Forward and Futures Markets

1. Definition and markets
2. Daily settlement
3. Eurodollar futures
4. Forward Rate Agreements (FRAs)

What is a forward contract? A legally binding agreement between two counterparties, calling for purchase and sale of an asset at a future time with a price agreed upon today.

What is a futures contract? A standardized forward contract, which is traded on an organized exchange, and follows mark-to-market (daily settlement) procedures on a daily basis.

Futures market ➔ ☺

Future market ➔ %*@&?! 

Three is no such thing as a “future contract” or “future market”. Some professional even don’t know the proper term. The right terminologies are “futures contract” and “futures market”.

Basic terminology:

Buyer of a forward contract:

- Agrees to buy the underlying asset in the future.
- Holds a long forward position: take delivery and make payments.
- Bets spot/forward price to increase.

Seller of a forward contract:

- Agrees to sell the underlying asset in the future.
- Holds a short forward position: make delivery and collect payments.
- Bets spot/forward price to drop.

- Settlement day: maturity of a forward contract.
- Settlement month: maturity of a futures contract.
- Forward (futures) price: settlement price, delivery price.

History of forward and futures markets:

- Europe: Middle Ages
- Japan: Two hundred years ago
- U.S.:
  - 1848: the Chicago Board of Trade (CBOT/CME)
  - 1874: the Chicago Mercantile Exchange (CME)
  - 1961: pork bellies
  - 1966: live cattle
  - 1972: foreign currencies
  - 1976: U.S. Treasury bills
  - 1977: U.S. Treasury bond
  - 1982: S&P 500 stock index
  - 2002: Single Stock Futures: http://www.onechicago.com/

Futures types:

- Grains and oilseeds: corn, oats, soybeans, rough rice, wheat
- Livestock and meat: feeder cattle, live cattle, live hogs, pork bellies
- Food and fiber: cocoa, coffee, cotton, sugar, orange juice
- Metals: copper, gold, silver
- Energy: crude oil, heating oil, natural gas

- Currency: British pound, Euro, Japanese yen
- Stock indices: S&P 500, Nasdaq 100, DJIA 30, FTSE 100
- Interest rates: T-bonds, Eurodollar
- Other: volatility, weather, real estate index

Mark-to-market (daily settlement) procedure:

- Initial margin (performance bond)
- Maintenance margin
- Margin call
- Mark to market
- Offsetting transaction
- Open interest

Example: Daily settlement

On Monday, April 14, you sold one Chicago Mercantile Exchange (CME) June Treasury bond futures contract at the price of 159 9/32 ($159,281.25). The T-Bond futures contract is based on $100,000 face value of T-bonds. The futures price is quoted on a percent and 1/32 of a percent basis.

The initial margin requirement is $3,080, and the maintenance margin requirement is $2,800.

You maintain your position every day through Friday, April 18, and then buy back the contract at the close price on April 18. See below how daily settlement is put to action.

Example: Daily settlement (cont.)

Date	Settlement Price	Settlement Price($)	Mark-to-Market	Other Entries	Account Balance	Explanation
4/14	159-01	$159,031.25	**$250.00**	$3,080.00	$3,330.00	Initial margin deposit of $3080. Profit of $250.
4/15	158-24	$158,750.00	**$281.25**		$3,611.25	Profit of $281.25.
4/16	160-04	$160,125.00	**-$1,375.00**		$2,236.25	Loss of $1375 A margin call triggered.
4/17	159-26	$159,812.50	**$312.50**	$843.75	$3,392.50	Cash $843.75 transferred to margin account.
4/18	158-16	$158,500.00	**$1,312.50**	-$4,705.00	$0	Profit of $1312.50. Position closed.

Net gain = $781.25. Check!

Futures quotations and transactions:

- Cattle-Feeder Futures (CME) 50,000 lbs.; cents per lb.
- Vol. = trading volume; O.I. = open interest.

	Open	High	Low	Settle	Change	Vol.	O.I.
May	75.00	75.10	74.70	74.75	-0.45	623	3,005
~~Aug.~~	~~75.70~~	~~75.20~~	~~74.30~~	~~74.37~~	~~-0.90~~	~~7,577~~	~~28,160~~

Example: Farmer Bob previously <u>bought</u> four May Feeder Cattle futures contracts at 69.80 cents per pound. He sold these contracts at the opening on the above date. What are the gains/losses?

Solution: Bob has four long contracts.

Purchase price = $0.6980

Sales price = $0.7500

Net gains = $(0.7500 – 0.6980) \times 50{,}000 \times 4 = \$10{,}400$

	Open	High	Low	Settle	Change	Vol.	O.I.
May	75.00	75.10	74.70	74.75	-0.45	623	3,005
~~Aug.~~	~~75.70~~	~~75.20~~	~~74.30~~	~~74.37~~	~~-0.90~~	~~7,577~~	~~28,160~~

Example: Farmer Joe previously sold five May Feeder Cattle futures contracts at 72.15 cents per pound. He bought these contracts back at the market close on the above date. What are the gains/losses?

Solution: Joe has five short contracts.

Purchase price = \$0.7475

Sales price = \$0.7215

Net gains = (0.7215 – 0.7475)×50,000×5= –\$6,500.

Eurodollar futures:

- The London Interbank Offered Rate (or LIBOR) is a daily reference rate based on the interest rates at which banks offer to lend unsecured funds to other banks in the London wholesale money market (or interbank market). LIBOR will be slightly higher than the London Interbank Bid Rate (LIBID), the rate at which banks are prepared to accept deposits.
- Which rate is higher? LIBOR or LIBID?

Eurodollar futures: (cont.)

- LIBOR is published by ICE (Intercontinental Exchange) at 11:45 am each day, London time, and is a filtered average of inter-bank rates offered by designated contributor banks. There are 16 such contributor banks and the reported rate is the mean of the eight middle values. There are seven maturities: overnight (1 day), 1 week, 1 month, 2 months, 3 months, 6 months, and 12 months.
- At least $350 trillion in derivatives and other financial products are tied to the LIBOR.
- How many LIBOR rates are there?

Eurodollar futures: (cont.)

- LIBOR is used as a reference rate for five major currencies: U.S. dollar (USD), Euro (EUR), Pound Sterling (GBP), Japanese Yen (JPY), and Swiss Franc (CHF).
- Q: What are the current LIBOR rates?

http://www.global-rates.com/interest-rates/libor/libor.aspx

- The Chicago Mercantile Exchange's Eurodollar contracts are based on three-month U.S. dollar LIBOR rates. They are the world's most heavily traded short term interest rate futures contracts and extend up to 10 years. Shorter maturities trade on the Singapore Exchange in Asian time. Visit http://www.cmegroup.com/trading/interest-rates/stir/eurodollar.html.

Eurodollar futures: (cont.)

- The Eurodollar futures contract is written on a \$1,000,000, three-month USD LIBOR rate. Settlement is in cash.
- IMM Eurodollar index value = 100 – LIBOR rate (%)
- The Eurodollar futures prices are quoted in the form of the IMM Eurodollar Index as follows:

$$\boxed{f = 1{,}000{,}000 \times \left(1 - \frac{100 - IMM\ Eurodollar\ Index}{100} \times \frac{90}{360}\right)}$$

http://www.cmegroup.com/trading/interest-rates/stir/eurodollar.html

Eurodollar Futures Quotes

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Month	Options	Charts	Last	Change	Prior Settle	Open	High	Low	Volume	Updated
APR 2016	OPT		99.3700	+0.01	99.36	99.3625	99.3700	99.3625	14,168	15:18:55 CT 30 Mar 2016
MAY 2016	OPT		99.345	+0.015	99.33	99.325	99.345	99.325	3,508	15:18:55 CT 30 Mar 2016
JUN 2016	OPT		99.310	+0.025	99.285	99.290	99.315	99.285	259,919	15:45:49 CT 30 Mar 2016
JUL 2016	OPT		99.275	+0.03	99.245	99.260	99.275	99.255	205	14:28:53 CT 30 Mar 2016
AUG 2016	OPT		99.260	+0.02	99.24	99.245	99.265	99.245	1,340	14:28:53 CT 30 Mar 2016
SEP 2016	OPT		99.235	+0.035	99.20	99.210	99.240	99.205	232,092	15:43:00 CT 30 Mar 2016
DEC 2016	OPT		99.170	+0.045	99.125	99.135	99.175	99.125	301,682	15:45:49 CT 30 Mar 2016
MAR 2017	OPT		99.120	+0.05	99.07	99.080	99.125	99.070	249,031	15:46:01 CT 30 Mar 2016
JUN 2017	OPT		99.060	+0.05	99.01	99.020	99.070	99.005	207,971	15:42:05 CT 30 Mar 2016
SEP 2017	OPT		99.000	+0.05	98.95	98.955	99.010	98.945	150,458	15:45:23 CT 30 Mar 2016
DEC 2017	OPT		98.925	+0.05	98.875	98.880	98.935	98.865	182,405	15:45:05 CT 30 Mar 2016

Eurodollar futures: (cont.)

- IMM Eurodollar index value = 100 – three-month-LIBOR rate (%)
- For example, if the index value is 94.12, then the three-month LIBOR rate is 5.88% per annum. The contract price, by definition, is:

$$f = 1{,}000{,}000 \times \left(1 - \frac{100 - 94.12}{100} \times \frac{90}{360}\right) = \$985{,}300$$

- The tick size in the IMM Eurodollar index equals to \$25 change in futures price: 1,000,000×0.01%×(90/360) = \$25.

Eurodollar futures: (cont.)

- As the IMM Eurodollar Index increases, the three-month LIBOR rate decreases, the futures price of the Eurodollar contract increases. Thus, the buyer benefits and the seller loses.
- As the IMM Eurodollar Index decreases, the three-month LIBOR rate increases, the futures price of the Eurodollar contract decreases. Thus, the seller benefits and the buyer loses.
- **Eurodollar futures contract is a futures contract on the price of an "imaginary" debt instrument based on the three-month USD LIBOR rate.**

Speculation on future LIBOR rates

- Suppose that the IMM Eurodollar Index for June 2020 Eurodollar futures is 95.78. It suggests that the market believes that the spot 3-month LIBOR rate in June 2020 is 4.22%.
- You expect that spot 3-month LIBOR rate in June 2020 is much higher than 4.22%. You expect it to be 6%.
- Q: What's the proper action to benefit?
  - If you hold your position until June 2020 and the spot rate turns out to be exactly 6%, what's your profit?

Speculation on future LIBOR rates

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- You expect that spot 3-month LIBOR rate in June 2020 is much higher than 4.22%. You expect it to be 6%.
- Q: What's the proper action to benefit?
  - If you hold your position until June 2020 and the spot rate turns out to be exactly 6%, what's your profit?
- Answer: Sell June 2020 Eurodollar futures today. If the spot rate turns out to be 6% in June 2020, the IMM Eurodollar Index becomes 100 – 6 = 94.00. You make (9578 – 9400)×25=$4450 per contract.

Speculation on future LIBOR rates

- Suppose that the IMM Eurodollar Index for June 2020 Eurodollar futures is 95.78. It suggests that the market believes that the spot 3-month LIBOR rate in June 2020 is 4.22%.
- You expect that spot 3-month LIBOR rate in June 2020 is much lower than 4.22%. You expect it to be 3.50%.
- Q: What's the proper action to benefit?
  - If you close out your position 2 days later when the Index becomes 95.57, what's your profit?

Speculation on future LIBOR rates

- Suppose that the IMM Eurodollar Index for June 2020 Eurodollar futures is 95.78. It suggests that the market believes that the spot 3-month LIBOR rate in June 2020 is 4.22%.
- You expect that spot 3-month LIBOR rate in June 2020 is much lower than 4.22%. You expect it to be 3.50%.
- Q: What's the proper action to benefit?
  - If you close out your position 2 days later when the Index becomes 95.57, what's your profit?
- Answer: Buy June 2020 Eurodollar futures today. If the Index becomes 95.57 and you close out the position, you make (9557 – 9578)×25= –$525 per contract. (A loser!)

Forward Rate Agreements (FRAs)

A forward rate agreement (FRA) is a forward contract in which one party pays a fixed interest rate, and receives a floating interest rate equal to a reference rate (the underlying rate, generally LIBOR). The payments are calculated over a notional principal (NP) amount over a certain period, and netted, *i.e.* only the differential is paid. FRAs are over-the-counter derivatives. An interest rate swap can be viewed as a portfolio of FRAs.

The payer of the fixed interest rate is also known as the buyer of the FRA, while the receiver of the fixed interest rate is the seller of the FRA. The buyer of the FRA bets the underlying reference rate to go up. The seller bets it to go down.

Forward Rate Agreements (FRAs) (cont.)

- A forward rate agreement (FRA) is a forward contract written on LIBOR which requires a cash settlement at maturity based on the difference between a realized spot reference rate (LIBOR) and a pre-specified forward (FRA) rate.
- An FRA has a zero value at initiation. Both counterparties agree to the FRA terms and sign the FRA contract. They settle cash payments at FRA expiration.
- The future value factor in money market is $(1 + r \times T)$ and not $(1 + r)^T$.

Forward Rate Agreements (FRAs) (cont.)

- A 2×8 FRA that expires in two months and is based on six-month LIBOR rate. The FRA rate is set at 5% today.
- In two months, the spot six-month LIBOR rate turns out to be 5.7%. Clearly the buyer wins. How much should the seller pay the buyer?
- Note that the FRA expiration is the beginning of the six-month LIBOR rate. A \$1 investment at the spot rate of 5.7% yields $\$1\left(1+5.7\%\times\frac{6}{12}\right)$ in six months. However, the same \$1 investment at the 5% benchmark FRA rate yields $\$1\left(1+5\%\times\frac{6}{12}\right)$.
- The long party should get the difference of $\$1\left[(5.7\%-5\%)\times\frac{6}{12}\right]$ at t = 8 months, or $\frac{\$1\left[(5.7\%-5\%)\times\frac{6}{12}\right]}{1+5.7\%\times\frac{6}{12}}$ at t = 2 months.

Forward Rate Agreements (FRAs) (cont.)

Payoff/profit formula of a FRA is negotiated between two counterparties. It is flexible as long as both counterparties agree to the terms in the payoff formula. A generic payoff formula (to the long party) generally takes the following form, even though each specific m×n FRA may adopt any variation and/or transformation of the following general formula:

$$FRA\ payoff = NP \times (reference\ rate\ - FRA\ rate) \times duration \times PV\ factor$$

Forward Rate Agreements (FRAs) (cont.)

$$FRA\ payoff = NP \times (reference\ rate\ - FRA\ rate) \times duration \times PV\ factor$$

$$FRA\ payoff = NP \times \frac{[reference\ rate\ - FRA\ rate] \times duration}{1 + reference\ rate \times duration}$$

$$FRA\ payoff = NP \times \frac{\left[\left(1 + S_m \times \frac{n-m}{12}\right) - \left(1 + FRA_0 \times \frac{n-m}{12}\right)\right]}{\left(1 + S_m \times \frac{n-m}{12}\right)}$$

$$FRA\ payoff = NP \times \frac{(S_m - FRA_0) \times \frac{n-m}{12}}{\left(1 + S_m \times \frac{n-m}{12}\right)}$$

Day-count convention

When we deal with fractional years, we need to count number of days in a reporting period. There are four ways to compute a fractional year. The following notation denotes "numerator # of days / denominator # of days"

- 30/30: e.g., 90/360, used in money market securities.
- Actual/30: e.g. 182/360, used in money market securities.
- ~~30/Actual: never used.~~
- Actual/Actual: e.g., 182/365, used in long-term fixed income securities.

Forward Rate Agreements (FRAs) (cont.)

Consider a two-month FRA, with NP of $10 million. The FRA is written on the three-month (91 days) LIBOR rate. Such a contract is referred to as a 2×5 FRA. The FRA rate is set today at 5.63% per annum. In two months time, at the maturity of the contract, the payoff to the long party by definition is:

$$payoff = \$10\,million \times \frac{[S(91) - 5.63\%] \times \frac{91}{360}}{1 + S(91) \times \frac{91}{360}}$$

Forward Rate Agreements (FRAs) (cont.)

$$payoff = \$10\,million \times \frac{[S(91) - 5.63\%] \times \frac{91}{360}}{1 + S(91) \times \frac{91}{360}}$$

where $s(91)$ is the spot three-month LIBOR rate at maturity. Suppose that at maturity, $s(91)$ is 5.90% per annum. In this case, the payoff to the buyer is

$$payoff = \$10\,million \times \frac{[5.90\% - 5.63\%] \times \frac{91}{360}}{1 + 0.0590 \times \frac{91}{360}} = \$6{,}724.71$$

Forward Rate Agreements (FRAs): (cont.)

On August 9, the spot five-month LIBOR rate was 5.55%, you sold a 4×9 FRA on LIBOR. The negotiated five-month FRA rate is 5.53%. The notional principal is $12 million. On December 9 the FRA matures. The spot five-month LIBOR rate is 5.66% and a 4×9 FRA rate is 5.72%. What is the value of your FRA? Use the following formula and 30/30 day count for your computation:

$$payoff = NP \times \frac{(reference\ rate - FRA\ rate) \times \frac{\#days}{360}}{1 + reference\ rate \times \frac{\#days}{360}}$$

Forward Rate Agreements (FRAs): (cont.)

$$payoff = NP \times \frac{(reference\ rate - FRA\ rate) \times \frac{\#days}{360}}{1 + reference\ rate \times \frac{\#days}{360}}$$

$$payoff = \$12\ million \times \frac{(5.66\% - 5.53\%) \times \frac{150}{360}}{1 + 0.0566 \times \frac{150}{360}} = \$6{,}350.24$$

The value of the short FRA is -$6,350.24.

FRAs are forward contracts on an interest rate.

Forward-Futures Pricing

1. Forward and futures valuation properties
2. Cost of carry model
3. Arbitrage with cost of carry model
4. Applications of cost of carry model

Basic notations:

- Spot price of an asset: S
- Forward price: F
- Futures price: f
- Value of a long forward position: V
- Value of a long futures position: v
- Expiration of forward contracts: T
- Any time before the expiration: t
- Today 0

Propositions related to forward and futures contracts:

Are forward (F) and futures (f) prices equal in the street?

- Default risk makes a forward contract less attractive: $F < f$
- Liquidity makes a futures contract more attractive : $F < f$
- Delivery options make a futures contract less attractive : $F > f$
- Being customized makes a forward contract more attractive: $F > f$

Cost of carry model:

Net cost of carry:	Cost of storage:	s
	Interest forgone:	r
	Dividend/coupon:	δ
	Convenience:	y
Total cost of carry:	$\theta = s+r-\delta-y$	

Cost of carry model:

Example: The spot price of gold is \$1400 per troy ounce and the annually compounded risk-free interest rate is 1.0%. Storage costs for gold are \$2 per troy ounce per year. What is the fair price of a one-year futures contract on gold? Note that the contract size is 100 troy ounces of gold.

(1 oz = 28.35 grams; 1 troy oz = 31.1035 grams)

Example: (cont.)

To find out the right futures price f, consider the following transactions:

Today:

- Buy 100 troy ounces of gold from the spot market;
- Put 100 troy ounces of gold into storage;
- Sell a one-year futures contract on gold with a futures price of f.
- Cash flow today:

  cost of 100 troy ounces of gold: \$140,000.

Example: (cont.)

Maturity day:

- Pay storage costs of gold;
- Deliver the 100 troy ounces of gold to the long party;
- Collect the futures price f;
- Cash flows on maturity day:

  pay the storage cost s: -2×100

  collect the futures price f: $+f\times100$

Example: (cont.)

Because these cash flows are known with certainty, there is no risk associated with these transactions. The appropriate discount rate should be the risk-free rate of interest:

$$1400(1+0.01) = f - 2$$

$$f = \$1416$$

In general:

$f = S+\theta \Rightarrow$ $f = 1400 + 1400(0.01) + 2 = \$1416$

Arbitrage between spot market and futures market (continued from the previous example):

Suppose one-year futures price of gold is $1470 per troy ounce:

The futures price is too high. The spot price is relatively too low. An arbitrageur should sell futures and buy spot:

1. Sell one gold futures contract @ $1470 for delivery in one year (zero cash flow).
2. Borrow $140,000 at the risk-free interest rate 1% for one year.
3. Buy 100 troy ounces of gold for $140,000.
4. Store the 100 troy ounces of gold for one year.
5. Net cash flow today is zero.

Arbitrage between spot market and futures market

At the maturity of the one-year contract:

1. Pay $200 for storage of gold.
2. Deliver 100 troy ounces of gold and collect $147,000 under the futures contract.
3. Pay $140,000×1.01 = $141,400 of interest and principal on the loan.
4. The net gain is: $147,000 – 141,400 – 200 = $5,400

   The arbitrage profit is $5400: (1470 – 1416)×100 = $5,400

Arbitrage between spot market and futures market

Suppose one-year futures price of gold is \$1410 per troy ounce:

The futures price is too low. The spot price is relatively too high. An arbitrageur should buy futures and sell spot:

1. Buy one gold futures contract @ 1410 for delivery in one year (zero cash flow).
2. Borrow 100 troy ounces of gold.
3. (Short) sell the 100 troy ounces of gold for \$140,000.
4. Invest the \$140,000 at the risk-free interest rate 1% for one year.
5. Net cash flow today is zero.

Arbitrage between spot market and futures market

At the maturity of the one-year contract:

1. The \$140,000 has been compounded to \$141,400.
2. Accept delivery of 100 troy ounces of gold for \$141,000 via the futures contract.
3. Return 100 troy ounces of gold to the lender and collects \$200 storage cost.
4. The net gain is: \$141,400 – 141,000 + 200 = \$600

   The arbitrage profit is \$600: $(1416 - 1410) \times 100 = \$600$.

Continuously compounded rate of cost factors:

The cost of carry can be specified by discrete measures of cash flows, like in the previous example, $2.00 per year per troy ounce, or by continuously compounded rates. Continuously compounded rates are easier to use, especially for financial futures.

Cost of carry model:

$$f = S \times e^{(r+s-\delta-y)T}$$

Continuously compounded rate of cost factors:

A stock index is a security that pays dividends. To a reasonable approximation, we can assume that the stock index provides a continuous dividend yield. If δ denotes the dividend yield rate and r is the continuously compounded risk-free rate, then the futures price f can be specified by the following equation:

$$f = S \times e^{(r-\delta)T}$$

Example: stock index futures

Consider a three-month futures contract on the S&P 500 Index. Suppose that the stock index provides a continuously compounded dividend yield of 1.2% per year, that the current index level is 1826, and that the continuously compounded risk-free interest rate is 0.5% per year. What is the no-arbitrage futures price? Note that the S&P 500 Index futures has a multiplier of $250.

$$f = S \times e^{(r-\delta)T} = 1826 \times e^{(0.5\% - 1.2\%)\frac{3}{12}} = 1822.81$$

http://www.cmegroup.com/trading/equity-index/us-index/sandp-500.html

Example: foreign currency futures

A foreign currency can be viewed as a stock index with a continuous dividend yield, which is the continuously compounded foreign risk-free interest rate. (why?) Pricing foreign currency futures follows the same principles as pricing futures contracts on any other financial securities, including stock indices.

$$f = S \times e^{(r-\delta)T}$$

where δ is the continuously compounded foreign risk-free interest rate.

Example: foreign currency futures

The cost-of-carry model when applied to currency futures is the well-known Interest-Rate Parity relation in international finance. It can be rewritten in the following forms:

$$f_{x/y} = S_{x/y} \times e^{(r_x - r_y)T}$$

$$f_{x/y} = S_{x/y} \times \left(\frac{1 + r_x}{1 + r_y}\right)^T$$

Example: foreign currency futures

Consider a six-month futures contract on the British pound. Suppose that the current exchange rate is \$1.7288 per pound, that the continuously compounded British risk-free interest rate is 4.1% per annum, and that the continuously compounded U.S. risk-free interest rate is 3.5% per annum. What is the no-arbitrage futures price?

$$f = S \times e^{(r-\delta)T} = 1.7288 \times e^{(3.5\% - 4.1\%)\frac{6}{12}} = \$1.7236$$

http://www.cmegroup.com/trading/fx/

Example: gold and silver futures: revisited

Gold and silver carry a storage cost and interest foregone. However, they do not pay dividends and because their markets are liquid, convenience of carrying them is small.

$$f = S \times e^{(r+s)T}$$

where s is the continuously compounded rate of storage.

Example: gold and silver futures: revisited

Consider a one-year futures contract on gold. Suppose that the spot price of gold is \$1400 per troy ounce, that the continuously compounded rate of storage is 0.2% per year, and that the continuously compounded risk-free interest rate is 1.5% per year. What is the appropriate futures price?

$$f = S \times e^{(r+s)T} = 1400 \times e^{(1.5\%+0.2\%)\times 1} = \$1424.00$$

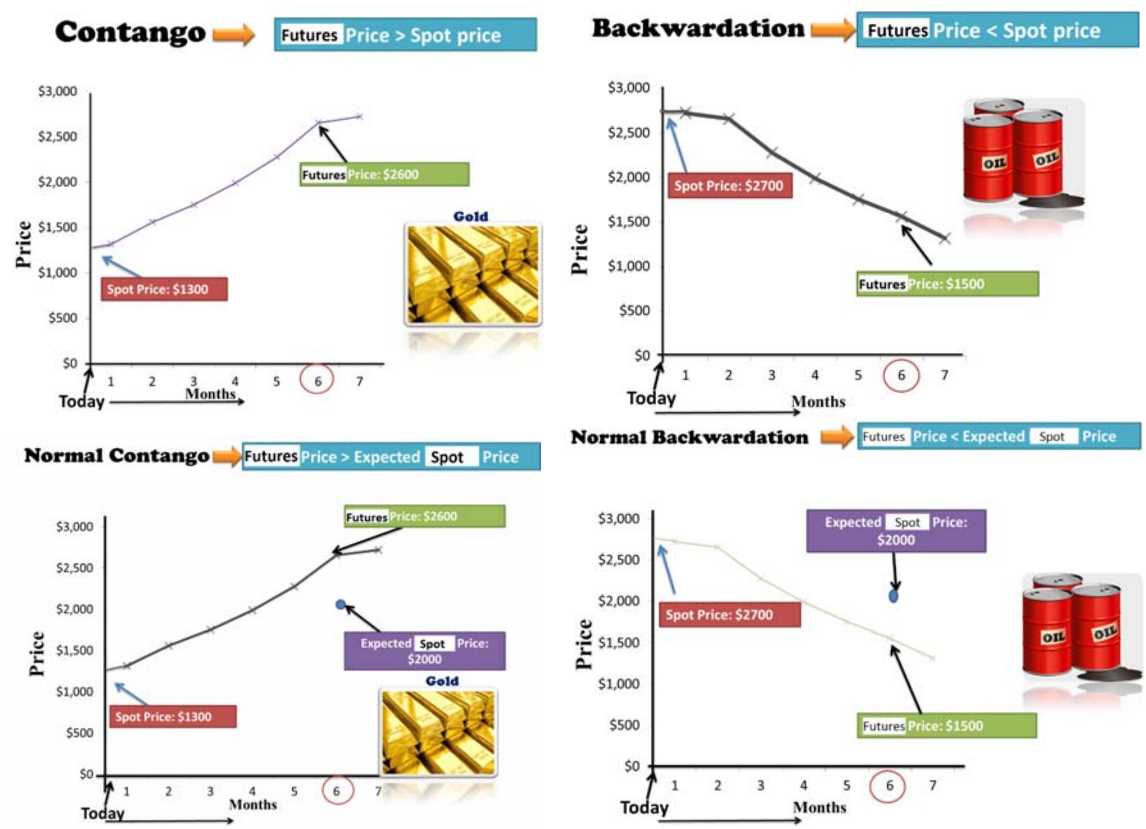
http://www.cmegroup.com/trading/metals/precious/gold.html

Convenience yields:

Users of a commodity feel that there are liquidity benefits from ownership of the physical commodity that are not obtained by the holder of a futures contract. These benefits may include the ability to profit from temporary local shortages or the ability to keep a production process running. The benefits are referred to as the convenience yield provided by the spot asset. The notation for continuously compounded convenience yield is y.

- What is a contango market? ($f > S$) or ($F > S$).
- What is an inverted market (backwardation)? ($f < S$) or ($F < S$).
- What are factors causing contango and backwardation? (cost of carry)

- Contango: $f > S$.
- Backwardation: $f < S$.
- Normal contango: $f > E(S_T)$.
- Normal backwardation : $f < E(S_T)$.



Swaps

1. Interest rate swaps
2. Foreign currency swaps
3. Commodity swaps
4. Equity swaps
5. Credit Default Swaps (CDS)

A financial swap is a contract between two institutions, called counterparties, to exchange a sequence of cash payments.

Contained in a swap contract is a specification of the rate of interest applicable to each cash payment, the currency in which each cash payment is made, the time table (dates, NPs, and prices) for the payments, provisions to cover the contingency that a counterparty might default, and other issues that affect the relationship between the counterparties.

Here is a three-year commodity swap with quarterly settlements, where A pays B fixed prices and B pays A floating prices of the underlying commodity.

Date	Notional Quantity	Prices
3/31/2020	2.2 million	$45.2
6/30/2020	2.6 million	$44.7
9/30/2020	2.5 million	$46.4
…	…	…
12/31/2022	3.3 million	$47.0

Commodity swaps are used mainly as a hedging vehicle and not a delivery vehicle.

The first currency swap agreement was executed in 1981 by Salomon Brothers (Salomon was acquired by the Traveler's Group in 1998 and then Traveler's was acquired by Citicorp in the same year. Citicorp spun off Traveler's Group in 2002. Interestingly, Traveler's Group replaced Citicorp as a Dow component in 2009.) between the World Bank and IBM. The first interest rate swap in the U.S. was negotiated in 1982. Swaps are further categorized into the following:

- Interest rate swaps
- Foreign currency swaps
- Commodity swaps
- Equity swaps
- Credit default swaps (They are not swaps.)

- From 1987 to 2012, the principal value of all outstanding swap contracts grew from less than \$1 trillion to \$426 trillion, which is more than five times the 2012 gross world product. \$379 trillion of the \$426 trillion was interest rate swaps. See http://www.bis.org/statistics/derdetailed.htm. Note that 2014 U.S. GDP was \$18.0 trillion (\$18.5 trillion of national debt in 2015), China \$11.4 trillion, Japan \$4.1 trillion, Germany \$3.4 trillion, UK \$2.9 trillion, and world \$77.3 trillion. Note that there are around 7.261 billion people in the world. Per capita GDP = USD\$10,779 per person. See http://data.worldbank.org/region/WLD
- The average notional principal value of interest rate swaps was seven times that of currency swaps.
- The average size of swap transaction is over \$100 million.
- The maximum tenor of a swap can be as long as 50 years.

Interest rate swaps:

In an interest rate swap, counterparty A agrees to pay counterparty B interest at a fixed rate and receive interest at a floating rate. (Who is the buyer of the swap, A or B?) The same notional principal is used in determining the size of the interest payments, and there is no exchange of principal.

An interest rate swap can be used to transform a fixed rate loan into a floating rate loan and vice-versa.

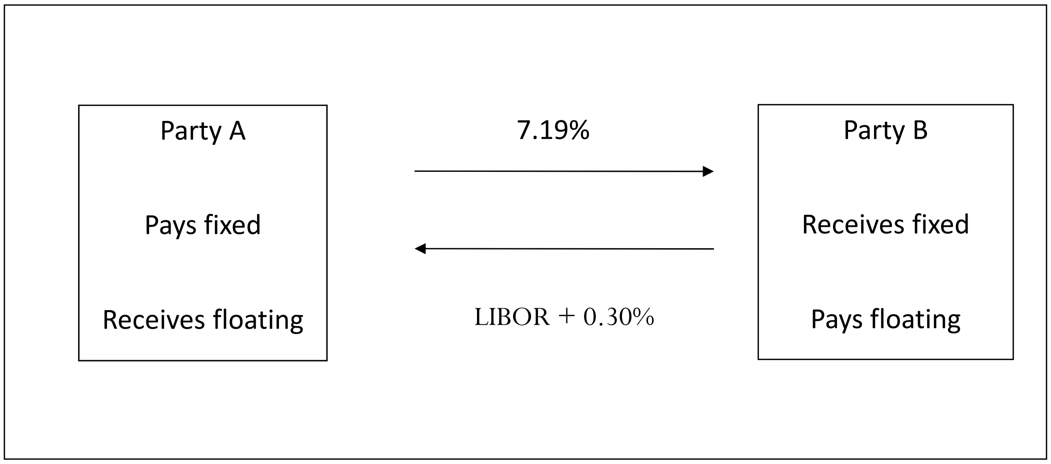
Example 1: a plain vanilla interest rate swap

Party A pays a fixed rate 7.19% per annum on a semi-annual basis, and receives from Party B six-month LIBOR+0.30%. The current six-month LIBOR rate is 6.45% per annum. The notional principal is $35 million. The tenor is in four years.

In this case, Party A pays Party B the net difference:

$$\$1,254,802.74 - 1,194,375 = \$60,427.74$$

The following figure describes cash flows in the swap:



The fixed rate in a swap is usually quoted on a semi-annual bond equivalent yield (BEY) basis. Therefore, the amount that is paid in the next six months is:

$$(\text{Notional Principal})\times(\text{days in period}/\mathbf{365})\times(\text{interest rate})$$
$$= (35{,}000{,}000)\times(182/\underline{\mathbf{365}})\times(0.0719)$$
$$= \$1{,}254{,}802.74$$

where it is assumed that there are 182 days in this particular period.

The floating side is quoted on a money market yield basis. Therefore, the payment is:

$$(\text{Notional Principal})\times(\text{days in period}/\mathbf{360})\times(\text{interest rate})$$
$$= (35{,}000{,}000)\times(182/\underline{\mathbf{360}})\times(0.0645+0.0030)$$
$$= \$1{,}194{,}375$$

Here is a brief summary of interest rate swaps:

- Interest payments are netted.
- Principal is not exchanged.
- Both counterparties are exposed to credit risk of the other party.
- The floating rate is observed and recorded one period ahead of payment day.

Example 2: interest rate swap (a CFA Level 1 question):

Assume that there are two corporations, AAA and BBB. Firm AAA has the highest S&P's bond rating, AAA. Firm BBB has a median S&P's bond rating, BBB. Because of different credit ratings of the two companies, their borrowing rates in the bond market are different. Firm BBB generally pays a higher rate when it issues bond in the market. The following are the required rates of return of their bond issues.

Firm	Fixed Rate	Floating Rate
AAA	8%	T-bond + 1.5%
BBB	10%	T-bond + 1.8%

Currently Firm AAA intends to issue floating rate bonds because it expects interest rates to fall. If it does so, it has to pay the T-bond rate plus 1.5%. Firm BBB intends to issue fixed rate bonds because it expect interest rates to raise. If it does so, it has to pay 10%.

A swap can be designed under this situation. Consider the fixed rate differential between the two firms, 10% – 8% = 2%. Now, consider the floating rate differential, 0.3%. The difference between the two differentials, which is 1.7%, is the total net benefit to be shared between the two counterparties if they enter into a swap.

Rules of a swap:

1. Get what you don't want.
2. Swap out what you don't want and swap in what you want.

The detailed procedure goes like this:

let AAA borrow at the fixed rate 8%;

let BBB borrow at the floating rate T-bond + 1.8%;

let AAA and BBB negotiate a swap:

AAA pays BBB T-bond rate;

BBB pays AAA 7.1%;

The 7.1% is negotiated between AAA and BBB.

The net borrowing rates after these transactions are:

Firm	bond market	inflow from swap	outflow from swap	total	savings
AAA	-8%	**+7.1%**	**-TB**	-(TB+0.9%)	0.6%
BBB	-(TB+1.8%)	**+TB**	**-7.1%**	-8.9%	1.1%

Note that the savings total to 1.7%, which corresponds to 2% – 0.3%.

Steps to construct an interest rate swap

1. Compute the difference in fixed rates (2%) and difference in floating rates (0.3%).
2. Compute the difference is the above two differences (1.7%). It is total benefits to be shared by A and B. If the difference is zero, then there is nothing to gain.
3. Negotiate an allocation scheme, say 0.6% to A and consequently 1.1% to B.
4. Based on what A desires (TB+1.5%) and cost savings of 0.6%, compute A's effective cost of issue (TB+0.9%).
5. Find the swap terms that transform A's actual issue (8% fixed) to the synthetic issue (TB+0.9%):
$$-8\% + swap = -(TB + 0.9\%) \rightarrow swap = -TB + 7.1\%$$
6. Confirm that the swap terms works for B, cost savings of 1.1%:
$$-(TB + 1.8\%) - swap = -(TB + 1.8\%) - (-TB + 7.1\%) = -8.9\%$$

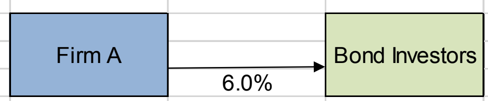
Homework:

- Managers of Firm AAA do not think that their firm benefits enough from the above swap. They argue that their firm is in a better financial situation than the counterparty, thus they demand more savings. Design a swap that generates 1% for Firm AAA, and consequently, 0.7% for Firm BBB.
- Firms with AAA rated bonds:

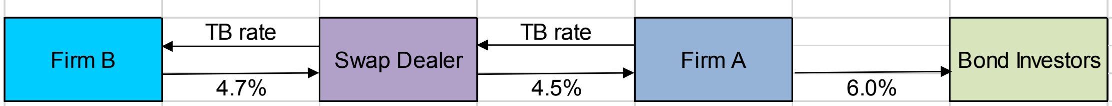
1. Exxon Mobil (XOM)
2. Johnson & Johnson (JNJ)
3. Microsoft (MSFT)
4. ~~Pfizer (PFE)~~
5. ~~Automatic Data Processing (ADP)~~
6. ~~Berkshire Hathaway (BRK.A)~~
7. ~~General Electric (GE)~~

Convert a Fixed-Rate Bond to a Floating-Rate Bond via an Interest Rate Swap

Before the swap:



1. Firm A issued a 6% fixed-rate bond a few years ago.
2. Firm A believes that interest rates will likely fall, making its fixed-rate bonds expensive to service.
3. Firm A and a swap dealer negotiate an interest rate swap.
4. Swap terms: Firm A pays the dealer 30-year Treasury Bond (TB) rate and receives 4.5%.
5. The notional principal of the swap is the total face value of Firm A's existing 6% bonds.
6. The tenor of the swap matches the expiration of Firm A's existing 6% bonds.
7. With the swap, Firm A's net cash flow will be -TB + 4.5% - 6.0% = -(TB+1.5%), which is a floating rate.
8. Independently, the swap dealer finds a different counterparty, Firm B, to reduce/eliminate the dealer's exposure.
9. Firm B, potentially transforms a floating rate loan into a fixed rate loan. Firm B expects rates to increase.
0. The swap dealer benefits 0.2% from the set of transactions. He is exposed to the credit risk of both A and B.



Interest rate swaps:

A generic fixed-for-floating interest rate swap can be viewed as a portfolio of a long floating-rate bond and short an otherwise identical fixed-rate bond.

Cash flows of a fixed-for-floating interest rate swap = cash flows of a long floating rate bond – cash flows of a long fixed rate bond

$$\boxed{value(swap) = value(floater) - value(fixed)}$$

Interest rate swaps:

In the previous example, the firm sold a fixed rate bond, and entered into a floating for fixed interest rate swap:

Firm's position

= – fixed rate bond + floating for fixed swap

= – fixed rate bond + (fixed rate bond – floating rate bond)

= – floating rate bond (with a spread)

– fixed rate bond + floating for fixed swap

= – synthetic floating rate bond

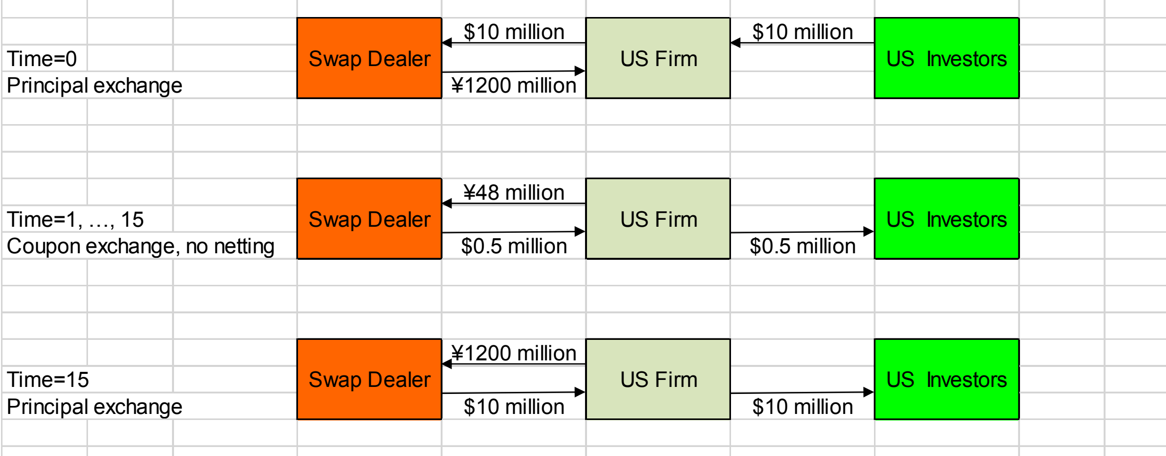
Foreign currency swaps:

In a foreign currency swap, one counterparty pays the other counterparty interest on a principal amount in one currency and receives interest on a principal amount in another currency. Principal amounts are exchanged at the beginning and the end of the life (tenor) of the swap.

A foreign currency swap can be used to transform a loan in one currency into a loan in another currency.

Convert a Dollar-Denominated Bond to a Yen-Denominated Bond via a Currency Swap

1. A US firm wishes to issue 15-year Japanese Yen denominated (¥1200 million) debt to open an office in Tokyo.
2. The firm is well established in the US and can issue dollar denominated debt in the US at 5%.
3. The firm is not well known in Japan and can issue yen denominated debt in Japan at 20%, which is expensive.
4. The firm issues 15-year US dollar denominated 5% debt, $10 million face value, in local US bond market.
5. The firm and a swap dealer negotiate a currency swap based on interest rates of 5% in USD and 4% in JPY.
6. The notional principals of the swap are $10 million and ¥1200 million, based on current exchange rate of $1=¥120.
7. The tenor of the swap is 15 years. Cash flow settlements are annual.
8. The principals are exchanged at the initiation and tenor of the swap.
9. Coupon interest payments are exchanged at the end of each year. They are not netted.
0. This swap is a generic fixed-for-fixed currency swap.



Foreign currency swaps:

A generic foreign currency swap can be viewed as a portfolio of a long bond denominated in one currency and a short bond denominated in a different currency.

$$\boxed{value(swap) = value(bond_{\$}) - value(bond_{¥})}$$

A generic foreign currency swap can be viewed as a collateralized loan.

Foreign currency swaps:

Foreign currency swap pricing refers to finding the fixed rate in one bond given terms of the other bond. In the case of floating-for-floating currency swap, pricing refers to finding the spread between two floating rates.

Foreign currency swap valuation refers to computing the DCF value of a swap to the swap buyer after swap initiation. The value of a generic foreign currency swap at any time is the value of the long bond denominated in currency A less the value of the short bond denominated in currency B.

Foreign currency swaps:

In the previous example, the firm sold a USD bond, and entered into a pay JPY and receive USD currency swap:

Firm's position

= – USD bond + currency swap

= – USD bond + (USD bond – JPY bond)

= – JPY bond

– USD bond + currency swap = – synthetic JPY bond

Example 3: valuing a plain vanilla foreign currency swap after initiation:

Consider a financial institution that holds a foreign currency swap for which the institution receives 4.8% per annum semi-annually in EUR and pays 3.4% per annum semi-annually in USD. The principals in the two currencies are 10 million EUR and 13.2 million USD. The tenor of the swap is two years from today. The current spot exchange rate is $1.27 per EUR (Has EUR appreciated or depreciated against USD since the swap was initiated?). The following table reveals information about the U.S. and Euro zone term structures of interest rates. Compute the USD value of the foreign currency swap to the EUR receiver.

USD and EUR term structure of interest rates

Maturity (Months)	Price of Zero-Coupon Bond	Price of Zero-Coupon Bond
	USD	EUR
6	0.9842 (3.22%)	0.9780 (4.49%)
12	0.9673 (3.38%)	0.9562 (4.58%)
18	0.9481 (3.65%)	0.9322 (4.85%)
24	0.9276 (3.90%)	0.9104 (4.92%)

Figures in parentheses are money market yields. For money market yields, future value factor is $(1 + r \times T)$, not $(1 + r)^T$.

$$\frac{1}{1+0.0365\times\frac{18}{12}} = 0.9481; \qquad \frac{1}{1+0.0449\times\frac{6}{12}} = 0.9780$$

The semi-annual coupon payments in EUR are:

(EUR10 million)×(0.048)×(0.5) = EUR 240,000

Therefore, the present value of the interest payments in EUR plus principal converted into USD is:

$$\begin{aligned} PV_A &= \text{EUR}240{,}000[0.9780+0.9562+0.9322+0.9104] \\ &\quad + 10{,}000{,}000[0.9104] \\ &= \text{EUR } 10{,}010{,}432.00 \\ &= \text{USD } (1.27)\times(10{,}010{,}432.00) \\ &= \text{USD } 12{,}713{,}248.64 \end{aligned}$$

The semi-annual coupon payments in USD are:

$$(\text{USD } 13.2 \text{ million})\times(0.034)\times(0.5) = \text{USD } 224{,}400$$

Therefore, the present value of the interest payments in USD plus principal is:

$$PV_B = \text{USD } 224{,}400[0.9842+0.9673+0.9481+0.9276] + 13{,}200{,}000[0.9276]$$
$$= \text{USD } 13{,}103{,}143.68$$

The USD value of the foreign currency swap to the EUR receiver is therefore:

$$PV_A - PV_B = 12{,}713{,}248.64 - 13{,}103{,}143.68 = -\$389{,}895.04$$

Commodity swaps:

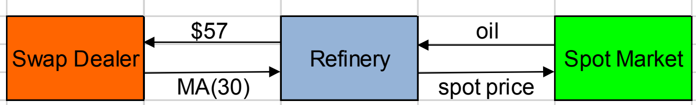
In a commodity swap, one counterparty agrees to pay the other counterparty a fixed rate per unit for a given notional quantity of some commodity and to receive a floating rate per unit for the same notional quantity. The floating rate is usually a moving average over some pre-specified period. The notional quantities of the commodity are not exchanged.

Example 4: Plain vanilla commodity swap:

Consider an oil refinery that has a constant demand for 200,000 barrels of oil per month and is concerned about volatile oil prices. It enters into a three-year commodity swap with a swap dealer. The current spot oil price is $65 per barrel. The refinery agrees to make monthly payments to the swap dealer at a rate of $57 per barrel. The swap dealer agrees to pay the refinery the moving average of daily prices for crude oil during the preceding month. The notional quantity is 200,000 barrels.

Reduce Price Volatility via a Commodity Swap

1. An oil refinery consumes 200,000 barrels of crude oil every month and it is subject to spot price volatility.
2. The refinery enters a commodity swap with a swap dealer. The notional quantity is 200,000 barrels.
3. The refinery agrees to pay $57 per barrel of oil and receive the moving average price in the proceeding 30 days, MA(30).
4. The tenor of the swap is 36 months. Cash flow settlements are monthly.
5. With the swap, the cost of oil to the firm is ($57 + spot price - MA(30)), which is much less volatile than spot price alone.



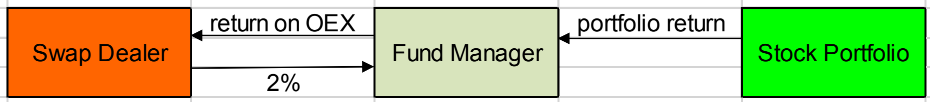
Equity swaps:

In an equity swap, one counterparty makes periodic fixed interest rate payments to the other counterparty for a given notional principal. The second counterparty pays the first counterparty a floating rate pegged to the total return on some stock index. Total return includes dividends and capital gains, though in some equity swaps returns are defined to be the capital gains on the index excluding any dividend payments.

Example 5: Plain vanilla equity swap:

Consider a portfolio of an equity fund whose return is highly correlated to the S&P 100 stock index. The fund manager is concerned about the risk exposure and decides to enter into an equity swap. The fund manager agrees to pay the swap dealer the S&P 100 return and receive from the swap dealer a fixed rate of 8% per annum. The payments are to be made quarterly and the notional principal is fixed at $100 million. The following figure illustrates this example.

1. A fund manager holds a $100 million stock portfolio, which is highly correlated to the S&P 100 Index (OEX).
2. The fund manager is concerned about a potential down turn in the stock market in the next six months.
3. The fund manager enters an equity swap with a notional principal of $100 million.
4. The fund manager agrees to pay the return on the OEX for the next six months and receive annualized 8%.
5. The tenor of the swap is six months. Cash flow settlements are quarterly.
6. With the swap, the quarterly return to the fund manager is (2% + portfolio return - OEX return).



Equity swaps:

A generic equity swap can be viewed as a portfolio of a long bond and a short stock (index).

In the previous example, the manager holds a stock index, and enters into a "pay stock index return and receive bond return" swap. His equity portfolio return is converted into a fixed-income return via an equity swap.

Manager's position
= + stock index + equity swap
= + stock index + (bond – stock index)
= + bond

+ stock index + equity swap = synthetic bond

Credit Default Swaps: Definition

- A credit default swap (CDS) is a <u>credit</u> derivative contract between two counterparties, whereby the "buyer" makes <u>periodic</u> payments to the "seller" in exchange for the <u>right</u> to a payoff (“<u>make whole</u>”) if there is a credit event (default or downgrade) in respect of a third party or "reference entity".

- The buyer typically delivers the defaulted asset to the seller for a payment of the par value. This case is known as "physical settlement".

- Or the seller pays the buyer the difference between the par value and the market price of a specified debt obligation. This case is known as "cash settlement".

Credit Default Swaps: Origin

- Forms of Credit Default Swaps had been in existence from at least the early 1990s, but the modern Credit Default Swaps were invented in 1997 by a team working for J. P. Morgan Chase. They were designed to shift the risk of default to a third party. The first CDS involved J. P. Morgan selling the credit risk of Exxon to the European Bank of Reconstruction and Development.

- Pop quiz:
  - ______________________ is the buyer of the CDS.
  - ______________________ is the seller of the CDS.
  - ______________________ is the reference entity.

How does CDS work?

1. Firm's financial health ⇑ (more than market expectations)
2. Firm's ability to meet its debt obligations ⇑
3. Firm's default risk ⇓
4. Cost of CDS ⇓

If we expect improvement in firm's financial health, sell a CDS at high price now and buy it back later at a lower price.

1. Firm's financial health ⇓ (more than market expectations)
2. Firm's ability to meet its debt obligations ⇓
3. Firm's default risk ⇑
4. Cost of CDS ⇑

If we expect deterioration in firm's financial health, buy a CDS at low price now and sell at a higher price later.

How does CDS work?

- Hedge existing exposures to credit risk.
  - Protecting the value of a bond portfolio
- Speculate on changes in credit spreads.
  - Betting a negative credit event (default/down grading)
    - buy a CDS now and sell it later for more.
  - Betting on increases in credit spreads (higher credit risk)
    - buy a CDS now and sell it later for more.
  - Betting on decreases in credit spreads (lower credit risk)
    - sell a CDS now and buy it back later for less!

Trade CDS like trading a stock

Hedging example

- A pension fund owns \$10 million worth of a five year bond issued by Risk Corporation.
- The pension fund buys a CDS from Derivative Bank in a notional amount of \$10 million that trades at 200 basis points.
- The pension fund pays 2% of \$10 million in quarterly (\$50,000/quarter) installment to Derivative Bank.

Hedging example

Risk Corporation does not default

- Pension fund makes quarterly payment of \$50,000 to Derivative Bank for 5 years.
- Risk Corporation returns \$10 million to pension fund.
- Pension fund loses CDS premium: $5\times10\times2\%=$ \$1 million.

Risk Corporation defaults

- Risk Corporation defaults at the end of year 3 and the recovery value of its bonds is \$0.37 per \$1 par.
- Pension fund stops paying the premium at firm default.
- Derivative Bank pays $\$10\times(1-0.37) = \$6.3$ million.
- Pension fund ends up with: $\$3.7 + 6.3 - 3\times(10\times2\%) = \$9.4$ million

Speculation example

- A speculator does not own any bonds issued by Risk Corporation. However, she speculates that the Risk Corporation would default on its bonds before their maturity, or that the credit spread of the firm's bonds will widen (buy CDS) / shrink (sell CDS).
- The speculator buys a CDS from Derivative Bank in a notional amount of $10 million that trades at 200 basis points.
- The speculator pays $50,000 per quarter installment to Derivative Bank.

Speculation example

Risk Corporation does not default

- Speculator makes quarterly payments of $50,000 to Derivative Bank for 5 years.
- Because Risk Corporation does not default, there is no payoff from the CDS.
- Speculator loses:

  $5\times10\times2\%=$ \$1 million.

Risk Corporation defaults

- Risk Corporation defaults at the end of year 3 and the recovery value of its bonds is $0.37 per $1 par.
- Speculator stops paying the CDS premium at firm default.
- Derivative Bank pays

  \$10×(1 – 0.37) = \$6.3 million.
- Speculator gains:

  \$6.3 – 3×(10×2%) = \$5.7 million.

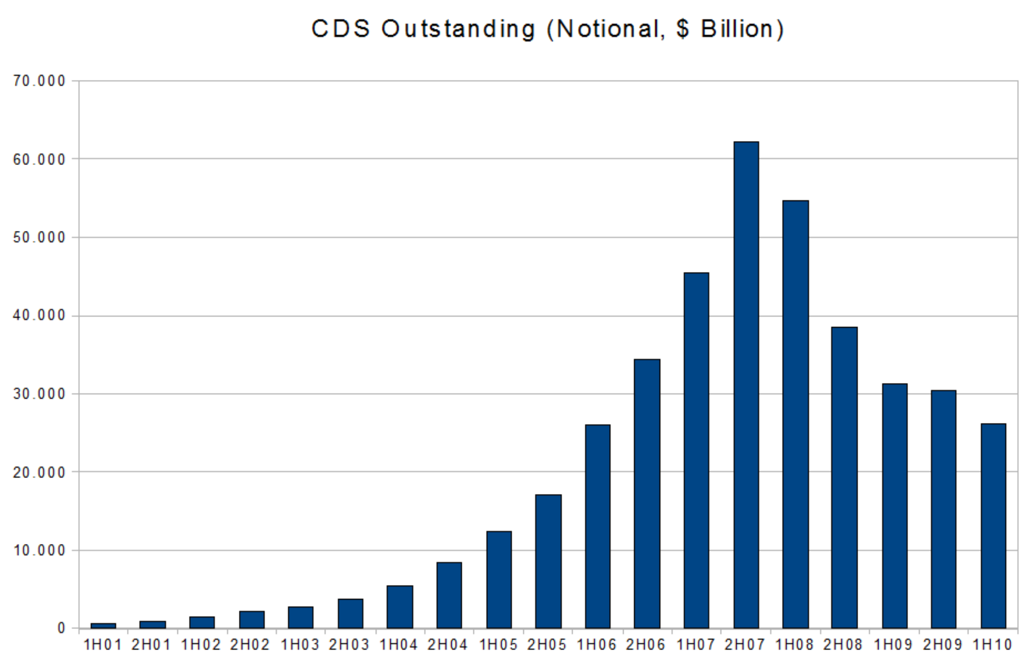
$62,000,000,000,000

- Credit default swaps are the most widely traded credit derivative product.
- The notional amount on outstanding CDS:

  $62 trillion in 2007.

  $55 trillion in the middle of 2008.
- Note that the 2007 World GDP was $54.1 trillion, U.S. GDP was $13.8 trillion. China 2008 GDP was $4.3 trillion. As of third quarter of 2008, the total value of U.S. corporate equities was $7.3 trillion, mutual funds $4.2 trillion, and total home value was $19.1 trillion.
- At the end of 2011, the total value of U.S. bond market is $37 trillion, and non-U.S. debt market is $120 trillion. In April 2012, Bloomberg reports that the total market value of U.S. stock market is $21.4 trillion and non-U.S. stock market is $32.6 trillion.

$62,000,000,000,000



The market of CDS

- The credit swaps market is unregulated:
  - "…completely lacking in transparency and completely unregulated." --Christopher Cox, Chairman of the U.S. SEC.
- When economy was booming, selling CDS is a low-risk way to collect premiums and earn extra cash (AIG former CEO's net worth was over $2 billion!).
- When economy soured, credit crunch and defaults generate huge losses to CDS writers (AIG lost $182 billion. Merrill Lynch was acquired and Lehman went bankrupt!), forcing them to default/bankrupt.

Lehman Bros.

- Lehman Brothers declared bankruptcy in September 2008. Lehman's bonds were later auctioned at 7.25 cents on the dollar.
- Buyers of CDS on Lehman's debt received large sums of payments to cover all losses from Lehman's bond default (92.75 cents on the dollar).
- Sellers of CDS on Lehman's debt received the Lehman debt and in return they were obligated to pay the contract buyers (the insured parties) the face value of the Lehman's debt to make the buyers "whole".
- From the previous page, $0.75 million of investments in CDS on Lehman's debt would have turned into $9.275 million in months, 1136% return!

Wachovia Bank…

9/24/2008: The cost rose for protecting Wachovia debt against default. To insure $10 million of WB debt against default for five years:

Before September 2008

- No upfront cost
- $650,000 annually

September 2008

- $2.5 million upfront
- $500,000 annually

General Motors …

- 11/11/2008: GM's benchmark 8.375 percent bond due 2033 has dropped to 25.75 cents on the dollar, from 36.5 cents at the end of October, according to MarketAxess. The bonds had traded at more than 80 cents on the dollar at the beginning of the year and currently yield 32.5 percent.
- Don't you just love high-yield bonds?
  - No, not really.

General Motors …

- The automaker's credit default swaps are also trading at extremely distressed prices, costing 68.5 percent the sum insured as an upfront cost, plus 5 percent in annual premiums for five years, according to Markit.
- That means it costs \$6.85 million to insure \$10 million in debt for five years, plus \$500,000 annually.
- GM eventually defaulted on its bonds and its bond price was under 10 cents on the dollar. Now, do you still like high-yield bonds?
- A speculator who bought the CDS on GM's debt at \$6.85 million would be paid over \$9 million, yielding over 30% in a matter of months.

Citigroup: 8/19/2011

- While shares of Citigroup have raced to the bottom with Bank of America, the bond market has more confidence. The cost to protect against a Citigroup default increased moderately -- with credit default swaps (CDS) trading at 189 basis points over the cost of a Citigroup bond -- while Bank of America CDS spreads are now at 297 basis points. Spreads on J.P. Morgan Chase CDS are trading at 115 basis points.

Berkshire Hathaway ...

- 11/20/2008: Buffett's BRK-A shares traded at $77,500 per share, down 48.9% from its year high of $151,650 per share. (The stock recovered to $215,000 in April 2015, nearly tripled in less than seven years). CDS on Berkshire traded at 475 (bps), up from 250 (bps) a week ago, and 129 (bps) two months ago.
- If you had <u>sold</u> a CDS at 475 bps then, you would have made money because CDS premium has decreased since then.

- Make money in the up market. Make money in the down market! That's the beauty of derivatives!