FIN 411 -- Investments: Futures Pricing

Futures contract is an agreement to buy
- a fixed amount (& quality) of a product
- at a specified price
- at a specified time in the future

At the time the contract is begun, no money changes hands (no investment)
- the value of the contract is returned to zero every day by "settling up"
  - transferring money from the seller(buyer) to the buyer(seller) if the futures price goes up(down)

Futures & Forward Contracts

Forward contract is an agreement to buy
- a fixed amount (& quality) of a product
- at a specified price
- at a specified time in the future
- no daily settling up

Thus, forwards and futures only differ because of the daily settling up provision
- important to reduce default risk
- randomness in short-term interest rates causes differences in forward & future values
Financial Futures Contracts: Stocks

Futures contract on the S&P 500 index:

- Chicago Mercantile Exchange (MERC)
- $500 times the index value
- very actively traded
- used for hedging large stock portfolios
  » portfolio insurance

S&P Index Futures: Arbitrage Pricing

Alternative strategies:

1. buy S&P futures at a price $F_0$ & Treasury bills with an interest rate of $r_f$ equivalent to buying the stock $S_0$
   » if the price of the index at maturity is $S_T$,
     then the payoff to (1) is:

     \[ [ S_T - F_0 ] + [ (1+r_f) S_0 ] \]

2. buy S&P index at a price $S_0$ and receive dividend D
   » the payoff to strategy (2) is:

     \[ [ S_T + D ] \]
Alternative strategies:

- Equating the payoffs to these two strategies gives:

  \[ F_0 = (1+r_f) S_0 - D \]

- in pseudo-return form:

  \[ \frac{[F_0 - S_0]}{S_0} = r_f - d \]

- the percent basis equals the difference between the interest rate \( r_f \) and the dividend yield \( d \) on the index.

S&P Index Futures: Arbitrage Pricing

Arbitrage relation is sometimes called the "cost-of-carry"

- buying the stock today costs you the time value of money

- but buying the futures contract costs you the dividend that the stockholder receives
Financial Futures Contracts: Bonds

Futures contract on 91 day Treasury Bills:

- Chicago Mercantile Exchange (MERC-IMM)
- $1,000,000 face value
- very actively traded

Futures contract on 15 year Treasury Bonds:

- Chicago Board of Trade (CBT)
- $100,000 face value
- 8% coupon assumed

Tbill Futures Contracts: Arbitrage Pricing

Forward Interest rates:

- the annualized yield on a k-day Treasury bill at time t is:

\[ y(k,t) = \ln\left[\frac{1}{P(k,t)}\right] \]

where \( P(k,t) \) is the price

- buy a 182 day Tbill with a yield \( y(182,t) \) and
- sell a 91 day Tbill with a yield of \( y(91,t) \)
- this creates a forward contract in a 91-day Tbill, with a yield:

\[ y(91,t+91) = \left\{ \frac{[1+y(182,t)]^2}{[1+y(91,t)]^1} \right\} -1 \]
Tbill Futures Contracts:
Arbitrage Pricing

Alternative strategies:

- buy forwards (futures) if forward rate is higher (lower) than the futures yield
- short-sell the other contract
- except for variation in interest rates over the life of the contracts (due to "marking to market" -- daily settling up of futures contracts), these are off-setting positions
  - (almost) riskless arbitrage

Tbond Futures Contracts:
Arbitrage Pricing

Alternative strategies (similar to Tbill analysis of forwards & futures, except):

- sellers of Tbond futures have several "quality delivery" options available for delivering of Tbonds when the futures contract matures:
  - (a) Which of several securities do you deliver? (about 40 bonds with 15 years to maturity or first call are available)
  - (b) Which day in the month do you deliver? (7 days to choose from)
  - (c) "Wild-card" option: 6 hours of bond trading after futures delivery price is set
Financial Futures Contracts: Relation to Option Pricing

Payoff
-150 -100 -50 0 50 100 150 200

Stock Price

- Buy Call

Financial Futures Contracts: Relation to Option Pricing

Payoff
-150 -100 -50 0 50 100 150 200

Stock Price

- Buy Call
- Sell Put
Financial Futures Contracts: Relation to Option Pricing

Long futures positions is equivalent to buying a call and selling a put with exercise prices equal to the futures price
- selling the futures is equivalent to selling a call & buying a put

Payoff from futures contract is symmetric
- you can make a lot of money if you guess right
- but you can lose a lot of money if you are wrong
Financial Futures Contracts: Other Contracts

Financial:
- other interest rates (GNMA, LIBOR, Eurodollar, etc.)
- other stock indexes (Value Line, MMI, etc.)
- Foreign exchange
- Metals (gold, silver, etc.)
- Options on Futures

Agricultural:
- corn, wheat, soybeans, potatoes
- pork bellies, cattle
- orange juice, coffee, sugar

Financial Futures Contracts: Summary

(1) Financial futures are a cheap way to take on a lot of risk
- low transactions costs
- large leverage (margins of 5 to 15%, versus 50% for stock purchases)
  - i.e., you have to provide about $100,000 of Treasury bills as collateral to bet $1,000,000 on stock or bond price moves

(2) Unless you have (macroeconomic) "inside information," you should use futures (& options) for risk management
- hedging
Hedging with Financial Futures: Portfolio Insurance

(3) Used to reduce the (market) risk of a large, well-diversified stock portfolio
   • (a) buy put options on S&P 500 (or 100) index
     » puts lower bound on losses
   • (b) sell call options on S&P 500 (or 100) index
     » increases value if stock prices fall or stay level, but you lose if stock prices rise a lot
   • (c) sell S&P 500 futures contracts against a portion of your portfolio
     » as if you were investing in Tbills with that portion of your investment

Financial Futures: Questions

(1) If you had inside information about a specific company, how might you use options or futures to augment your investment strategy? Discuss:
   • options on individual stocks
   • options on market indexes
   • futures on market indexes

(2) If you wanted to adjust the risk of your company's pension fund portfolio, would you use options & futures to do this? Why, or why not?