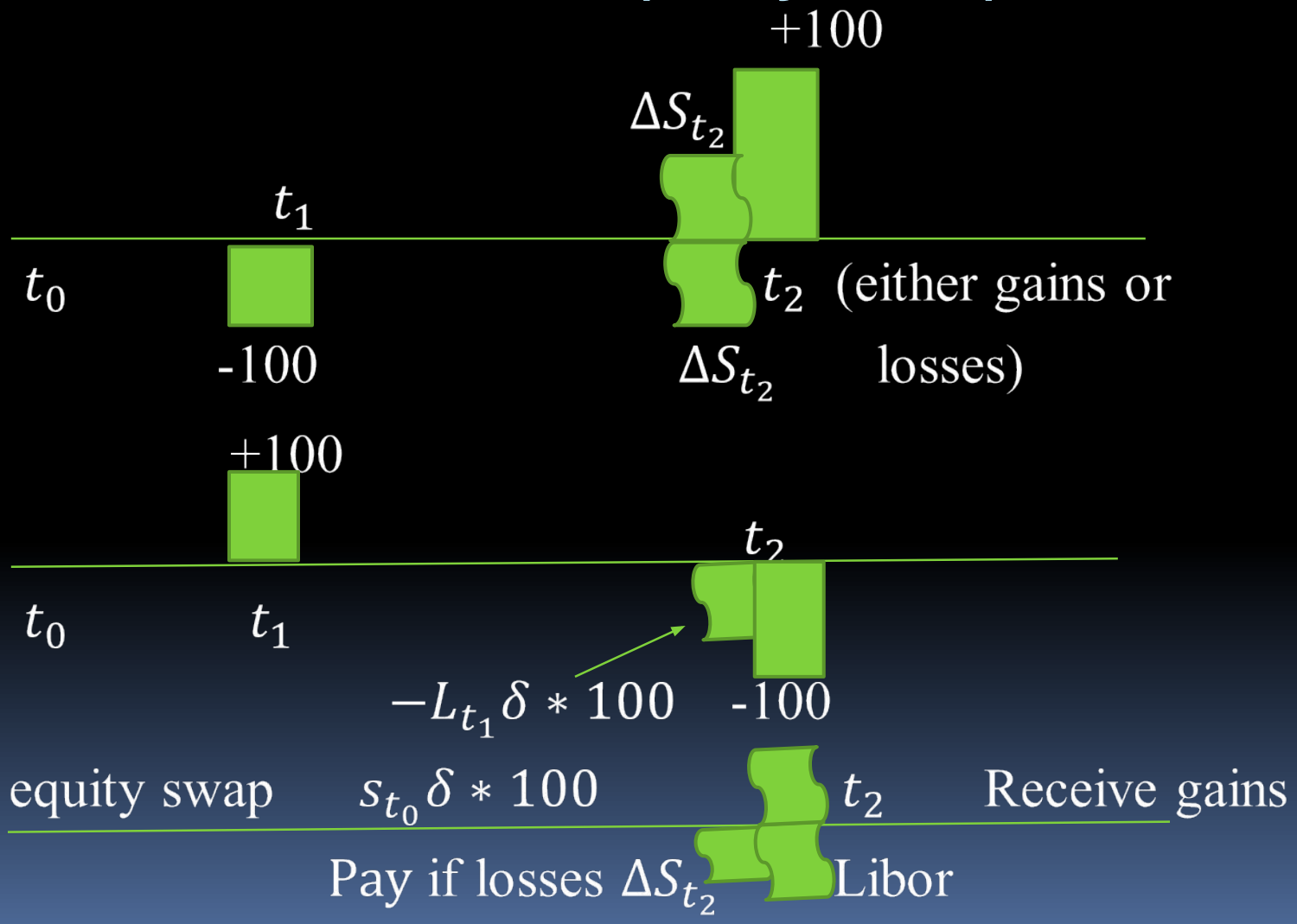
$$PV_{t_1} = \frac{L_{t_1}\delta * 100}{(1+L_{t_1}\delta)} + \frac{100}{(1+L_{t_1}\delta)} = 100$$

- The value of this contract is zero. Thus the value of LIBOR loan can be added(subtracted) to the value of any instrument

Example of financial engineering: Construction of interest rate swaps



Example of financial engineering: Construction of equity swaps



Conclusion

- Financial engineering involves application of mathematical methods to solve such financial issues as securities valuation , risk management portfolio optimization , etc.
- In derivatives financial market the financial derivatives , which allow the transfer of unwanted risks, are traded.
- Over the counter markets have no formal organization and are characterized by greater flexibility of traded instruments.

Conclusion 2

- Default free forward LIBOR loan is equivalent of zero on financial markets.
- It has zero initial value and it's addition or subtraction does not risk market risk characteristics of additional instrument .
- Interest rate swaps and equity swaps essentially represent transaction of buying bonds or stocks paired with taking a LIBOR loan.