The Derivative Market

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Outline

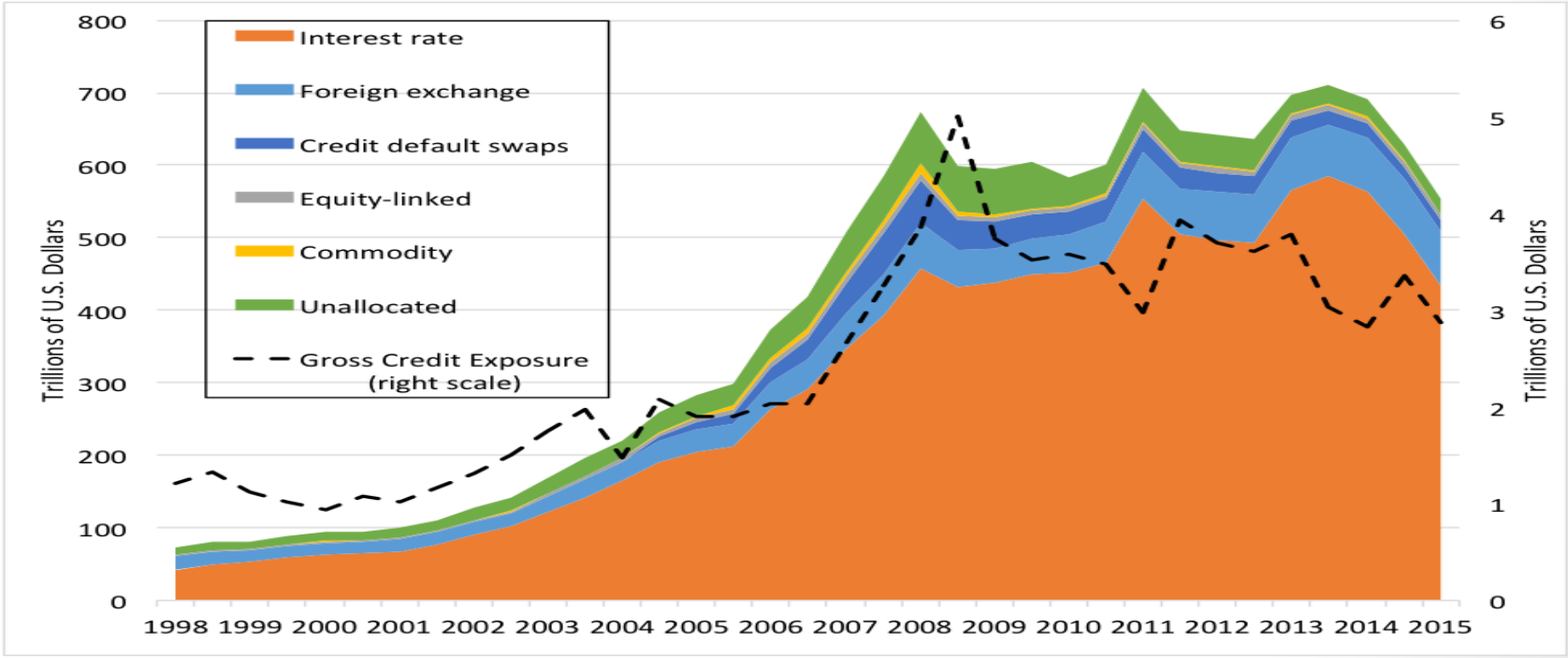
- Definition of Derivatives
- Current Market Size
- Why do People Invest in this Market?
- History of the Development of Derivatives
- Breakdown of the Derivative Market
  - Future Contracts
  - Forward Contracts
  - Swaps
  - Options
- Risk Factors
- Its Influence on the Economy

What is a Derivative?

- A derivative is a security with a price that is dependent upon or derived from one or more underlying assets.
- It is a contract between two or more parties based upon the asset or assets. Its value is determined by fluctuations in the underling assets.
- The most common underlying assets include stocks, bonds, commodities, currencies, interest rates and market indexes.
- The Most common derivatives are Options, Future/Forward contracts and Swaps.
- It can be traded through OTC or through Exchanges.

Size of Derivative Market

- $553 trillion at end of 2015
- > 10 times world GDP
- 6 times world's stock and bond's market
- Grew to $700 trillion in 2011, but is having some fluctuations in recent years.



Purposes for Investors

- **Earn money without physical settlement**
- **Protect your securities against fluctuations**
- **Transfer of risk**

Brief History of Derivatives

- Earliest uses around 8,000 B.C. in Sumer & Greece.
- Development of trading centers (like OTC) during Medieval Europe
- First future market in 1700 Japan
- Widespread in size and coverage of underlying assets in 1970's

Breakdown of the Market

- Future Contract:
  - **Futures are contracts that represent an agreement to buy or sell a set of assets at an agreed upon price, a specified time in the future for a specified amount.**
    - Used in major stock markets, major currency pairs, and major interest rates.

Future Example

- For example, suppose that on July 31, 2014 Diana owned ten thousand shares of Wal-Mart (WMT) stock, which were then valued at $73.58 per share. Jerry agrees to a futures contract with Diana, dictating that in one year's time Jerry will buy Diana's ten thousand Wal-Mart shares at their current value of $73.58.
  - If the value of Diana's stock declines, her investment is protected because Jerry has agreed to buy them at their July 2014 value.
  - And if the value of the stock increases, Jerry earns greater value on the stock, as he is paying July 2014 prices for stock in July 2015.

Valuation of Futures

- **Cost of Carry Model**
- **FP = SP + (Carry Cost – Carry Return)**
  - FP: future price
  - SP: spot price
  - Carry Cost refers to the cost of holding the asset till the futures contract matures. This could include storage cost, interest paid to acquire and hold the asset, financing costs etc.
  - Carry Return refers to any income derived from the asset while holding it like dividends, bonuses etc.
  - A net of these two is called the net cost of carry.

FUTURES PRICING ACCORDING TO COST OF CARRY MODEL

Breakdown of the Market

- Forward Contracts:
  - **Forwards are futures, which are not standardized. They are not traded on a stock exchange.**
    - Unlike standard future contracts, a forward contract can be customized to any commodity, amount and delivery dates. Riskier for higher chance of default.

Forward Example

- For Example, assume that an agricultural producer has 2 million bushels of corn to sell six months from now. He enters into a forward contract with its financial institution to sell 2 million bushels of corn at a price of $4.30 per bushel in six months.
  - In six months, if price per bushel rises higher than $4.30, say $5.00. The producer owes the institution $1.4 million.
  - If the price declines to lower than the contract price, say $3.50, the financial institution will pay the producer $1.6 million.

Breakdown of the Market

- Swaps:
  - **A swap is most often a contract between two parties agreeing to trade loan terms, which are called interest rate swaps.**
  - **One might use an interest rate swap in order to switch from a variable interest rate loan to a fixed interest rate loan, or vice versa.**
    - It can be made using interest rates, currencies or commodities.

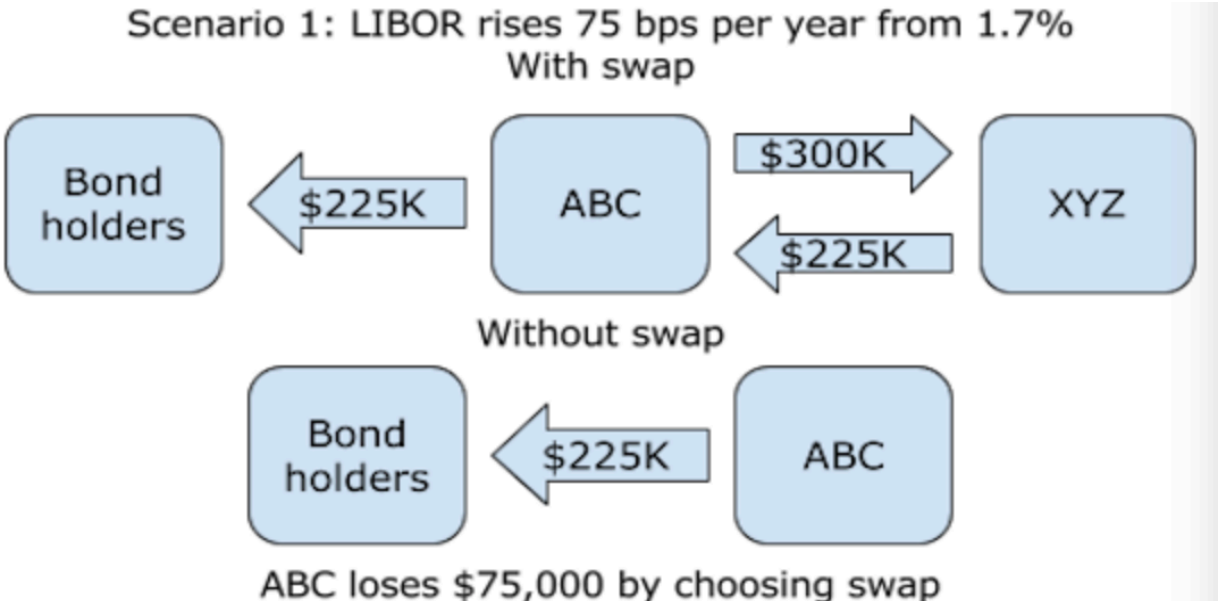
Swap example

- For example, say ABC Co. has just issued $1 million in five-year bonds with a variable annual interest rate defined as the London Interbank Offered Rate (LIBOR) plus 1.3%. LIBOR is at 1.7%, low for its historical range, so ABC management is anxious about an interest rate rise.

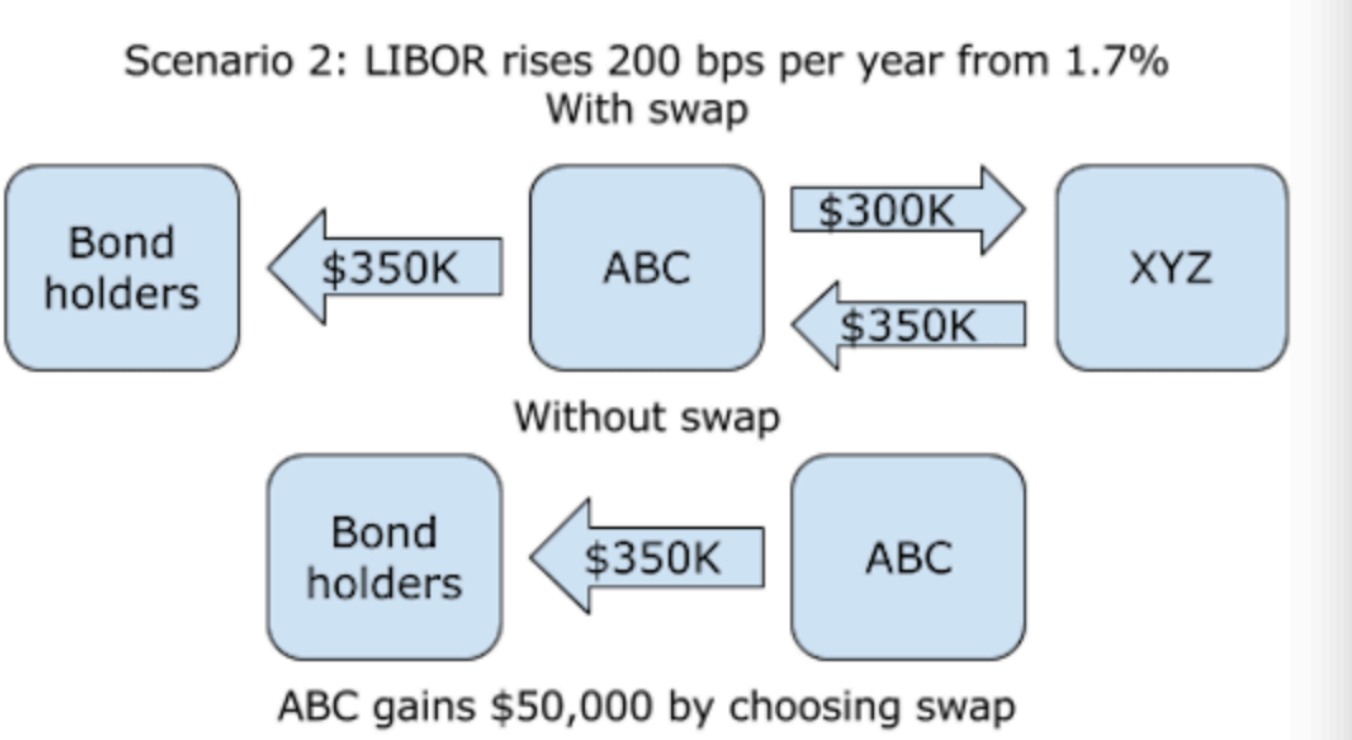
- They find another company, XYZ Inc., that is willing to pay ABC an annual rate of LIBOR plus 1.3% on a notional principal of $1 million for 5 years.

- In other words, XYZ will fund ABC's interest payments on its latest bond issue. In exchange, ABC pays XYZ a fixed annual rate of 6% on a notional value of $1 million for five years. ABC benefits from the swap if rates rise significantly over the next five years. XYZ benefits if rates fall, stay flat or rise only gradually.

- Scenario 1
- If LIBOR rises by 0.75% per year, Company ABC's total interest payments to its bond holders over the five-year period are $225,000:
- 225000=1000000*(5*0.013+0.017+0.0245+0.032+0.0395+0.047)
- In other words, $75,000 more than the $150,000 ABC would have paid if LIBOR had remained flat:
- 150000=1000000*5*(0.013+0.017)
- ABC pays XYZ $300,000:
- 300000=1000000*5*0.06
- ABC's net loss on the swap comes to $75,000.



- Scenario 2
- In the second scenario, LIBOR rises by 2% a year. This brings ABC's total interest payments to bond holders to $350,000
- 350000=1000000*(0.013*5+0.017+0.037+0.057+0.077+0.097)
- XYZ pays this amount to ABC, and ABC pays XYZ $300,000 in return. ABC's net gain on the swap is $50,000.



Valuation of Swaps

$$P_{\text{fix}} = \sum_{i=1}^{n} N \cdot R \cdot \alpha_{i-1,i} \cdot D_i,$$

- *Pfix* = present value of cash flows for the fixed leg,
- *N* = notional principal amount,
- *R* = fixed coupon rate,
- *n* = number of coupons payable between value date and maturity date,
- *αi- 1,i* = accrual factor between dates *i* - 1 and *i* based on the specified accrual method, and
- *Di* = discount factor on cash flow date *i*.

Valuation of Swaps Continued

$$P_{\text{flt}} = \sum_{i=1}^{n} N \cdot F_{i-1,i} \cdot \alpha_{i-1,i} \cdot D_i,$$

$$F_{i-1,i} = \frac{1}{\alpha_{i-1,i}} \left(\frac{D_{i-1}}{D_i} - 1 \right),$$

- *Pfit* = present values of cash flows for floating leg,
- *N* = notional principal amount,
- *Fi-1, i* = (implied) forward rate from date *i* - 1 to date *i*,
- *αi- 1,i* = accrual factor from date *i* - 1 to date *i* based on the specified accrual method
- *n* = number of cash flows from settlement date to the maturity date, and
- *Di* = discount factor on cash flow date *i*.

- **Pay floating, receive fixed**

Pswap = Pfix - Pflt,

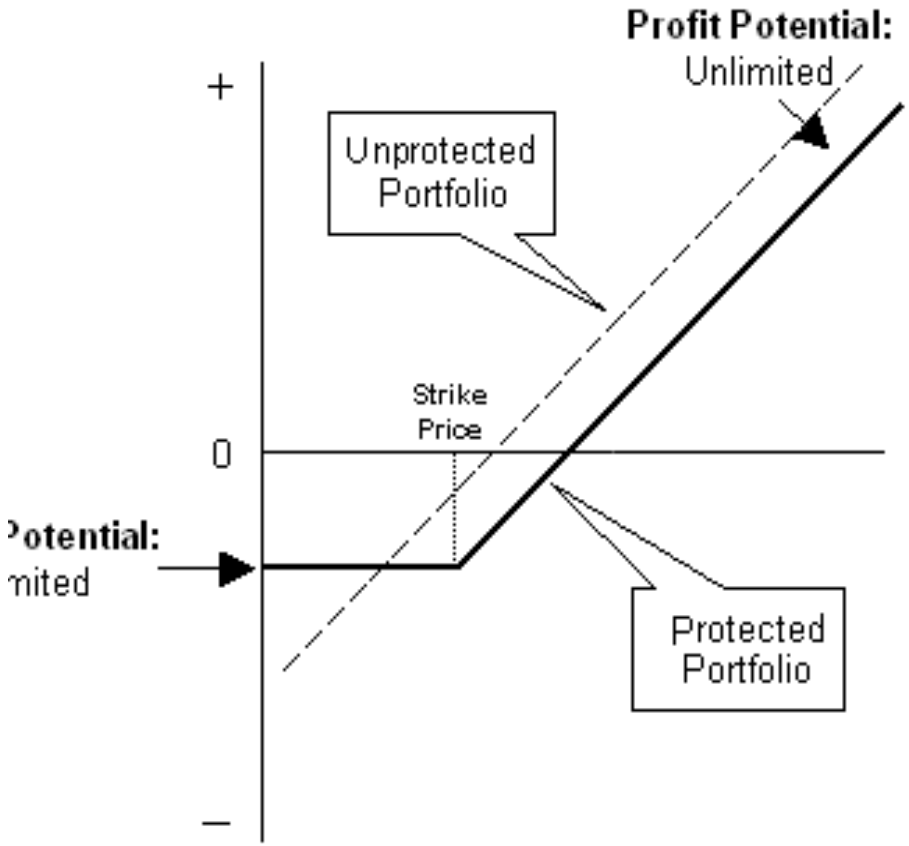
- **Pay fixed, receive floating**

Pswap = Pflt - Pfix

Breakdown of the Market

- Options:
  - **These contracts are quite similar to futures and forwards. However, there is one key difference. Once you buy an options contract, you are not obligated to hold the terms of the agreement.**
    - Mostly used in hedging and speculation of the stock markets.

Example



Volatility:
Increase = Positive E
Decrease = Negative

Time Decay:
Negative Effect

Valuation of Options

- **Option price=intrinsic value+ time value**
- **Intrinsic value**
  - Call Option Intrinsic Value = Underlying Stock's Current Price – Call Strike Price
  - Put Option Intrinsic Value = Put Strike Price – Underlying Stock's Current Price

HOW PREMIUM OPTIONS PRICING IS ARRIVED AT

Valuation of Options Continued

- **Option price=intrinsic value+ time value**
- **Time Value**
  - The more time an option has until it expires, the greater the chance it will end up in the money.
  - The time component of an option decays exponentially.
  - As a general rule, an option will lose one-third of its time value during the first half of its life and two-thirds during the second half of its life.
  - Also impacted greatly by underlying stock's volatility.

Stock:	GE	Price	34.80			Expires:	1 month
	Call Option				Put Option		
Intrinsic Value	Time Value	Option Price	Strike Price	Intrinsic Value	Time Value	Option Price	
4.80	0.20	5.00	30.00	0.00	0.01	0.01	
0.00	0.53	0.53	35.00	0.20	0.40	0.60	
0.00	0.01	0.01	40.00	5.20	0.80	6.00	
		= In the Money					

Stock:	GE	Price	34.80			Expires:	9 months
	Call Option				Put Option		
Intrinsic Value	Time Value	Option Price	Strike Price	Intrinsic Value	Time Value	Option Price	
4.80	2.05	6.85	30.00	0.00	1.17	1.17	
0.00	3.70	3.70	35.00	0.20	2.62	2.82	
0.00	1.75	1.75	40.00	5.20	0.35	5.55	
		= In the Money					

Stock:	AMZN	Price	38.70			Expires:	1 month
	Call Option				Put Option		
Intrinsic Value	Time Value	Option Price	Strike Price	Intrinsic Value	Time Value	Option Price	
3.70	0.30	4.00	35.00	0.00	0.17	0.17	
0.00	0.65	0.65	40.00	1.30	0.55	1.85	
0.00	0.05	0.05	45.00	6.30	-0.20	6.10	
		= In the Money					

Stock:	AMZN	Price	38.70			Expires:	9 months
	Call Option				Put Option		
Intrinsic Value	Time Value	Option Price	Strike Price	Intrinsic Value	Time Value	Option Price	
3.70	6.41	10.11	35.00	0.00	4.00	4	
0.00	7.50	7.50	40.00	1.30	4.80	6.10	
0.00	4.97	4.97	45.00	6.30	3.00	9.30	
		= In the Money					

Risk Factors

- **Counter party default risk**
- **Hidden tail risk**
- **High leverage**
- **Chain reactions**

Influences on the Economy

- **Tools in determining both current and future prices of assets**
- **Risk reallocation**
- **Increase in trade volumes and investments of underlying assets**
- **Indication of underlying assets performance**

Sources

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