

Lecture 11

Forwards and Futures

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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:

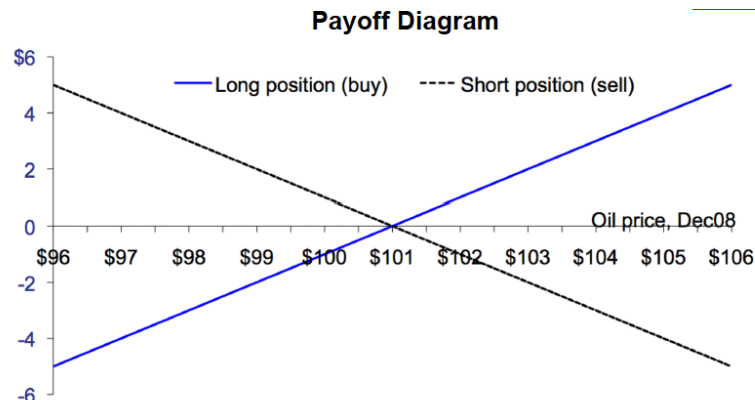
1. Agricultural commodities
2. Metals and minerals (including energy contracts)
3. Foreign currencies
4. Financial futures
 - Interest rate futures
 - Stock index futures

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

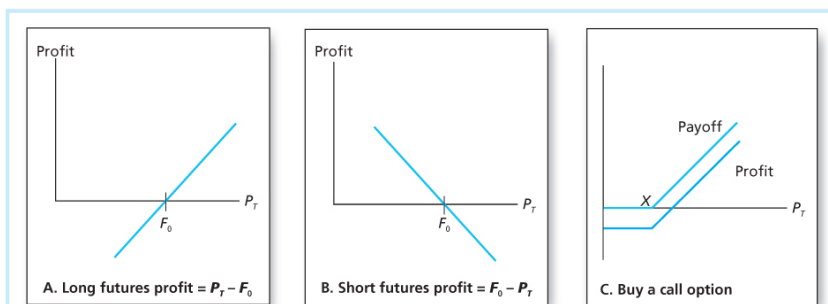
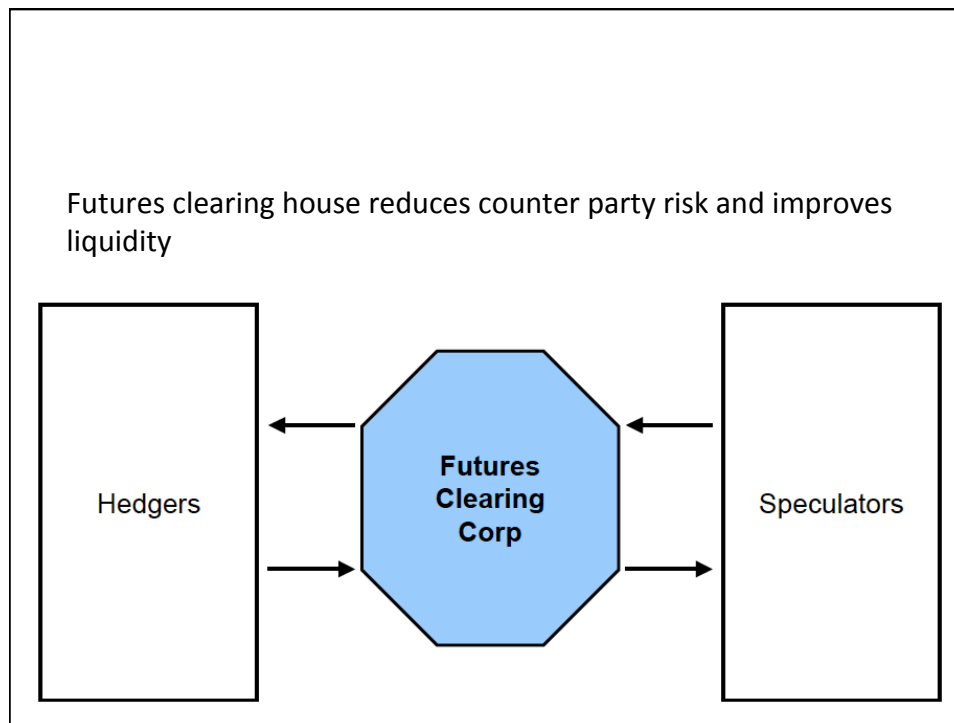
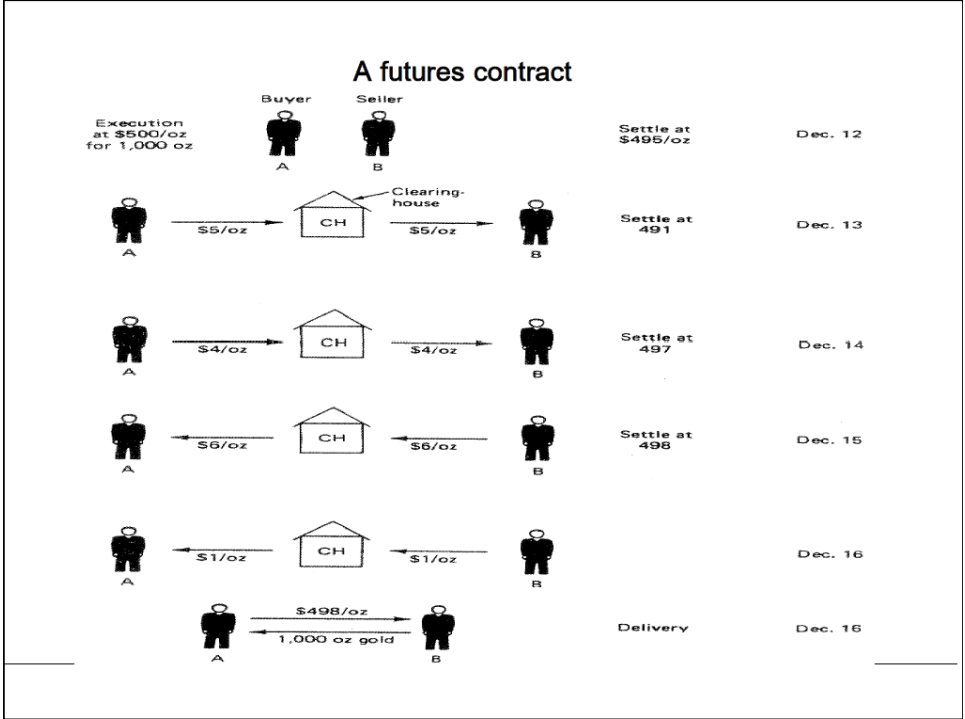
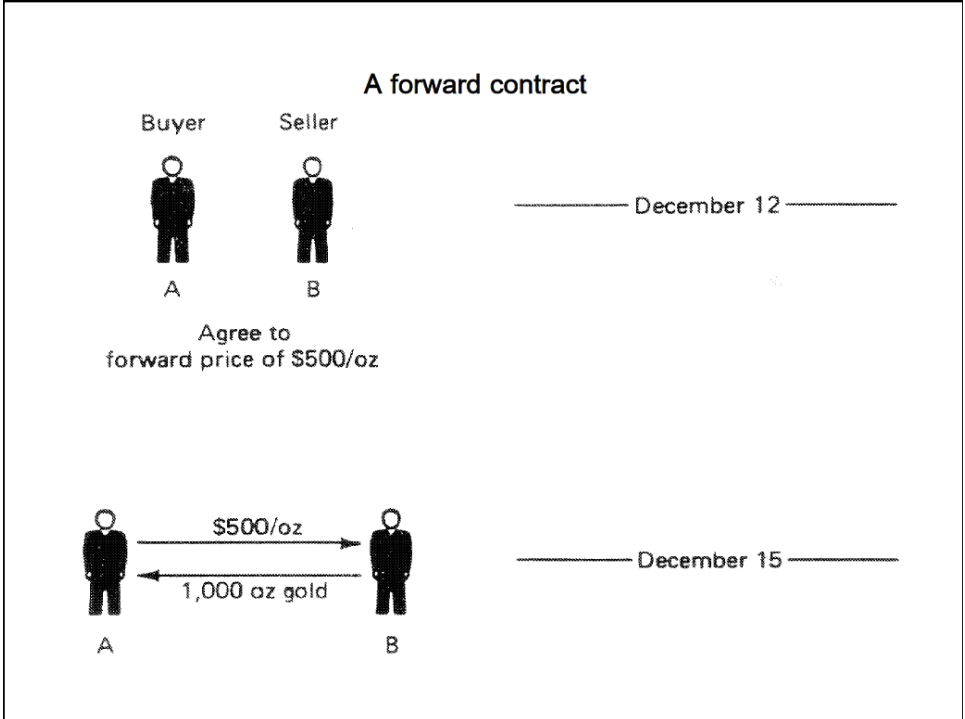


Figure 22.2 Profits to buyers and sellers of futures and options contracts



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



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 your 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.
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- 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 T_1 and futures price $F(T_1)$; (2) enter a short position with maturity T_2 and futures price $F(T_2)$; (3) at T_1 when the first contract expires buy the asset and borrow $F(T_1)$ dollars at the risk free rate (4) pay back the loan with interest at time T_2 .

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

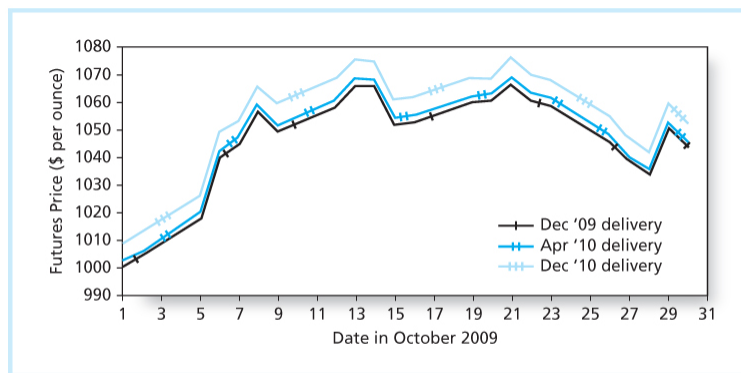


Figure 22.6 Gold futures prices

Futures Prices vs. Expected Spot Prices

How well does the futures price forecast the ultimate spot price?

- Expectations Hypothesis
 - Futures price equals expected value of the future spot price
 - Ignores risk premiums that must be built into future prices when ultimate spot prices are uncertain
- Normal Backwardation
- Contango
- Modern Portfolio Theory

Normal Backwardation

- For most commodities there are natural hedgers that want to shed risk.
- These hedgers will take a short position to deliver the commodity that a guaranteed price
- To induce speculators to take the long positions they need to offer them an expectation of profit.
- Speculators will only enter the contract if the futures price is below the expected spot of the commodity
- Future prices will therefore be below the expected spot price and will rise over the life of the contract until the maturity date

Contango

- Natural hedgers are the purchasers of a commodity rather than a supplier (long hedgers)
 - They will be willing to pay a premium to lock in the price that they must pay for the commodity to shed risk
 - Speculators must be paid a premium to enter the short position
 - Therefore, the futures price will exceed the expected spot price
- The compromise view is the “net hedging hypothesis” where the strong side of the market will be the side that has more natural hedgers and the strong side will pay a premium to induce speculators to enter into enough contracts to balance the positions.

Futures Price Over Time

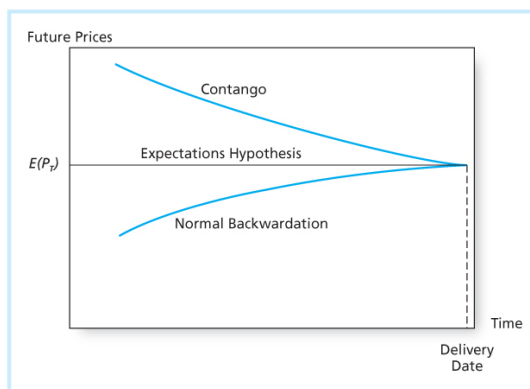


Figure 22.7 Futures price over time, in the special case that the expected spot price remains unchanged

Modern Portfolio Theory

- Refines the notion of risk i.e if commodity prices pose positive systematic risk, futures prices must be lower than expected spot prices

Homework

- Ch 22 Qu 2, 7, 8, 11, 16, 18