Lecture 11
Forwards and Futures

Pym Manopimoke, PhD, Bank of Thailand

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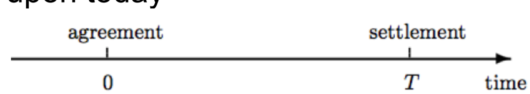
Forwards

- Forward – an agreement to buy (sell) at a future date a given amount of a commodity or an asset at a price agreed upon today



- The price fixed now for future exchange is the forward price
- Example: Tofu manufacturer needs 100,000 bushels of soybeans in 3 months. Current price of soybeans is $12.50/bu but may go up
  - Wants to make sure that 100,000 bushels will be available
  - Enter 3 month forward contract for 100,000 bushels of soybeans at $13.50/bu
  - Long side buy 100,000 bushels from short side at $13.50/bu in 3 months

Features of forward contracts

- Traded over the counter (not on exchanges)
- Custom tailored
- No money changes hands until maturity

Advantages of forward contracts
- Flexibility

Disadvantages of forward contracts
- Illiquidity
- Counter party risk

Futures

- Futures - similar to forward but is an exchange-traded, standardized contract that is marked to the market daily.
- Key difference in futures
  - Standardized contracts create liquidity
  - Traded on exchanges
  - Guaranteed by the clearing house - little counter-party risk
  - Marked to market – gains/losses settled daily or “pay as you go”
  - Margin account required as collateral to cover losses

Futures

Futures contracts are traded on a wide variety of assets in four main categories:

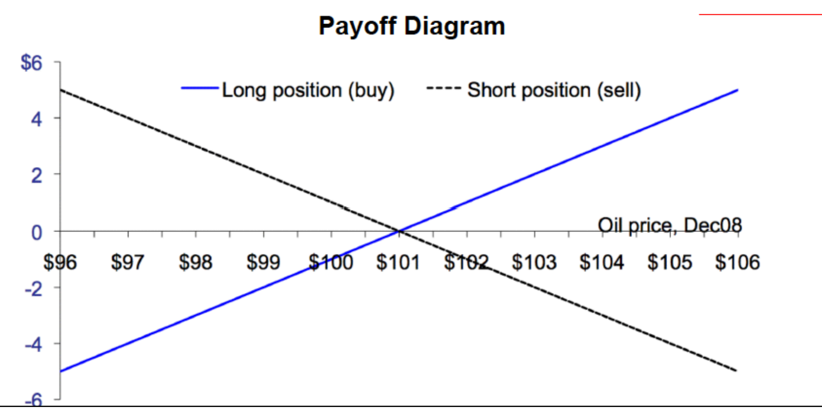
1. Agricultural commodities
2. Metals and minerals (including energy contracts)
3. Foreign currencies
4. Financial futures
   - Interest rate futures
   - Stock index futures

Key terms for futures contracts

- Futures price: Agreed-upon price at maturity
- Long position: Agree to purchase
- Short position: Agree to sell
- Profits on positions at maturity:
  - Long:
  - Short:

Zero Sum Game

- Profit to long = Spot price at maturity - Original futures price
- Profit to short = Original futures price - Spot price at maturity
- The futures contract is a zero-sum game, which means gains and losses net out to zero.



Profits to Buyers and Sellers of Futures and Option Contracts

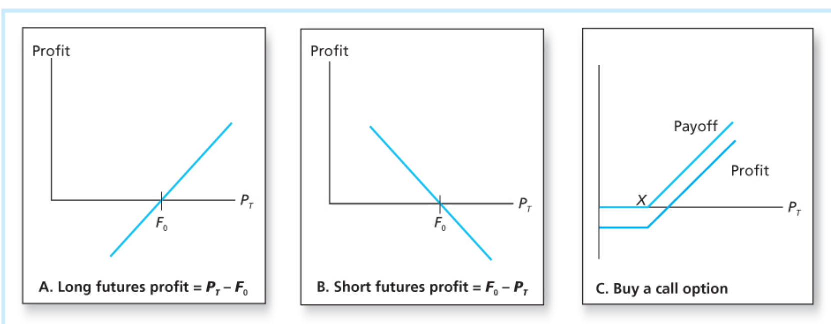
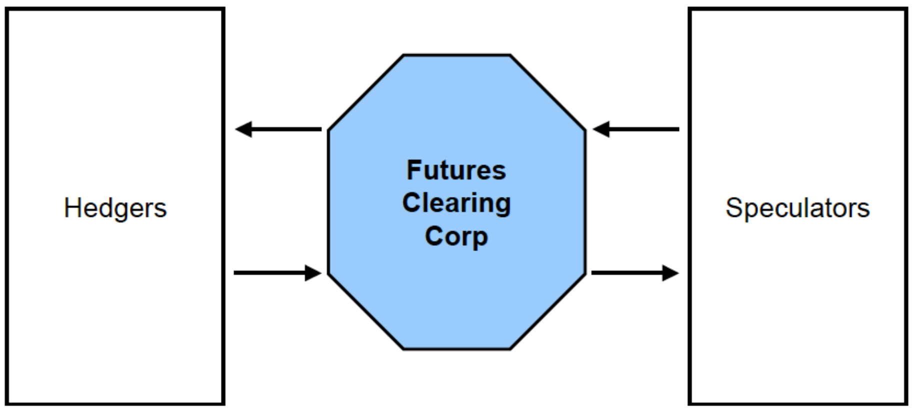


Figure 22.2 Profits to buyers and sellers of futures and options contracts

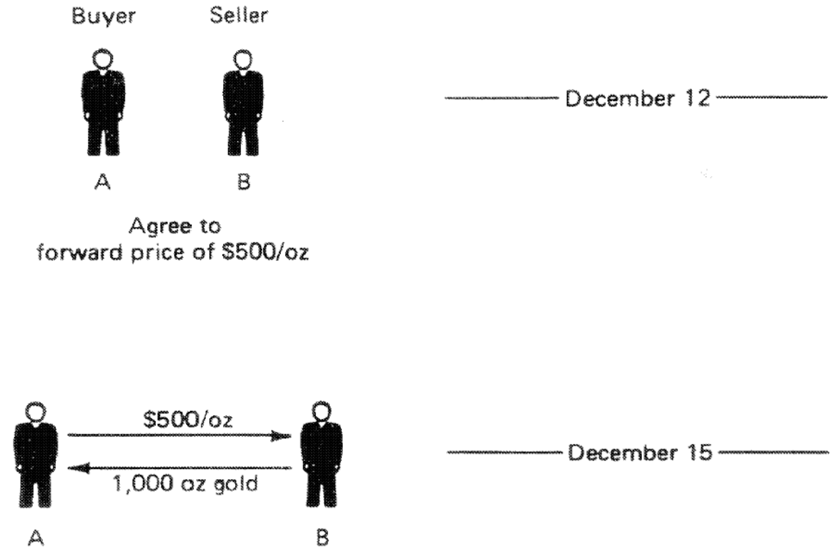
Futures clearing house reduces counter party risk and improves liquidity



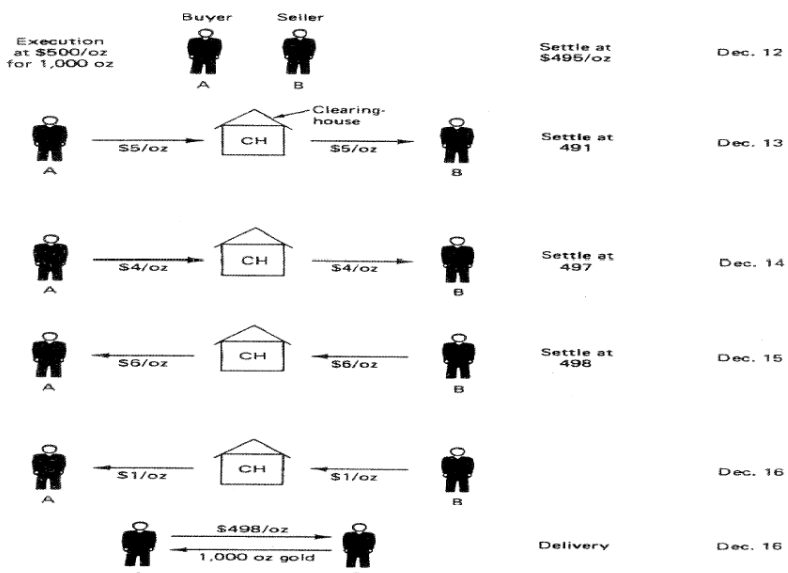
Margin and Trading Arrangements

- Initial Margin: Funds deposited to provide capital to absorb losses
- Marking to Market: Each day the profits or losses from the new futures price are reflected in the margin account
- Maintenance or variance margin: Established value below which a trader's margin may not fall

A forward contract



A futures contract



Example

Assume the current futures price for silver for delivery 5 days from today is $30.10 per ounce. Suppose that over the next 5 days, the futures price evolves as follows:

Day	Futures Price
0 (today)	$30.10
1	30.20
2	30.25
3	30.18
4	30.18
5 (delivery)	30.21

If you enter a long position in a contract with 5,000 ounces/ contract, what is the daily mark-to-market settlements for each contract?

Futures and Leverage

- Initial margin requirement for an oil contract is 10%. At a current futures price of $91.86, contract size of 1000, this requires a margin of:
- A $2 jump in oil price leads to:

Futures and Hedging

How might one use financial futures to hedge risk in each of the following circumstances?

- You own a large position in a relatively illiquid bond that you want to sell
- You have a large gain on one of your Treasuries and you want to sell it, but you would like to defer the gain until next tax year
- You will receive you annual bonus next month that you hope to invest in long-term corporate bonds. You believe that bonds today are selling at quite attractive yields, and you are concerned that bond prices will rise over the next few weeks.

Futures Pricing

Two ways to acquire an asset for some date in the future:

1. Purchase it now and store it until T
2. Take a long position in futures with maturity date T

The Spot-Futures Parity Theorem says that these two strategies must have the same market determined costs

Parity Example

Consider gold selling at $400 with current futures price $440. The risk free rate is 10% and assume that gold has no storage costs.

- Strategy A: Buy gold and hold it for a year
- Strategy B: Put funds aside today and buy a gold futures contract with one year to maturity

Strategy A	Action	Cash Flow at t	Cash Flow at T
	Buy gold	$-S_t$	S_T
Strategy B	**Action**	**Cash Flow at t**	**Cash Flow at T**
	Long gold futures	0	$S_T - F_t$
	Invest $F_t/(1+r_f)^{T-t}$ in TBill	$-F_t/(1+r_f)^{T-t}$	F_t
	Total For B	$-F_t/(1+r_f)^{T-t}$	S_T

- Strategy A and Strategy B give identical payoffs at T, regardless what the future gold price is.
- Hence they should cost the same at t.

- This formula is also called the cost of carry formula as the futures price is the spot price plus the cost of carry the gold
- The cost of carry formula does not work for agriculture products and many commodities (perishable, high storage costs, seasonality)

Arbitrage

- What if the futures price ($420) is less than what the cost of carry formula gives ($440)

Short gold	$400	$-S_T$
Long gold futures	0	S_T – $420
Invest $F_t/(1+r_f)^{T-t}$ in TBill	$420/(1+10%)	$420
Total	$400-$420 / (1+10%) = $18.18	0

Spot-Futures Parity Theorem (with dividends)

- With a perfect hedge, the futures payoff is certain -- there is no risk.
- A perfect hedge should earn the riskless rate of return.
- This relationship can also be used to develop the futures pricing relationship.

Hedge Example

- Investor holds $1000 in a mutual fund indexed to the S&P 500.
- Assume dividends of $20 will be paid on the index fund at the end of the year.
- A futures contract with delivery in one year is available for $1,010.
- The investor hedges by selling or shorting one contract.

The Spot-Futures Parity Theorem

Arbitrage Possibilities

- If spot-futures parity is not observed, then arbitrage is possible.
- If the futures price is too high, short the futures and acquire the stock by borrowing the money at the risk free rate.
- If the futures price is too low, go long futures, short the stock and invest the proceeds at the risk free rate.

Spread Pricing: Parity for Spreads

$$F(T_1) = S_0\,(1 + r_f - d)^{T_1}$$

$$F(T_2) = S_0\,(1 + r_f - d)^{T_2}$$

$$F(T_2) = F(T_1)(1 + r_f - d)^{(T_2 - T_1)}$$

Example

- Consider this arbitrage strategy to derive the parity condition for spreads: (1) enter a long futures position with maturity date T1 and futures price F(T1); (2) enter a short position with maturity T2 and futures price F(T2); (3) at T1 when the first contract expires buy the asset and borrow F(T1) dollars at the risk free rate (4) pay back the loan with interest at time T2.

Spreads

- If the risk-free rate is greater than the dividend yield ($r_f > d$), then the futures price will be higher on longer maturity contracts.
- If $r_f < d$, longer maturity futures prices will be lower.
- For futures contracts on commodities that pay no dividend, d=0, F must increase as time to maturity increases.

Gold Futures Prices

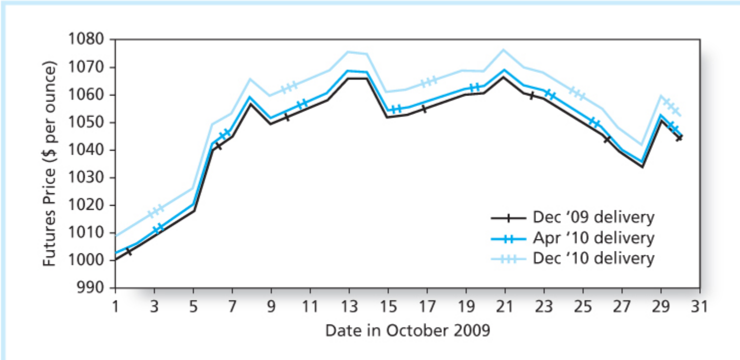


Figure 22.6 Gold futures prices