

Futures

Reference: Bodie et al, Ch 22

Econ 457

Week 14-a

Outline

1. Short Sales
2. Forward Prices
3. Futures Markets
4. Practice

1. Short Sales

Mechanics

Short Sale: Selling a security you don't own, expecting its price to decline

Process:

1. **Borrow shares** from broker's inventory or another client
2. **Sell borrowed shares** immediately at current market price
3. **Buy back shares** later to "cover" the short position
4. **Return shares** to lender
5. Pay dividend/interest to share lender during short period

If the price falls (rises) during the time that the security has been borrowed, then the short seller is able to buy it back at a lower (higher) price than it was sold for. This generates a profit (loss) from the short sale.

1. Short Sales

Example, see Hull p 102

Purchase of Shares

- Purchase 500 shares for \$120 per share: -\$60,000
- Receive dividend: +\$500
- Sell 500 shares for \$100 per share: +\$50,000
- Net profit: -\$9,500

Short sale of shares

- Borrow 500 shares and sell them for \$120: +\$60,000
- Pay dividend: -\$500
- Buy 500 shares for \$100 per share: -\$50,000
- Replace borrowed shares and close short position
- Net profit: +\$9,500

Notes: The two positions are symmetric. The short seller must pay the dividend. We have not yet accounted for the cost of borrowing, or interest earned by the short seller from the cash received.

1. Short Sales

Short Squeeze

Short sales require borrowing the security. The security may be available from the broker. In some cases, hard to locate securities may have an associated borrowing fee.

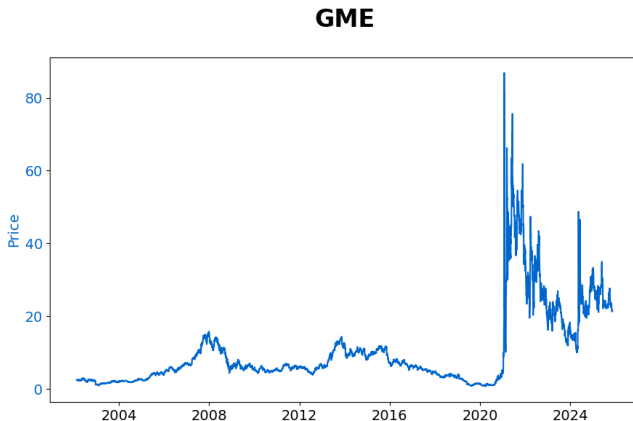
Most short sales require posting margin. Short sellers are subject to margin calls if prices move adversely. The position may be closed by the broker if the seller fails to post margin.

In order to close their position, the short seller must buy back the security. A *short squeeze* is when the security becomes very expensive, but short sellers must buy it anyways in order to close positions.

1. Short Sales

Game Stop

There was a short squeeze in GameStop (GME) in January 2021.



1. Short Sales

Word of Caution

Short squeezes don't always work, of course. They are predicated on the supply of stocks to borrow are limited. If the short sellers are able to borrow more stocks in order to maintain or add to their short position, then the price may go down. In that case, the "squeezer", who is likely leveraged, may have to close her position.

The financial panic of 1907, which eventually led to the creation of the Federal Reserve, started with large losses to a brokerage house that was finance a failed short squeeze in United Copper stocks.

2. Forward Prices

General Formula - No dividends

A forward contract is an agreement to buy and sell a security at a specified date in the future at a specified price. The *forward price* is the agreed upon future price in that transaction.

For a non-dividend paying security, a general formula for the forward price is:

$$F_0 = S_0 \cdot (1 + r_f)$$

Where

- F_0 = the forward price
- S_0 = the price of the security today
- r_f = the risk-free rate

2. Forward Prices

General Formula - Proof

The proof is based on a no-arbitrage argument.

Specifically, if the price were either higher or lower, it would be possible to enter into a profitable *riskless* arbitrage. As we generally assume profitable riskless arbitrages don't exist (somebody will do them if they do!) then the price cannot be either higher or lower than the formula.

2. Forward Prices

General Formula - Proof

Case 1: If $F_0 > S_0 \cdot (1 + r_f)$, then the following is a riskless arbitrage:

- Borrow money today at the riskfree rate
- Use the money to buy the security for S_0
- Simultaneously sell the security forward at F_0
- At maturity, deliver the security you bought into the forward contract, repay the loan
- Total profit: $F_0 - S_0 - S_0 \cdot (r_f) > 0$

Exercise: what are the specific steps to enter into a riskless arbitrage if $F_0 < S_0 \cdot (1 + r_f)$? (hint: will require selling the security short)

2. Forward Prices

General Formula - Dividends

In order to incorporate dividends, remember that the short seller must pay dividends to the lender. Reconstructing the no-arbitrage argument and including that fact leads to the following:

For a dividend/coupon paying security, a general formula for the forward price is:

$$F_0 = S_0 \cdot (1 + r_f) - I$$

Where

- F_0 = the forward price
- S_0 = the price of the security today
- r_f = the risk-free rate
- I = income from the security (dividends or coupons)

2. Forward Prices

General Formula - Dividends

A more general statement of this formula, assuming continuous compounding and allowing for multiple periods is:

$$F_0 = S_0 \cdot e^{(r_f - q)T}$$

Where

- F_0 = the forward price
- S_0 = the price of the security today
- r_f = the risk-free rate
- q = yield from the security
- T = time to delivery, expressed in years

2. Forward Prices

General Formula - Dividends

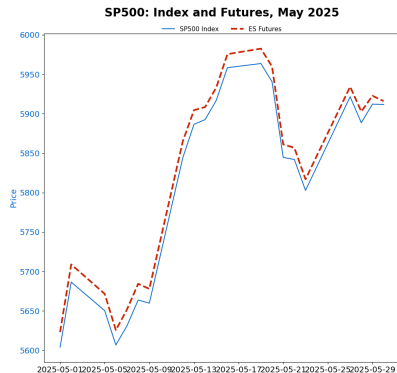
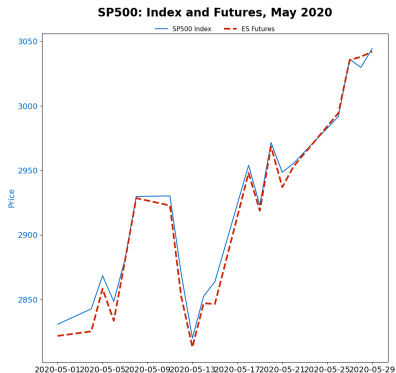
Here is the same formula in discrete time (not continuous time):

$$F_0 = S_0 \cdot (1 + r_f - q)^T$$

Note that when the risk-free rate is greater than the yield, then forward price will be *higher* than the current price. Conversely, in cases where the yield is greater than the risk-free rate, then the forward price will be *lower* than the current price.

2. Forward Prices

Forward v Spot Prices



2. Forward Prices

Forward v Spot Prices

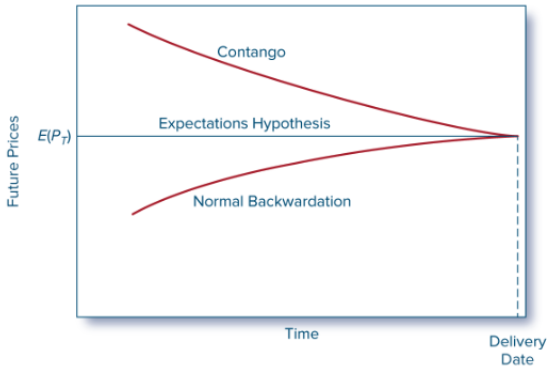
More examples:

- High yielding currencies (i.e. Emerging Markets) will have futures prices that are below the spot prices, in order to account for the yield on the underlying security. When futures prices are **below** spot prices (due to high yields or convenience value), this is known as "backwardation"
- You can think about the storage costs for a commodity as being a factor of the earnings. Commodities with high storage costs will have lower earnings, therefore higher futures prices. When commodity futures prices are **above** spot prices, this is known as "contango"

2. Forward Prices

Forward v Spot Prices

Forward prices always converge to spot prices at the time of the delivery



3. Futures Markets

Futures vs. Forward Contracts

Feature	Forward	Futures
Trading	OTC (private)	Exchange-traded
Standardization	Customized	Standardized
Counterparty Risk	Yes (bilateral)	None (clearinghouse)
Margin	Usually none	Daily margin calls
Settlement	At maturity	Daily mark-to-market
Liquidity	Low	High

3. Futures Markets

History

- **1848** Chicago Board of Trade (CBOT) established to facilitate forward trades in grains
- **1972** Chicago Mercantile Exchange (CME) introduces first currency future
- **1974** Commodity Futures and Trading Commission (CFTC) established as the regulator
- **1976** CBOT introduces first interest rate future
- **1982** CME introduces S&P future (after receiving regulatory approval from the CFTC and SEC)
- **2007** CME and CBOT merge

3. Futures Markets

History

Market Summary > CME Group Inc

274.91 USD

+ Follow

+266.33 (3,104.08%) ↑ all time

Nov 24, 1:28 PM EST • [Disclaimer](#)

1D | 5D | 1M | 6M | YTD | 1Y | 5Y | Max



Open	273.39	Mkt cap	98.75B	52-wk high	290.79
High	274.90	P/E ratio	26.65	52-wk low	224.62
Low	271.04	Div yield	1.82%	Qtrly Div Amt	1.25

3. Futures Markets

CME

CME's "featured products":

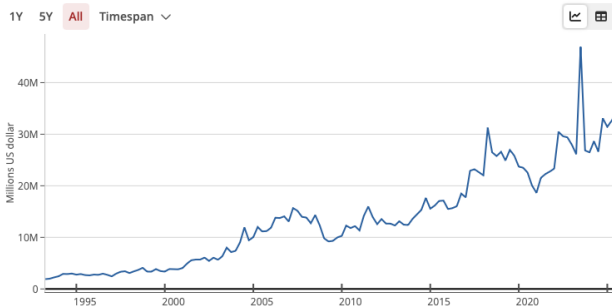
- Corn (ZC)
- Soybean (ZS)
- WTI Crude Oil (CL)
- Henry Hub Natural Gas (NG)
- S&P 500 (ES)
- Nasdaq-100 (NQ)
- Euro FX (6E)
- 10-year T-Note (ZN)
- SOFR (SR3)
- Gold (GC)
- Copper (HG)

There are lots, lots more products...

3. Futures Markets

Size of Futures Market

Global interest rate, total futures, Total all currencies, on North American exchanges, outstanding - notional amounts, Quarterly



3. Futures Markets

Details

Futures Contracts Specifications:

1. What can be delivered into the contract (example: No. 2 Soft Red Winter wheat, Treasury bonds with maturity between 6.5-10 years)
2. The quantity that must be delivered (example: 5,000 bushels of wheat, \$100,000 face value of Treasury bonds)
3. Delivery dates (typically a quarterly cycle)

3. Futures Markets

Details

Exchange Traded: Futures are typically traded and cleared on a centralized exchange.

- The exchange maintains a Central Limit Order Book, where participants have placed limit orders to buy and sell. Transactions occur automatically when bids and offers are met.
- The exchange maintains margin accounts for all participants. The exchange requires daily mark-to-market and may require posting additional margin.
- Individual investors transact through their broker, and the broker has an account on the exchange.

Practice

1. Why might an individual purchase futures contracts rather than the underlying asset?
2. Are the following statements true or false?
 - All else equal, the futures price on a stock index with a high dividend yield should be higher than the futures price on an index with a low dividend yield.
 - All else equal, the futures price on a high-beta stock should be higher than the futures price on a low-beta stock.
3. A futures contract on a non-dividend paying stock index with a current value 150 has a maturity of one year. If the T-Bill rate is 3% what should the futures price be? What if the maturity of the contract is in 3 years?