

DERIVATIVES – FUTURES

- A derivative is a contract or agreement whose value depends upon the price of some other (underlying) commodity, security or index.
- A. **FORWARD CONTRACTS**
 - **Forward**: an agreement between 2 parties that is initiated at one point in time, but requires the parties to the agreement to perform, in accordance with the terms of the agreement, at some future point in time.
 - **Seller / Holder of the Short Position**: Party obliged to **Deliver** the Stated Asset
 - **Buyer / Holder of the Long Position**: Party obliged to **Pay** for the Stated Asset
 - **Deliverable Item/ Underlying Asset**: asset to be traded under the terms of the contract
 - **Settlement / Maturity / Expiration**: Time at which the contract is to be fulfilled by the trading of the underlying asset.
 - **Contract Size**: Quantity of the underlying asset that is to be traded at the time the contract settles
 - **Invoice Amount / Forward Contract Price**: Amount that must be paid for the contract size of the underlying asset by the holder of the long position at the time of the settlement
 - Forward Contracts are NOT Investments; they are simply agreements to engage in a trade at a future time and at a fixed price. Thus, it costs NOTHING to enter into such a contract; Since nothing is Bought or Sold, contracts are Entered Into or Sold Out. There are THREE ways to Close Out (Settle) a contract
 - **Enter an Offsetting Transaction**:
 - **Making/Taking Physical Delivery of the underlying commodity under the terms & conditions specified by the contract**:
 - **Cash Settlement**
 - **Over-the-Counter** Forward Contracts are Flexible, but 3 major disadvantage
 - **ILLIQUID**: designed for specific needs
 - **CREDIT RISK**: No collateral or marked to market, rather it is just trust
 - **UNREGULATED**: no formal body regulates the players in the market

B. FUTURES CONTRACTS

- **Futures**: special forms of forward contracts that are designed to reduce the disadvantages associated with forward agreements. Indeed, they are Forwards whose terms have been STANDARDIZED to that they can be traded in a public marketplace. Less Flexible, but more liquid.
 - Usually traded on FUTURES exchanges, who establish terms of standardization, rules or Pit trading, daily price limit, trading hours, and settlement price methods.
 - Regulated by the **CFTC**.
 - **Brokers**: *Account Executives* who take orders from customers and relay them to the floor; and *Floor Brokers* who operate on the floor and execute orders for others and for themselves.
 - **CLEARINGHOUSE**: interposed between each side and guarantees the contract.
 - **POSTING MARGIN, MARKING TO MARKET**
 - Capital Gains are based upon the **NET DAILY SETTLEMENT** gains or losses that occur in a tax period, rather than upon the net gains or losses that result from contracts that are closed out during a tax period.
 - **FUTURES** is a **ZERO** sum GAME

C. RELATIVE CREDIT RISKS IN FORWARD v. FUTURES CONTRACS

- To ease Credit Risk in the Futures Market, there are 3 types of protections built-in, as opposed to a mere Forward Contract
- **Daily Settlement:** Unrealized Gains/Losses must be settled with cash on a Daily Basis (by way of Margin Calls & Account Crediting/Debiting between Clearinghouse & Regular Accounts)
- **Margin:** Accounts must maintain sufficient balances in their accounts so as to be able to cover several days worth of potential mark-to-market transfers.
- **Clearinghouse:** Guarantees the transactions & insures settlement of the daily mark-to-market gains & losses

D. USES OF FUTURES & FORWARDS

1. Speculation

- Ratio of the Profit to the amount of funds that were potentially at risk, rather than the ratio of the profit to the cash that was put up on margin is the correct way to measure the return on investment
- Advantages of Using Futures/Forwards for Speculative Purposes:
 - Lower Transaction Costs and better Liquidity
 - No need for Storage or Insurance
 - Can Sell Short in the Futures/Forwards, which may not be possible in the Spot Market
 - Employs a great deal of leverage
- Disadvantages of Using Futures/Forwards for Speculative Purposes:
 - With lots of Leverage, Huge Losses could be incurred
 - Margin Calls means that there is a need (potentially) to have lots of free cash

2. Hedging

- 2 Types of Hedges: the **Long Hedge** where the Hedger takes a long position & the **Short Hedge** where the Hedger takes a Short Position
- **Long Hedges:** are used when One is EXPECTING to Acquire an asset in the future, but there is concern that its price might rise in the meantime. To alleviate this price risk, the Hedger takes a long position in the futures contract and then if the price does rise, his profit on the Hedge can be used to offset the higher cost of purchasing the commodity. The same principal applies if the price falls. Either way, the net price paid for the commodity in the future can be fixed in the present.
- **Short Hedges:** Used to reduce risk associated with possible changes in the price of OWNED Assets. Same Principals.
- Difficulties encountered when using Futures as Hedges
 - TO succeed, need to understand complex relationships
 - Might not work if Futures are MISPRICED
 - Hedging Profits generate Tax consequences because the daily settlement cash inflows from unrealized financial gains/losses on futures used as hedges are taxable, even though the offsetting loss incurred in the value of the commodity held long is NOT tax deductible until realized

3. Arbitrage

- Arbitrage is an opportunity to make a risk-less profit without having to make any net investment. There is a no Arbitrage principle in Financial Theory.
- However, market imperfections allow for some arbitrage opportunities.

SOCIAL PURPOSES of Futures:

- Risk Shifting from Hedgers to Speculators
- Price Discovery

E. TYPES & CHARACTERISTICS OF FUTURES CONTRACTS

COMMODITY FUTURES

Position Held to Settlement	Gain on Long = Loss on Short = K-Size * (S _s - F ₀)
Position NOT Held to Settlement	Gain on Long = Loss on Short = K-Size * (F _t - F ₀)
Daily Settlements	Gain on Long = Loss on Short = K-Size * (F _t - F _{t-1})

STOCK INDEX FUTURES

- Stock Index Futures are Settled in Cash, rather than Physical Delivery
- Index Multipliers: S&P → 500, NYSE → 500, MMI → 500, NIKKEI → 5

Position Held to Settlement	Gain on Long = Loss on Short = Multiplier * (S _s - F ₀)
Position NOT Held to Settlement	Gain on Long = Loss on Short = Multiplier * (F _t - F ₀)
Daily Settlements	Gain on Long = Loss on Short = Multiplier * (F _t - F _{t-1})

TREASURY BOND FUTURES

- Settled with the Physical Delivery of Treasury Bonds. To satisfy, the holder of the short must deliver **100** Treasury Bonds (\$100,000 par value) that mature in (or can't be called for) at least **15 years**
- Since many Treasury Bonds could possibly be delivered, require a Conversion for Quotes on the Deliverable Bond

Invoice Price _{DB} = (F ₀ * Conversion Factor _{DB}) + Accrued Interest _{t_{DB}}	
Position Held to Settlement	Gain on Long = Loss on Short = \$1,000 * (F _s - F ₀) * Conversion Factor _{DB}
Position NOT Held to Settlement	Gain on Long = Loss on Short = \$1,000 * (F _t - F ₀)
Daily Settlements	Gain on Long = Loss on Short = \$1,000 * (F _t - F _{t-1})

TREASURY BILL & EURODOLLAR FUTURES

- TREASURY BILL: require the holder of the short to deliver \$1,000,000 face value of treasury bills that mature 3 months from the delivery date. A T-bill future (IMM index) is stated as:

$$F_0 = \text{IMM Index} = 100 - R_0 : R_0 \text{ is the Annualized Discount Rate; i.e., } 100 - 95 = 5$$

$$\text{Invoice Price}(\%) = 100 - [R_0 t_m / 360]$$

- If the quoted price is 95, that does NOT mean that when 1,000,000 face value of 3 month treasury bills are delivered at the time of settlement the invoice price to be paid is \$950,000. Rather, the Quotation of 95 means that the contracted price to be paid on settlement day is a price that will correspond to an ANNUALIZED discount of 5% at that time. Will be 98./75.
- 1 Basis Point (.01) change in the IMM Index for 90 day treasury bills = \$25 change in its dollar value.
- EURODOLLAR: similar to treasury bills, but different.

$$R_0^* = [R_0 / \text{Price}] [360 / t_m]$$

$$\text{Invoice Price}(\%) = 100 - [R_0^* t_m / 360]$$

For Both Treasury Bill & Eurodollar Futures

Position Held to Settlement	Gain on Long = Loss on Short = \$2,500 * (S _s - F ₀)
Position NOT Held to Settlement	Gain on Long = Loss on Short = \$2,500 * (F _t - F ₀)
Daily Settlements	Gain on Long = Loss on Short = \$2,500 * (F _t - F _{t-1})

CURRENCY FUTURES

- Most Currency Trading takes place between banks. But, there are speculative opportunities

Position Held to Settlement	Gain on Long = Loss on Short = Contract Size _{X,Y} * (S _{X,Y,s} - F _{X,Y,0})
Position NOT Held to Settlement	Gain on Long = Loss on Short = Contract Size _{X,Y} * (F _{X,Y,t} - F _{X,Y,0})
Daily Settlements	Gain on Long = Loss on Short = Contract Size _{X,Y} * (F _{X,Y,t} - F _{X,Y,t-1})

F. VALUING FORWARD & FUTURES CONTRACTS

- Forwards & Futures are NOT investable Assets. Rather, they are agreements that are valued by an arbitrage pricing model called the **spot-futures parity theorem** or the **cost-of-carry relationship**

$$F_0 = S_0 * [1 + (r_f t_m / 360)] + C_P - I_P$$

F_0 is the Futures Contract Price

S_0 is the Spot Price of the Underlying Asset

r_f is the Risk Free Rate

t_m is the number of days 'til the contract Matures

C_P is the cost of Storing Insuring the Underlying asset over the life of the contract

I_P is the income generated by the underlying asset over the life of the contract in the form of interest or dividends, plus any interest that can be earned on such payments from the time they are received until the contract expires

r_f is the risk free rate, and if the spot & futures markets are mispriced, it is the IMPLIED REPO rate, which is the rate that will be earned risk free by the arbitrageur

- Basis** is the spread between the spot price of an underlying commodity and the price of a futures contract on the commodity. $\text{Basis} = S_0 - F_0$
- Convergence**; on settlement day, the price of a futures contract will equal the price of the underlying commodity in the spot market (the basis will be zero). $F_s = S_s$
- Calendar Spread** is the difference in price between 2 futures contracts that have the same underlying commodity, but 2 different settlement dates.

$$F_{0 \text{ Distant}} = F_{0 \text{ Near}} [1 + r_f * ((t_m \text{ distant} - t_m \text{ near}) / 360)]$$

- If the prices of Nearby Contracts are Higher than those of Distant Contracts, the futures market is said to be INVERTED

Valuing Stock Index Futures Contracts

- Valued according to the Spot-futures Parity Theorem. But the Cost of Storing & Insuring is Negligible.

$$F_0 = S_0 * [1 + (r_f t_m / 360)] - D_P$$

- Stock Index Arbitrage is Effectuated through Program Trading.

Valuing Treasury Bond Futures Contracts

- Also uses the Spot-Futures Parity Theorem, but there are some unique features. For example, several bonds can satisfy the delivery requirements. But there is the conversion factor.
- Instead, it is a **2 Step Process**: Determine the INVOICE PRICE of a Deliverable Bond & then get the FUTURE Price of the MOST Deliverable Bond (the Cheapest Bond with the HIGHEST YTM)

$$\text{Invoice Price}_{DB} = S_{DB} * [1 + (r_f t_m / 360)] - I_{DB}$$

$$F_0 = (\text{Invoice Price}_{DB} / \text{Conversion Factor}_{DB})$$

- Contract Price of a Treasury Bond Futures is Based upon the Spot Price and the Conversion Factor of THE Most Deliverable Treasury Bond in the Market

Valuing T-Bill & Eurodollar Futures Contracts

- Also uses the Spot-Futures Parity Theorem to value, but the contracts are QUOTED as 100 – Annualized discount rate at which they are priced. It is a Multi-step Process.

1. Determine the Invoice Price to be paid for a 3 month treasury bill, or euro, when the contract matures.

$$\text{Invoice Price} = S_0 * [1 + (r_f t_m / 360)]$$

2. Determine the Dollar Discount Rate

$$D_F = 100 - \text{Invoice Price}$$

3. Annualize the Dollar Discount rate to Obtain the Annualized Discount Rate that corresponds to the Invoice Price of the 3 month Treasury at the time of Settlement.

$$F_0 = 100 - [(360/90) * D_f]$$

$$\text{Maturity of T-Bill Underlying a T-Bill Future} = \text{Maturity of Contract} + 3 \text{ Months}$$

$$\text{Implied Repo Rate} = [(\text{Invoice Price of Contract} / \text{Spot Price of T-Bill Underlying the Contract}) * (360/t_m)]$$

- Arbitrage Opportunities Exit if the Implied Repo Rate is different from the borrowing rate or risk free rates

Valuing Currency Futures Contracts

$$F_{Y/X} = S_{Y/X} \left[\frac{(1 + r_Y \text{ Periodic})}{(1 + r_X \text{ Periodic})} \right]$$

$$F_{X/Y} = S_{X/Y} \left[\frac{(1 + r_X \text{ Periodic})}{(1 + r_Y \text{ Periodic})} \right]$$

Covered Interest Arbitrage

- Interest rate parity defines the relationship between the value of a forward currency exchange rate and the spot exchange rate because it is a no-arbitrage solution. If interest rate parity does not hold, an arbitrage opportunity exists.
- If the forward market is too expensive, the covered interest arbitrage requires the arbitrageur to short the forward and buy the spot (and vice versa)

G. HEDGING WITH FORWARD & FUTURES CONTRACTS

To plan a hedging strategy, several decisions must be made.

1. Determine the Appropriate Hedging Vehicle

- The pricing movements of the hedging vehicle should closely correlate with the price movements of the commodity being hedged.
- If not the same commodity, a cross-hedge may need to be employed.
- Try to choose a futures contract whose contract size divides as evenly as possible into the quantity of the commodity being hedged.
- Choose a futures contract that settles close to the hedging horizon.
- Choose a liquid hedging vehicle

2. Determine the Proper Hedge Ratio

3. Determine the Target Price that is likely to be achieved by using the hedge

- May be difficult to calculate

$$V_{\text{target}} = F_0 + (S_L - F_L) = F_0 + \text{Basis}_L$$

L is the lifting date

4. Determine the Probable Effectiveness of the Hedge

Determining the Number of Contracts Required to Perform a Total Hedge

$$N_F = - (\text{Hedge Ratio} / \text{Contract Size}) * (\text{Quantity of the Commodity to be Hedged})$$

Determining the Hedge Ratio

$$\text{Hedge Ratio} = (\text{COV}_{C,F} / \sigma_F^2) = (\rho_{C,F} \sigma_C / \sigma_F) = B_F$$

Cross-hedging

- When the commodity underlying the hedging vehicle is different from the commodity being hedged, the resulting hedge is a cross-hedge.
- If at all possible, try to avoid using a cross-hedge because of its increased riskiness
- The higher the R^2 between the cross-hedged commodities, the more effective the cross-hedge

Hedging Equity Portfolios with Stock Index Futures Contracts

$$N_F = - [\beta_P / \text{Dollar Multiplier of } K * F_0] * [\text{Value of Portfolio being Hedged}]$$

$$N_F = - [(\beta_P / (1 + r_{t_m} / 360)) / \text{Dollar Multiplier} * \text{Spot Value of Index}] * [\text{Value of Portfolio}]$$

- In theory, the hedge should be reformulated daily because futures contracts require that daily financial settlements be made. This is called TAILING THE HEDGE.

Hedging with T-Bill Futures: ??? hope it is not on Exam

Hedging with Currency Futures

$$N_F = - (\text{Hedge Ratio} / \text{Contract Size}) * (\text{Quantity of Currency Being Hedged})$$