derivatives

Basis = *Current Cash Price - Futures Price*   **Spot-Future Parity**: $F_{0,t} = S_0 (1+C)$

Futures - Futures Parity: $F_{0,d} = F_{0,t}(1+C)$ **Implied Repo Rate**: $C = (F_{0,t} / S_0) - 1$

Futures Pricing for Stock Indices: $F_{0,t} = S_0(1+C) - \Sigma D_i(1+r_i)$

Interest Rate Parity: $F = S [(1+r_d) / (1+r_f)]$

Risk-Minimizing Hedge for Stock Futures:

      No. Contracts = [Portfolio Value / (Multiplier)(Futures Price)] $\beta_{Portfolio}$

T-Bill Pricing: *Price = Face Value - [(Discount Yield)(Face Value)(Days to Maturity) / 360]*

Tailed Hedge # of Contracts=*Unhedged # K / (1+Annual Reinvestment Rate)$^{\#days\ in\ hedge\ horizon/360}$*

CF Model: *[Face Value of Underlying / \$100,000](Conversion Factor)*

PS Model: *# K per Bond = [$R_F P_i D_i / R_i F P_F D_F$] RV*

BP Model: *Relative #K = [$PVBP_{Spot} / PVBP_{Futures}$] (Relative Volatility)*

$\Delta_{Call} = (C_1-C_0)/(S_1-S_0) = \Delta C/\Delta S$ $\Delta_{Put} = \Delta_{Call} - 1$

(Fixed Rate Payment)$_t$ = (Swap Fixed Rate)(#Days/360)(Notional Principal)

(Floating Rate Payment)$_t$ = (Reference Rate)$_{t-1}$(#Days/360)(Notional Principal)

BPV = *(Modified Duration)(Portfolio Market Value)(.0001)*

#Contracts = (Target BPV - Current Portfolio BPV) / BPV of a Futures Contract OR

 [(Target Duration)(Target Portfolio Value) - (Current Duration)(Current Portfolio Value)]

       (Futures Duration)(Value of a Futures Contract)

Keep (1 - |Δ_{put}|) proportion of your portfolio invested in risky assets and put the rest in risk-free bills

COST Of Cash = Cash Weight * (Equity Return - Cash Return)

Return Pick-up = Weight * (Synthetic Equity Return - Cash Return)

= Cash Value to Invest / Value of a Futures Contract

Derivatives Basics

flashcard concepts

- An arbitrage opportunity is a chance to make a riskless profit with no investment. No investment means traders get access to the short sale funds so that they can take along position
- The No-arbitrage principal means that prices are efficient and that the quoted price does not contain any arbitrage possibilities
- Forwards are privately negotiated deals to sell an asset in the future
- Futures Contracts are highly structured exchange-traded contracts to sell an asst in the future
- How do Forwards Differ from Futures?

Forwards	*Futures*
Private Contracts	Exchange Traded Contracts
Unique Contracts	Structured Contracts
Default Risk	Guaranteed by Clearinghouse
Require no Upfront cash	Require Margin Account deposits
Low or NO regulation	Regulated

- Options give the Holder the Right to Buy (Sell) an asset during a time period for a specific price
  - Call Options are the right to buy the asset at a set price
  - Put Options are the right to sell the asset as a set price
  - The Option writer is the person selling the option

derivatives

- Options on Futures are option contracts where the underlying asset is a futures contract. When a call option is exercised
  - The Buyer gets a long futures position and receives cash equal to the futures settlement price less the options exercise price from the option writer
  - The Seller gets a Short Futures position and pays the holder of the option cash equal to the futures settlement price less the options exercise price
- Swaps are agreements between two parties (counter-parties) to exchange future cash flows. The advantages of swaps over futures and options is their flexibility and lack of regulation
- Derivatives are important because
  - They add to market completeness
  - They enable traders to speculate
  - They enable firms to manage their risk by hedging
  - They enable arbitrage
  - They increase trading efficiency (low cost and increase liquidity)
- A long position indicates that you bought or own the futures contract
- A short position indicates that you have sold or are short the futures contract
- Open interest is the number of contracts currently outstanding
- Trading Volume is the number of contracts traded during a certain time period
- Speculators accept risk for expected profits
- Hedgers trade futures to reduce some pre-existing risk exposure
- Futures Contracts are standardized as to quantity, quality, maturity and delivery dates. Standardization promotes market liquidity.
- A tick is the minimum price fluctuation
- The clearinghouse of an exchange splits all trades and acts as the counter-party to all open contracts. The clearinghouse guarantees performance on all contracts.
- Initial margin is the money (cash, letters of credit, or T-bills) put up to initiate a trade
- Maintenance margin is the minimum level to which the margin account can fall
- Variation Margin is the cash deposit needed to restore the margin account to its initial level once a margin call is placed. Variation margin must be paid in cash
- Daily settlement and marking-an-account-to-market is the process of removing losses from or adding profits to a trader's margin account on a daily basis
- A Futures Position may be closed by:
  - physical delivery
  - reversing or offsetting trade
  - exchange of physicals. an exchange of physicals is the only legal off-the-floor transaction allowed. An exchange for physical differs from a delivery in that: (a) traders actually exchange goods, (b) the contract is not closed on the floor of the exchange, and (c) two traders privately negotiate the terms of the transaction
- Types of Futures Contracts
  - Agricultural and Metallurgical
  - Interest Rates
  - Currencies
  - Indexes
- Social purposes of futures markets
  - Price Discovery & Hedging

derivatives

- A Call option gives its owner the right to purchase an underlying good at a specified price for a specified time
- A Put option gives its owner the right to sell the underlying good at a specified price for a specified time period
- An option's exercise or strike price is the price at which the underlying stock can be bought or sold by exercising the option
- An option's premium is what traders have to pay for the option
- MONEYNESS - When does the option have value?
    - S-X = + a call option is in-the-money   put option is out-of-the-money
    - S-X = 0 a call option is at-the-money   put option is at-the-money
    - S-X = - a call option is out-of-the-money   put option is in-the-money
- American Options can be exercised ON or BEFORE the option's expiration date
- European Options can only be exercised at the option's expiration date
    - American option values will equal or exceed European option values
    - American options are more common
    - European options are easier to analyze
- Why trade options?
    - Speculation & Leverage
    - Risk Reduction & Hedging
    - They are Cheaper because they have lower transaction costs
    - To avoid tax exposure
    - To avoid market restrictions
- Option prices are generally higher the longer the time to expiration
- For Call Options, the lower the strike price relative to the stock's underlying price, the more the call option is worth
- For Put Options, the higher the strike price relative to the stock's underlying price, the more the put is worth
- Types of Options Contracts:
    - Stock Options
    - Index Options
    - Foreign Currency Options
    - Futures Options
- At expiration, the intrinsic value of an American options equals that of a European option
- The Intrinsic Value of a Call option is the MAXIMUM of [0, S-X]
- The Intrinsic Value of a Put option is the Maximum of [0, X-S]
- For Calls at EXPIRATION:
    - The Call Buyer's Maximum Loss is the Call Option's Premium
    - The Breakeven point for the buyer and seller is the Strike Price plus the Premium
    - The Profit Potential to the Buyer of the Option is Unlimited
    - The Potential Loss to the Writer of the Call Option is unlimited
    - The Call Holder will exercise the option whenever the stock's price exceeds the strike price
    - The Greatest Profit the Writer of a Call option can make is the premium
    - The Sum of the Profits between the buyer and seller of the call option is always zero

- For Puts at EXPIRATION:
    - The Put Buyer's Maximum Loss is the Put Option's Premium
    - The Maximum Gain to the Buyer of the Put is limited to the value of the exercise price less the premium
    - The Maximum Loss to the Writer of a Put is the Value of the Exercise Price less the premium
    - The Put Holder will exercise the option whenever the stock's price is less than the strike price
    - The Greatest profit the writer of a put can make is the premium
    - The Sum of the Profits between the buyer and seller of the put option is always zero
- A COVERED Call = Long (own) Stock and Short (write/sell) Calls
- With an at-the-money covered call: (where strike price = stock's price at initiation)
    - Loss if the Stock Price Falls = Starting Stock Price - [Ending Stock Price + Premium}
    - Maximum Gain is the Premium
- With an out-of-the-money Covered Call: (where Strike Price > Stock's Price at Initiation)
    - Loss if the Stock Price Falls = Starting Stock Price - [Ending Price of Stock + Premium]
    - Maximum Gain is the Premium + (Stock Price - Stock Price at Initiation)

Futures Pricing

flashcard concepts

- The settlement price for a futures contract is the price to which contracts are marked-to-market. This is not necessarily the final trade price of the day. The settlement committee decides on the settlement price.
- Open interest is the number of contracts that are currently outstanding for a particular maturity date
- The basis equals the spot price minus the futures price. The basis converges to zero at contract expiration because the futures price must equal spot at maturity
- In a normal market, the futures price exceeds the spot price. In an inverted market, the futures price is less than the spot
- A spread measures the difference between two futures contracts - one long-term, the other near-term
- Carrying charges include storage, insurance, transportation and finance costs. Financing costs tend to far outweigh the other components of carrying costs
- The IMPLIED REPO rate is the Cost of Carry that is Inferred by the price differential between spot and futures
- In cash-and-carry arbitrage, you borrow funds to purchase the underlying commodity and at the same time sell a futures contract on that commodity. Futures prices are constrained by cost-and-carry arbitrage
- Transactions costs, differential borrowing and lending rates, and restrictions on short sales all have an impact on the cost-of-carry relationship. Instead of having an exact relationship between the theoretical futures price and the spot asset, these additional costs force bounds on the futures pricing relationship. Remember, large commercial traders may not be affected very much by these restrictions, so the original cost of carry model does a pretty good job of explaining the futures pricing relationship

derivatives

- Assets that exhibit the characteristics of FULL CARRY must be (a) easy to short-sell, (b) have a large supply, (c) have non-seasonal production and consumption, and (d) be easy to store
- T-bill futures require the delivery of a 90-92 day T-bill upon contract maturity with a par value of $1 Million
- T-bill futures rates represent traded forward rates of interest. They are the 90-day interest rate n periods from today
- The relationship between the current term structure of interest rates and T-bill futures yields dictates arbitrage opportunities between the cash and futures markets. Alternatively, if the implied repo rate exceeds the sort-term financing rate, perform cash-and-carry arbitrage. If the implied repo rate is less than the short-term financing rate, then perform reverse cash-and-carry arbitrage
- Since T-bonds pay Explicit interest, the present value of accrued interest must be considered when determining the fair value of T-bond futures prices
- All major stock index futures contracts (a) are settled in cash, (b) have multipliers of $500, and (c) trade on a quarterly cycle
- The existence of dividends is the main distinguishing feature of stock index futures relative to other types of financial futures contract. Dividends serve to reduce the cost-of-carry for tock index futures
- Program trading is a necessity in most index arbitrage settings due to the large number of stocks to keep track of. Potential problems with index arbitrage include (a) tracking many pricing discrepancies simultaneously, (b) trades must take place instantaneously (program trading is a must), (c) dividend payments must be estimated, and (d) the future value of dividend receipts must be estimated
- Foreign Exchange futures prices are driven by Interest Rate Parity. IRP states that risk-free rates in two countries should be the same after adjustment for the currency exchange
- In foreign exchange futures, the cost of carry can be approximated by the interest rate differential. Also, the interest rate differential must equal the forward premium or discount or else arbitrage is available
- In a covered interest arbitrage strategy, lend in the country with the higher US dollar interest rate. Borrow in the country with the lower US dollar rate. This assumes that your home country is the US
- These are important formulas from the reading:

$F = S(1+C)$ where C is the Implied Repo Rate

$S_0(1-T)(1+fC_L) < F_{0,t} < S_0(1+T)(1+C_B)$ where T is Transactions Costs, C_B is Borrowing Costs, C_L is the Lending Rate and f is the percent of proceeds from the short sale

$F_{0,t} = S_0(1+C) - \Sigma D_i(1+r_i)$ where D_i is the Dividend rate on ith stock, r_i is interest earned reinvesting the ith dividend until futures maturity, C is Cost of Carry --> INDEX

$F = S[(1+r_d)/(1+r_f)]$ where r_d is dollar interest rate and r_f is foreign interest rate in Covered Interest Arbitrage for Currency Futures Trading

Cost-of-carry $\cong$ domestic interest rate - foreign interest rate $\cong$ F/S - 1

derivatives

1. DEFINE the futures pricing terms *settlement price, open interest & implied repo rate.*
The SETTLE price is the price at which futures contracts are marked-to-market for the previous day. The settlement price is not necessarily the last trade price of the day. For example, if the final minutes of trading were highly volatile, the commodity's settlement committee will review the end-of-day trading patterns and determine a 'fair' settlement price
OPEN INTEREST is the number of contracts that are currently outstanding for a particular maturity date. As the maturity date of the contract nears, open interest will fall as market participants trade offsetting contracts to close their positions to avoid physical delivery. At contract maturity, open interest will equal zero. The open interest tends to be highest when a contract is in the middle of its life.
$C = (F_{0,t}/S_0) - 1$ Also known as the Implied Repo Rate
If the cost of carry is NOT equal to the Repo Rate, then riskless arbitrage is possible in a perfect market. If the implied repo rate exceeds the actual repo rate, then the futures are overpriced. To gain a riskless profit, you would sell the futures and buy the spot with borrowed money at the repo rate

2. COMMENT on the *Convergence Property* of futures contracts and its relative stability over time relative to changes in the underlying commodity
The spot price of a commodity or financial instrument is the current cash price or the price for immediate delivery. The futures price represents the price today for delivery at some future point in time (the maturity date). As the maturity date nears, the pricing differential between the spot and futures must converge toward zero. In fact, on the maturity date, the spot price must equal the futures price because the futures price has become the price today for delivery today - the same as spot. The basis tends to be STABLE. Even though the futures and spot prices may be swinging wildly, the basis will be relatively stable due to the cost-of-carry arbitrage relationship that defines the basis

3. EXPLAIN the procedures that underlie cash-and-carry arbitrage and reverse cash-and-carry arbitrage for interest rate futures contracts
Cash-and-Carry Arbitrage - If the futures yield is too low, sell futures, borrow $ at the low financing rate (3%) and buy the T-Bill that can be delivered against our futures sale (the 142-day T-bill in this case). At futures maturity, deliver your bill to satisfy your futures sale, repay debt and collect profit
Reverse Cash-and-Carry Arbitrage - If the futures yield is too high, buy futures, borrow at the high financing rate (8%) and buy the T-Bill that matures on the delivery date of the futures contract. Take delivery of the futures and hold that bill until maturity. Collect the proceeds from the maturing bill, repay the debt and collect the profits

4. Today is October 13. You have been given the following info:
69-day T-Bill yield is 6%
159-day T-Bill Yield is 7 %
December T-Bill Futures yield is 8.2% (expiring December 21)
DETERMINE if an arbitrage opportunity is available given the above interest rates and
DESCRIBE the procedure that would be used to obtain a riskless profit

First, check for an arbitrage opportunity by computing the 90-day forward rate 69 days from today

$$(1+f)^{90/360} = [(1+.07)^{159/360} / (1+.06)^{69/360}] = 1.0188906$$
$$f \text{ is annualized at } 7.78\% = (1.0188906)^{360/90} - 1$$

Since the futures yield (8.2%) is too high, perform a reverse cash-and-carry arbitrage by buying futures, borrowing at 7%, buy the 6% T-bill with borrowed money, take delivery of the futures, hold that 90-day bill until maturity. Collect proceeds, repay debt and reap profits

Today:
- Borrow $970,559.50 = $1 Million * (1 / $1.07^{159/360}$) by issuing a 159 day bill at 7%
- Buy a 69 day bill yielding 6% with the proceeds. This bill will pay $981,459.66 upon maturity
- Buy the futures

In December:
- Collect $981,459.66 from your T-Bill
- Pay $980,490 = $1 Million * (1 / $1.082^{90/360}$) upon delivery of the futures. Hold this bill for 90 days
- You reaped $981,459.66 - $980,490 = $969.66 of riskless profit

In March:
- Collect $1 Million from maturing T-bill
- Pay $1 Million to satisfy your 159 day loan at 7%

5. DESCRIBE any additional considerations that may be required when analyzing arbitrage opportunities for T-Bond futures
T-bonds pay periodic interest payments. The result is that you have to consider the present value of these cash flows in your arbitrage computations

6. COMMENT on the carrying cost that underlies stock index futures pricing
Stock index futures differ from other futures contracts in that the underlying securities pay dividends. In simple cash-and-carry arbitrage, the futures price equals the spot price * cost of carry. Since stocks pay dividends, the cost of carry is reduced by dividends received while holding the underlying index.

7. INDICATE the spot-futures pricing relationship for currency futures contracts and OUTLINE the Cost-of-Carry relationship for these securities
The Price of a foreign currency futures is:
$F = S [(1+r_d) / (1+r_f)]$

derivatives

The cost-of-carry in foreign currency futures pricing can be approximated by the interest rate differential between the 2 countries. The interest rate differential should be equal to the forward premium or discount. Hence,

Cost-of-carry $\cong$ domestic interest rate - foreign interest rate $\cong$ (F/S) - 1

8. You have been given the following currency exchange rates and Eurocurrency rates

COUNTRY	YIELD	1-Year Forward Rate ($/FC)	Spot Rate ($/FC)
US	6%	---	---
Canada	8%	0.70	0.72
Germany	4%	0.65	0.625

For each currency, relative to the dollar (do not consider cross-rates), DETERMINE whether or not an arbitrage opportunity exists. If an arbitrage opportunity exists, INDICATE the currency that should be borrowed in the arbitrage procedure

Canada: (1+.06) ≠ .7/.72 (1+.08) = 1.05. Since the Eurodollar rate does not equal the hedged Canadian rate, then an arbitrage opportunity exists. Borrow in Canada

Germany: (1+.06) ≠ (.65/.625)(1+.04) = 1.0816. Again, an arbitrage opportunity exists. Borrow in the US

<mark>*Hedging Review*</mark>

<mark>flashcard concepts</mark>
- In a SHORT HEDGE, you sell futures to 'lock in' the sale price of an underlying commodity or asset. In a LONG HEDGE or ANTICIPATORY HEDGE, you buy futures.
- A CROSS-HEDGE is any situation where the hedge vehicle is not perfectly correlated with the underlying OR when the hedge horizon does not exactly match the maturity of the futures
- The purpose of hedging is to reduce risk - not make a profit. This is because futures contracts have a symmetrical payoff profile
- We use quotation marks around 'lock in' to denote that the sale price is only a certainty if the hedge horizon meets the futures maturity date. Several factors can have an impact on the effectiveness of a hedge:
  - If the hedge horizon is not equal to the contract's maturity, the BASIS may move unfavorably. In other words, it may cost more to unwind the position than expected
  - If a multiple of the contract size does not exactly match the size of the exposure, then you will either have to over- or under-hedge
  - In stock index futures, if the beta of the underlying portfolio changes during the hedge horizon, the effectiveness of the hedge will fail
  - In a cross-hedge, if the correlation between the underlying and the hedge vehicle fall, the effectiveness of the hedge will be reduced.
- The two methodologies used to compute the hedge ratio are (a) COV/VAR and (b) the slope coefficient from a regression of the spot against the futures
- T-bill and Eurodollar futures follow the same pricing relationships. However, the Eurodollar futures differ from the T-bill futures in that Eurodollars settle in cash and the Eurodollars are based on a $1 Million time deposit in a foreign bank (the rate that most often applies to the Eurodollar futures is US $ LIBOR). The yield to both contracts is the 90-day rate beginning at the maturity of the futures

derivatives

- Memorize the following pricing relationships

Index Value = 100 - Yield --> for both T-Bill and Eurodollar
Price = \$1 Million - [(Discount Yield)(\$1 Million)(# days) / 360] --> T-Bill & Eurodollar
P = PAR / (1+r)$^{\text{days}/360}$ standard equation for fixed income
#K = [Portfolio Value / (Multiplier)(Futures Price)]β$_{\text{Portfolio}}$ to hedge with Stock Index futures

- Transaction exposure relates to the physical conversion of currencies to consummate the purchase of goods and services in a cross-border environment. Translation exposure relates to how currency movements affect the financial statements of the parent company where the parent owns a foreign subsidiary

Problem Set: Hedging by Kolb
1. DEFINE both a long and short hedge. Also, PROVIDE an example of a cross-hedge
In a long hedge you buy futures contracts. In a short hedge, you sell futures contracts. The motivation for both long and short hedging is to reduce the risk of an underlying exposure.
A cross-hedge is a hedge in which the hedge vehicle (the futures) is not perfectly correlated with the underlying exposure that is being hedge. For example, you are an emerging markets portfolio manager based in the US and would like to hedge your exposure to an emerging market's currency. Unfortunately, there are not futures contracts that are directly written on this currency. However, you know that the emerging market's currency is highly correlate with the British pound. Therefore, you hedge your exposure to the emerging market by entering into British pound futures contracts.

2. EXPLAIN the concepts that underlie risk minimization hedging
The key concept that underlies a risk minimization hedge is that of correlation. If the underlying asset and futures do not move in tandem - a one-for-one hedge ratio, then we must consider the relative correlation between the underlying and the hedge vehicle. The hedge ratio for a risk minimization hedge is given by:

HR = Covariance between the Futures and Portfolio / Variance of the Futures

3. OUTLINE a procedure that can be used to estimate the minimum variance hedge ratio
An effective way to estimate the risk minimizing hedge ratio is to rund the following regression:
$\qquad$ Spot = $\alpha + \beta$(futures)$+\varepsilon$
Where Spot and futures should be measured as percentage price changes in the spot and futures respectively
The slope coefficient Beta from this regression is our estimate of the hedge ratio. To gauge the effectiveness of this regression, we look at its R^2. More effective regressions - and hence, hedge ratios- will exhibit higher R^2's

4. You own a \$30,000,000 stock portfolio with a beta of .89. The S&P 500 futures are trading at 920. COMPUTE the number of futures contracts needed to hedge your systematic risk.
#K = [30,000,000 / (500)(920)]*(.89) = 58 contracts

derivatives

5. CONTRAST Transaction Exposure with Translation Exposure

Transaction Exposure: case where the hedger will be physically converting one currency into another and would like to eliminate the risk of fluctuating exchange rates

Translation Exposure: relates to the ACCOUNTING for foreign currency transactions. SFAS 52 outlines the procedures for foreign currency reporting under US GAAP. Translation exposure hedging involves reducing the volatility in reported earnings due to changes in exchange rates

6. You own a 180-day T-bill that trades to yield 4%. The T-bill futures for delivery 90 days from today are trading to yield 4.5%. Both yields are given on a discount basis. DESIGN an appropriate interest rate hedge to lock in the sale price of your bill 90 days from today and COMPUTE the hedged sale price

We will perform a short T-bill hedge by selling the T-bill futures for delivery 90 days from today. With the hedge, will receive

Price = $1Million - [(.045)($1Million)(90) / 360] = $988,750 for the T-bill upon delivery

7. Your firm will purchase DM 10,000,000 worth of Widgettes on December 21, 1998. The current $/DM exchange rate is $.625 and the December futures rate is $.640. DESIGN the appropriate currency hedge to 'lock in' your US dollar purchase price of Widgettes and COMPUTE the hedged US $ cost of your purchase

You want to hedge the DM exposure by selling US dollars for DM at the futures rate of $.640. The hedged cost of the purchase in $ is ($.64)(DM 10 Million) = $6,400,000

Swaps

flashcard concepts

- In a PLAIN VANILLA interest rate swap, you enter into a contract with a counter-party to pay a fixed rate of interest and receive a floating rate based on a notional principal value.
- In an Interest Rate Swap, the Notional Principal Value is not exchanged and periodic cash flows are denominated in the same currency. The floating rate of interest is typically pegged to LIBOR. The fixed rate is quoted as the T-note rate of the same maturity plus a spread
- Unlike futures contacts, swaps (a) have default risk, (b) are OTC traded, (c) have multiple settlement dates, and (d) are not marked-to-market
- In a currency swap, principal values are exchanged at the initiation of the contract. Intermediate cash flows and principal values are denominated in different currencies. Fixed-for-fixed swaps are a common type of currency swap contract
- BASIS RISK is the risk that the swap's floating rate cash flows will not exactly match the firm's floating rate cash flows. An example might be spread widening or tightening between LIBOR and the commercial paper rate
- CREDIT RISK or default risk is a key element in swap contracting. Swap spreads may be adjusted depending on the credit risk of a counter-party
- Mis-Match Risk is a key risk for swap dealers. Dealers face the risk that suitable counter-parties cannot be found for some swap contracts. The dealer can hedge his exposure by trading Eurodollar futures contracts

derivatives

1. DEFINE the terms Interest Rate Swap and Currency Swap

Interest Rate Swap - A contractual agreement in which two parties agree to exchange periodic interest payments. The periodic cash flows are denominated in the same currency

Currency Swap - A contractual agreement in which two parties agree to exchange periodic interest payments. The periodic cash flows are not denominated in the same currency

2. STATE Two Characteristics of swap contracts that differ from standard exchange-traded futures contracts

Swaps differ from futures in the following ways:

- Each swap is negotiated in the over-the-counter market and there is no limit as to the contract's terms or size. Swaps are extremely flexible

- Unlike exchange traded futures contracts, OTC swaps contain DEFAULT Risk. Since there is no daily mark-to-market procedure for swaps, each counter-party faces the risk that the other counter-party may default on its accrued obligations

3. DESCRIBE the cash flow characteristics of a plain vanilla interest rate swap

At origination, the terms of the swap are negotiated. However, there is no exchange of cash flows at origination.

At each settlement date, the pay-fixed counter-party is obligated to pay for the receive-fixed party a fixed amount based on the agreed upon Treasury yield plus a spread. The receive-fixed party is obligated to pay a floating amount based on a reference rate such as LIBOR. NOTE: only the net cash flow is exchanged.

4. You have been provided with the following interest rate swap quotations:

Swap Mat. (yrs)	Treas. Yld.	Bid Spread	Ask Spread	Effective Fixed Swap Rate
3	6.87	27	30	7.14-7.17
4	7.13	29	32	7.42-7.45
5	7.28	25	28	7.53-7.56

You have contracted with a major US bank to be the floating rate payer in a plain vanilla, three-year, semi-annual swap with a $50,000,000 notional principal. Assume that the first and second settlement dates are 182 days apart. LIBOR is currently 5.5%

On the first settlement date, US dollar LIBOR falls to 4.5%. COMPUTE the NET cash flow on the first and second settlement dates. Indicate the direction of payment.

Since you are the floating rate payer, the bank is, by definition, the fixed rate payer. Since the bank is paying fixed, the bank contracts to provide the fixed rate at the BID of the quotation (the lower interest rate).

$$\text{(Fixed Rate Payment)}_1 = (.0714)(182/365)(\$50\text{Million}) = \$1,780,110$$
$$\text{(Floating Rate Payment)}_1 = (.055)(182/365)(\$50\text{Million}) = \$1,390,278$$

So the net payment to the floating-rate payer is $1,780,110 - $1,390,278 = $389,832

In the second period, the reference rate changes 4.5% LIBOR. Since the fixed rate receipt does not change, only compute the floating rate payment

$$\text{(Floating Rate Payment)}_2 = (.045)(182/365)(\$50\text{Million}) = \$1,137,500$$

So the net payment to the floating-rate payer is $1,780,110 - $1,137,500 = $642,610

derivatives

5. Most currency swap contracts are quoted on a fixed/floating basis. You understand that in a fixed/floating swap, you receive fixed rate, foreign currency denominated payments in return for floaing rate, US dollar LIBOR-based payments. However, your firm wishes to receive fixed-rate foreign payments and make fixed rate dollar payments. DESCRIBE how you would construct the proper fixed/fixed currency swap to meet your firm's needs

A fixed/fixed currency swap is actually a composite transaction consisting of a floating-for-fixed currency swap and a fixed-for-floating domestic interest rate swap. Since you want to receive fixed payments denominated in the foreign currency and pay fixed payments denominated in US dollars, you would enter into the following contracts:
- *Currency Swap*: Receive Fixed Rate, foreign-currency denominated payments and pay US LIBOR floating. But you want to make fixed rate payments denominated in US dollars. So you also need an interest rate swap
- *Interest Rate Swap*: You receive US based LIBOR payments and agree to make fixed rate US dollar-denominated payments

6. Suppose that a US based corporation has issued 6-year bonds denominated in German marks. The bonds hae 6% annual coupons with a par value of DM 20,000,000. The current spot exchange rate is 1.40 DM/$. The firm must pay DM 1,200,000 in coupon payments each year. Upon issuance of the bonds, the firm enters into a fixed/fixed currency swap with a bank. The current US dollar interest rate is 8% and the current German interest rate is 6%. COMPUTE and LIST the cash flows of the currency swap.

The corporation swaps its DM 20,000,000 for $14,285,714. Note that the initial principal value is converted at the current spot rate (DM 20,000,000 * [1/1.4]). The US dollar interest rate in the swap is 8% and the German mark rate is 6%. Therefore, on each payment date, the bank pays the firm DM 1,200,000 and the firm pays the bank $1,142,857. At maturity, the bank pays DM 21.2 Million and the firm pays $15,428,571

Interest Rate Futures

flashcard concepts
- To shorten the maturity of an existing T-bill investment, sell T-bill futures.
- To lengthen the maturity of a T-bill investment, buy T-bill futures. Buy as many futures contracts as you can with the expected proceeds from the sale of your existing T-bill
- To create a synthetic fixed rate loan from an existing floating rate loan, sell Eurodollar futures. To create a synthetic floating rate loan from an existing fixed rate loan, buy futures.
- A Eurodollar futures contract controls a $1 Million, 90-day LIBOR deposit upon maturity of the futures. The price value of a basis point for a Eurodollar futures is $25
- A Strip Hedge matches futures contracts with the interest rate exposure being hedged. For example, to hedge six future interest rate reset dates, sell futures that correspond to each reset date
- A stack hedge piles up all of the futures contracts for a multi-period hedge on the first interest rate reset date. Stack Hedges may outperform strip hedges due to the potential illiquidity of farther out futures contracts. Stack hedges may under-perform if the yield curve steepens or twists in an adverse fashion
- To tail a hedge, simply divide the naïve number of contracts by the reinvestment rate discount factor. Tailing works best when the number of contracts is large

derivatives

- IN a cross-hedge, the correlation between the spot and futures is less than perfect. An example of a cross-hedge would be the hedge of corporate bonds with T-bond futures
- The Face Value Naïve model hedges an exposure by matching the face value of the spot position with the face value of the futures. You may over-or under-hedge with this model depending on the relative sensitivity of each security to changes in interest rates
- The Market Value Naïve Model matches the market value of spot and futures
- The Conversion Factor Model is the application of the FVN model to T-bond futures. The conversion factor is used to adjust the FVN model in this case
- The Regression Model uses the slope coefficient from the regression of cash market yields against futures market yields. The drawbacks to this model are that (a) the regression analysis is not forward looking, (b) data may be difficult to obtain, and (c) the convergence of bond prices to par value may influence regression results. Despite these drawbacks, the Regression Model is widely used
- The Price Sensitivity Model uses the relative duration of the spot asset and the futures to account for the relative interest rate sensitivity between the two assets. The Price Sensitivity Model is widely used in practice
- Memorize the following equations:

T-Bill Pricing: Price = Face Value - [(Discount Yield)(Face Value)(Days to Maturity) / 360]
Tailed Hedge # K = Untailed Hedge # K / (1+annual reinvestment rate)$^{\text{#days investment horizon / 360}}$
Conversion Factor Model: [Face Value Underlying / 100,000] * (Conversion Factor)
BP Model: Relative #K = [PVBP$_{Spot}$ / PVBP$_{Futures}$] * (Relative Volatility)
Price Sensitivity Model = #K per Bond = [R$_F$P$_i$D$_i$ / R$_i$FP$_F$D$_F$] * (Relative Volatility)
K to Δ Duration = $\frac{[(Duration_{Target})(Portfolio\ Value_{Target}) - (Duration_{Current})(Portfolio\ Value_{Current})]}{(Duration_{Futures})(Value\ of\ a\ Futures\ Contract)}$

- Interest rate futures have gained in popularity as an immunization device because they have lower transaction costs than bond portfolios and are more marketable and more liquid than bond portfolios.
- Using interest rate futures, the duration of an existing bond portfolio can be decreased (increased) by selling (buying) interest rate futures

Problem Set: Interest Rate futures by Kolb
1. DISCUSS the TWO potential outcomes that may apply when you want to shorten the maturity of an existing T-bill investment
To shorten the maturity of a T-bill investment, you must sell T-bill futures. There are 2 cases which apply:
- You could deliver your existing T-bill against the T-bill futures sale. For this case to apply, you must ensure that your existing T-bill will have 90-92 days left in its maturity upon expiration of the futures
- You can unwind your futures position immediately prior to the expiration of the futures and sell your existing T-bill at the same time. Both of these alternatives will have the effect of locking in short-term T-Bill yield

derivatives

2. Your firm has an existing liability that has a quarterly fixed rate of interest for the next 270 days. OUTLINE a procedure that your firm can follow to convert this fixed-rate debt to floating rate debt using only interest rate futures contracts

You can convert this fixed rate debt to a 'floating rate' structure by buying Eurodollar futures
- If interest rates rise, your long futures position will post a loss that will effectively raise your
      cost of borrowing
- If interest rates fall, you will realize a gain on your futures position. This gain will serve to
      decrease your effective cost of debt. Hence, as interest rates change, your cost of
      borrowing floats

3. DEFINE and DISCUSS Strip & Stack hedges

In a strip hedge, futures contracts are matched with the maturity of the corresponding risk exposure. In a stack hedge, all futures contracts that are used for hedging are 'stacked by using only the near-in maturity futures.
- In a Stack Hedge, you are only hedged against movements in interest rates during the initial
      period or if all interest rates change by the same amount. A stack hedge will not perform
      as well when interest rates shift farther out in the maturity spectrum or if the yield curve
      twists or steepens. Alternatively, a stack hedge may outperform if all interest rate
      movements over the life of the loan are concentrated within the first period
- A Stack Hedge may be preferred to a Strip hedge if there is not sufficient volume or liquidity in
      farther out futures contracts. The liquidity of near-term futures contracts may make a
      stack hedge more viable - and in some cases, the only alternative

4. You have decided to sell 1,000 T-bill futures contracts to hedge a long exposure to short-term interest rates. DISCUSS the impact of the mark-to-market feature of futures contracts on this hedge and propose an adjustment to your hedge to account for your discussion

Interest rate futures contracts are market-to-market on a daily basis. Therefore, there may be a cash flow mismatch between your futures hedge and underlying exposure. For example, suppose that you sell Eurodollar futures and interest rates rise. As interest rates rise, cash will be deposited into your margin account on a daily basis to settle your gains. To adjust for this cash flow difference, TAIL the HEDGE Ratio as follows:

Tailed Hedge #K = (Untailed Hedge #K) / (1+Annual Reinvestment Rate)$^{\text{\#days hedge horizon / 360}}$

5. STATE and JUSTIFY the appropriate use of both the Face Value Naïve hedging model and the Market Value Naïve hedging model

The FVN and MVN Models are appropriate for hedging short-term, pure discount instruments such as T-bills and commercial paper. The justification for their use in these situations is that the SENSITIVITY of the Spot and Futures is not a large concern. In other words, the DURATION of short-term instruments is relatively low and the correlation between various short-term instruments (CP and T-Bills, ex) is relatively high

derivatives

6. You own a T-Note with a duration of 3 years that currently sells for Par Value. You have chosen to use a Face Value Naïve model for your hedge. COMPARE the relative performance of T-Bill futures and T-Bond futures when used as the hedge vehicles relative to your bond

From the perspective of the duration or interest rate sensitivity of each hedge vehicle relative to the underlying exposure:

- If you employ the FVN model, you will have sold too few T-bill futures contracts to hedge movements in your T-note since the duration or interest rate sensitivity of the T-bills is much lower than your existing T-note. If interest rates change, the T-bill futures will move less than your T-note and the hedge will perform poorly - you will be under-hedged

- With the FVN model you will have sold too many T-bond futures contracts because the T-bond futures will be more sensitive to a change in interest rates than your existing T-note position because the duration of the T-bond futures exceeds that of your T-note

7. You believe that interest rates are going to increase and want to hedge your $200 Million Treasury portfolio using interest rate futures. The portfolio has a duration of 8 years. A treasury bond futures contract is available with a duration of 5.5 years and a price of 99.123 % of par. The appropriate YTM for your portfolio and the futures contract is 8%. CALCULATE the number of futures contracts necessary to hedge if you want to reduce portfolio duration to 6 years. CALCULATE the number of contracts necessary to make the portfolio insensitive to increases in interest rates

In order to reduce portfolio duration to 6 years, begin with the basic formula:

$D_P P_P = D_B P_B N_B + D_F F P_F N_F$

note: the Treasury bond futures contracts carry a face of $100,000 thus the value of the interest rate futures contract is 99 2/16 of $100,000 or $99,125

$(6)(200,000,000) = (8)(200,000,000) + (5.5)(99,125)(N_F)$

Solving for N_F, is 734 contracts. The negative sign indicates that you take a short position in the interest rate futures contract

To eliminate the impact of interest rate risk, portfolio duration would have to be reduced to zero

$(0)(200,000,000) = (8)(200,000,000) + (5.5)(99,125)(N_F)$

Solving for N_F, is 2,935 contracts. The negative sign indicates that you need to take a short position in the interest rate futures contract

Stock Index Futures

flashcard concepts

- The true CAPM β differs from the β that is used as the risk-minimizing hedge ratio because (a) the CAPM β is estimated by regressing portfolio returns against the returns to the true, unobservable market portfolio and (b) the β used in the hedge ratio is the return to your portfolio regressed against the return to the futures.
- To alter the β - or systematic risk - of an equity portfolio, buy or sell futures. To INCREASE risk, buy futures. To Decrease risk, sell futures. Use the following formula to determine the number of contracts to buy or sell relative to your desired adjustment factor:

#K = [Portfolio Value / (Multiplier)(Futures Price)] * $(\beta_{Portfolio})$ * (Adjustment Factor)

- To Create a synthetic stock portfolio, buy futures contracts and invest the rest of your money in T-Bills

derivatives

- To create a synthetic cash position, buy stock and sell stock index futures. This is the same as saying that a risk-minimizing hedge should produce a risk-free rate of return
- The goal of portfolio insurance is to protect a portfolio's value from falling below a pre-specified floor value
- Memorize the list of steps necessary to implement a dynamic hedge:
  - Choose a Floor Value
  - Evaluate Volatility
  - Set the Initial Hedge Position
  - Rebalance & Monitor

Problem Set: Stock Index Futures by Kolb

1. You own a $30 million stock portfolio with a β of 0.80. You are optimistic that the stock market will increase dramatically in value over the next three months and you would like to increase the systematic risk of your portfolio in an attempt to take advantage of this potential upward swing in stock prices. State three possible actions that you could take to capitalize on your forecast

You could:
- *Sell some of your existing LOW β securities and buy HIGH β securities*
- *Buy index futures, or*
- *Buy index call options*

2. You have decided to use index futures to increase the systematic risk of the portfolio described in question 1 by 50%. The S&P 500 futures with expiration in three months are trading at 900. COMPUTE the number of futures contracts to purchase

#K = [30,000,000 / (500)(900)](.8)(.50) = 26.67 or 27 Contracts

3. You own a $50 million position in an equity portfolio that is designed to mimic the S&P 500. The 3-month S&P 500 futures are trading at 930. CREATE a portfolio that will produce the risk free rate of return over the next three months

Since we own the $50,000,000 portfolio that mimics the S&P 500, all we need to do is sell the appropriate number of futures contracts as prescribed in the risk-minimizing hedge computation:

#K = [50,000,000 / (500)(930)] (1.0) = 107.52 or 108 contracts

Use the β = 1.0 because the underlying portfolio is designed to mimic the S&P 500

derivatives

4. DEFINE the concept of a dynamic hedge and OUTLINE a procedure to implement a dynamic hedge using futures contracts

The key to dynamic hedging is to hedge the portfolio when the market is falling and to systematically remove the hedge when the market is rising. Said differently, you want to be hedged on the downside but still enjoy the upside potential. Here is your basic procedure to implement a dynamic hedge

- Choose a FLOOR value for the portfolio. If the total value of the portfolio reaches this level, you will institute a full risk-minimizing hedge
- Evaluate the VOLATILITY of the market and your portfolio (also analyze the downside risk with a semi-deviation). Higher volatility implies a higher probability for a large downward price move
- Set the INITIAL HEDGE position. If volatility is low (high), then the initial hedge position will be small (large).
- REBALANCE and MONITOR the hedge position as the market moves. As the market falls, sell more future contracts. As the market rises, unwind your futures hedge to leave more of the portfolio exposed to upside potential

5. DISCUSS the key difference between the CAPM β and a practical measure for the risk-minimizing hedge ratio using equity futures

The key difference is that the CAPM β is estimated by regressing the returns to your portfolio against the true or unobservable market portfolio whereas the risk-minimizing hedge ratio in equity futures is found by regressing your portfolio's returns against the return to the futures. The key is that the futures are a proxy for the true or unobservable market portfolio

Option Payoffs and Option Strategies

flashcard concepts

- Portfolio insurance using put options is performed by purchasing a put option that is based on an underlying stock position. For example, if you own a portfolio that mimics the S&P 100, you can purchase the S&P 100 put options to protect your portfolio from downside moves.
- Portfolio insurance strategies using options differ from portfolio insurance strategies using futures because (a) futures have a symmetric payoff profile, (b) futures are marked-to-market daily, and (c) futures are costless to initiate
- The net payoff profile from a protective put position has the same structure as a call option. Hence, to mimic a protective put, buy calls and invest in T-bills
- The cumulative probability distribution for an option insured portfolio will lie above the cumulative distribution indicates that insurance is costly because if the option finishes out-of-the-money, an uninsured position will Dominate the insured position. The key result here is that insurance is costly

derivatives

- Put-call parity is the arbitrage condition that links the option market to the cash market. Memorize the formula and be able to solve put-call parity for any of its components given the other three

$$Call_t - Put_t = Stock_t - Xe^{-r(T-t)}$$

- If C-P exceeds S-PV(X), then sell a call, buy a put, buy the stock and borrow the present value of the exercise price
- If C-P is less than S-PV(X), then buy a call, sell a put, short sell the stock, and lend the present value of the exercise price
- To synthetically replicate the underlying stock option using options, buy a call, sell a put, and lend the present value of the exercise price

Problem Set: option payoffs and option strategies by Kolb
1. CONTRAST the effect of the FLOOR VALUE of Portfolio insurance using options with portfolio insurance using futures contracts
To institute a portfolio insurance strategy, the floor value must be specified. The difference of the effect of the floor value between the two strategies is as follows:
- In an option-based strategy, the strike price of the put options is set near the floor value. Hence, if the expiration of the option contracts matches the hedge horizon, then little trading needs to be performed after the hedge is initiated. This is due to the fact that if the stock price falls below the floor value, then the options will be exercised and the floor value will be guaranteed
- In contrast with options, the futures strategy changes dynamically as the stock price approaches the floor value. As the stock price falls toward the floor, more futures contracts are sold until the portfolio value meets the floor. At the floor value, enough futures contracts are sold to meet the requirements of a risk-minimizing strategy

2. You own a portfolio that mimics the S&P 100. The mean (and current) price per share of your portfolio is $825. You have decided to initiate portfolio insurance by buying OEX puts with a strike price of $775 for $10 each. You have determined that the standard deviation of your portfolio's price movements is $50. DRAW an approximate cumulative price distribution for your hedged portfolio and COMPARE that distribution to an approximate unhedged distribution. Be sure to label all axes and points of interest approximately
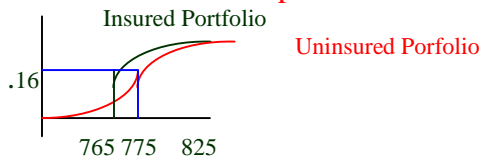
Remember, from probability theory that 68% of all observations in a normal distribution fall between -1 and 1 standard deviations. Hence, looking only at the downside and using the fact that one standard deviation price move is worth $50, there is a 16% chance that the portfolio's value will fall below $775. Since the puts cost $10 and this is a sunk cost, there is a 16% probability that the portfolio's terminal value will be $765. The cumulative distribution for the insured portfolio will lie everywhere above the cumulative distribution of the uninsured portfolio for prices above $765. This behavior illustrates the cost of hedging. If the option finishes out-of-the-money, the insured position will be dominated by the uninsured portfolio.

derivatives

3. A put with an exercise price of $40 has a price of $1. A Call option with the same exercise price costs $5. The risk-free rate is 5% and the option has 3-months left to expiration. ESTIMATE the current value of the stock

Using Put-Call Parity, we can solve for the stock price as follows:

$$\text{Stock} = \text{Call} - \text{Put} + \text{PV}(X)$$
$$43.50 = 5 - 1 + 40e^{-.05(.25)}$$

4. A put with an exercise price of $40 and a three-month expiration costs $1 and the corresponding call option with the same exercise price costs $5. The risk-free rate is 5% and the stock price is $42. DETERMINE whether or not an arbitrage opportunity exists and COMPUTE the net profits from any arbitrage.

Lay out put-call parity and determine the overvalued side of the equation

$$5 - 1 = 42 - 40e^{-.05(.25)} \rightarrow 4 \neq 2.50$$

The options market is overvalued. So, sell the call, buy the put buy the stock and borrow the present value of the exercise price. The net profit is $1.50

Option Sensitivities and Hedging

flashcard concepts
- Δ measures the change in the call option per dollar change in the underlying stock
- Δ can be measured by computing the change in the option and dividing by the change in the underlying stock
- Δ can also be measured by computing $N(d_1)$ from the Black-Scholes option pricing model
- Δ is the slope of the option valuation f. As the call option becomes deep in-the-money, delta approaches 1. As the option falls out-of-the-money, delta approaches 0
- Δ of a Put option equals the Δ of a corresponding Call option - 1
- θ (Theta) measures the time decay of option value
- Vega measures the option's sensitivity to changes in the volatility of the underlying stock. The option's sensitivity to changes in volatility is at its greatest when the option is at-the-money. Call and put options increase in value as volatility rises because the chance that the option finishes in-the-money is greater
- A Delta neutral portfolio is derived by combining a long stock position with short call options. The number of options to sell is computed as $1/\Delta$
- Rebalancing is a key consideration in Delta neutral hedging. A Δ neutral hedge only holds for very small changes in the underlying stock price. As the stock price moves, so does the option delta and the hedge needs to be rebalanced by buying or selling more calls
- You can also develop delta neutral portfolio by buying put options. The movement in the put relative to the underlying stock is given by the put = call delta - 1.

Problem Set: Option sensitivities & hedging by Kolb
1. You own a portfolio that consists of one stock. You would like to create a portfolio delta of 1.40. Call options on your stock currently have deltas of 0.40. CREATE a portfolio which increases the delta to the desired level.
h = (1.4 - 1) / .4 = 1. Therefore, to increase your portfolio delta to 1.4, buy 1 call option for each share of stock held

derivatives

2. You have been examining the behavior of a call option. This morning, the stock price rose $0.50 but the option value only increased by $0.20. EXPLAIN the behavior of the call option

The option's delta describes the price behavior of the call option in relation to the underlying stock price. In this case, the option is either at or just below the money since the option only moved $.20 when the stock rose $.50. The delta of this option can be approximated as $.2 / $.5 = .40 -- in other words, for a $1 move in the stock price, we expect the option price to move by $.40

3. You own 1000 shares of XYZ Corp. XYZ is currently trading at $70 per share. You checked on your Bloomberg this morning and found that XYZ's December call options had a delta of 0.60. DESIGN an appropriate delta neutral hedge for your position in XYZ Corp. BRIEFLY DISCUSS ONE potential problem with the hedge position you have created

First, let's compute the number of calls to sell per share of stock that we hold long. 1/.6 = 1.667 = number of calls to short per share. Hence, to create the appropriate delta neutral hedge for 1000 shares, sell 1667 calls

A potentially serious problem with this hedge is the TIMING between when you computed the delta and when you actually traded the calls. If the stock price moved considerably from the time the delta was computed, the effectiveness of the hedge will be diminished because the delta may have shifted and an incorrect number of calls would have been sold

4. DISCUSS the relationship between a delta neutral hedge and movements in the underlying stock price

A delta neutral hedge only holds for very small changes in the value of the underlying stock. Hence, REBALANCING is an important consideration. As the underlying stock moves, so does the delta of the call option. As the delta changes, the number of calls that need to be sold to maintain a risk-free position changes. Hence, to continuously maintain a delta neutral position would be very costly in terms of transactions costs.

5. DISCUSS the relationship between changes in the volatility and call options prices

Vega measures the sensitivity of the option's price to changes in the volatility of the underlying stock. Important features of vega are:

Options are most sensitive to changes in volatility when they are at-the-money. Deep out- or deep in-the-money options have little sensitivity to changes in volatility (i.e., vega is zero) The following diagram illustrates this behavior
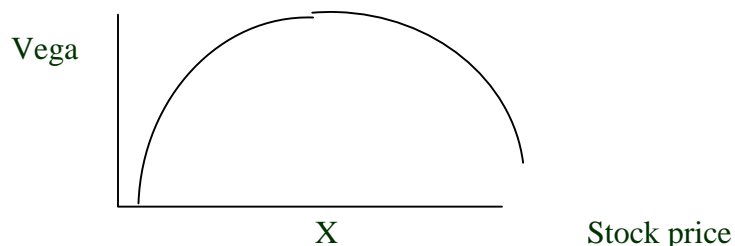
derivatives

Swaps

- An EQUITY SWAP is a swap in which one set of cash flows is based on the return to an equity index. For example, you could receive the total return to the S&P 500 index and pay a fixed rate of interest
- A RECEIVER's SWAPTION gives you the right to receive fixed at a Certain Rate on or Before a Certain date. You pay a premium to purchase this right. The receiver swaption seller holds the obligation to pay fixed
- A PAYER's SWAPTION gives you the right to pay fixed
- A FORWARD RATE AGREEMENT (FRA) is a one period swap. For example, a 3x6 FRA is a contract that allows you to pay a fixed rate of interest 6 months from today and receive a floating rate payment based on LIBOR 3 months from today. The fixed rate is set today
- A swap can be thought of as a STRIP or a series of FRA agreements with successively longer maturity dates. The swap fixed rate is computed as the present-value average of the FRA rates
- Extendable swaps - note that the swaption that is attached to the base swap is of the same variety (payer's to pay-fixed, receivers to receive fixed). Also, the maturity date of the original swap = the exercise date of the swaption
  - Extendable pay-fixed = pay-fixed swap + receiver's swaption
  - Extendable receive-fixed = receive-fixed swap + receiver's swaption
- Cancelable Swaps - the swaption attached to the base swap is of the opposite variety and the exercise date of the swaption is prior to the maturity date of the original swap
  - Cancelable pay-fixed = pay-fixed swap + receiver's swaption
  - Cancelable receive-fixed = receive-fixed swap + payer's swaption
- A Receive-fixed swap can be mimicked by issuing a FRN and buying a fixed-rate note with the proceeds. Alternatively, a pay-fixed swap can be mimicked by issuing a fixed-rate note and buying a floating rate note with the proceeds
- Eurodollar futures can be used to hedge the risk of the floating rate side of a swap contract. If the dealer is the pay-floating party, then short ED futures positions timed to coincide with each settlement date will eliminate the risk of rising interest rates (as rates rise you win on your short ED futures position and lose on the swap). If the dealer is the receive-floating party, then a long ED futures position will provide the necessary hedge
- A long call on LIBOR plus a short put on LIBOR with the same exercise price and maturity will have the same payoff as an FRA
- A Cap is a portfolio of call options on LIBOR. A floor is a portfolio of put options on LIBOR. A Collar is a long call plus a short floor on LIBOR
- In a zero-cost collar, the long call and short put share the same exercise price. The payoffs to a pay-fixed swap can be mimicked by a zero-cost collar. The payoffs to a receive-fixed swap can be mimicked by a reverse zero-cost collar (a short call and a long put on LIBOR).
- Synthetic fixed rate debt can be created by combining an existing floating rate debt issue with a pay-fixed swap
- Synthetic floating rate debt is created by combining existing fixed rate debt with a receive-fixed swap

derivatives

- You can create synthetic callable debt by combining existing non-callable debt with a long receiver's swaption position. You have essentially purchased an option to create synthetic floating rate debt in the futures
- A synthetic non-callable debt issue can be created by combining existing callable debt with a short receiver's swaption position. If the option buyer exercises, synthetic fixed rate debt is created. If the buyer does not exercise, your firm keeps the premium, reducing net borrowing costs
- Synthetic dual currency debt uses existing domestic currency debt in conjunction with a fixed-for-fixed currency swap with no exchange of notional swap principal

Problem Set: swaps by Kolb

1. You currently own a $50 million bond portfolio that pays 7% fixed on a quarterly basis and would like to shift your exposure to the equity markets over the next year. Using only swap contracts, DESIGN a strategy which would allow you to appropriately shift your exposure

You would enter into an equity swap where you pay-fixed and receive the total return to an appropriate equity index (most likely the S&P 500) with quarterly settlement. Assuming that market swap fixed rates are 7%, you would pay 7%/4 each quarter and receive the total return to the equity index each quarter. The notional principal value would be set at $50 million

2. Your firm has issued $100 million of fixed-rate payment exposure (your firm is paying fixed). You would like to capitalize on an expected decline in interest rates by entering into a receive-fixed swap contract. You also know that if interest rates rise substantially during the life of the swap contract, your firm's cost of funds could increase substantially. RECOMMEND and DISCUSS a different type of swap contract that would protect your firm from rising interest rates

A cancelable receive-fixed swap would be effective in this situation. The cancelable receive-fixed swap is a combination of a plain receive-fixed swap plus a payer's swaption. If interest rates fall, your firm will pay a lower floating rate of interest and the swaption will finish out-of-the-money. However if on the exercise date of the swaption interest rates rise above the strike rate, you will exercise your right to enter into a pay-fixed swaption = locking in your cost of funds

3. SWAP dealers can employ Eurodollar futures contracts to hedge the risk of the floating-rate side of any swap contract. DISCUSS each of the following two issues as they relate to the use of Eurodollar futures as a hedge device for swap contract risk:

Liquidity - Swap contracts may have relatively long terms to maturity. Hence, any hedge vehicle will need to exhibit relatively good long-term liquidity. The Eurodollar futures are highly liquid contracts and even have relatively good liquidity farther out in the maturity spectrum. Hence, from a liquidity perspective, ED futures represent an effective hedge vehicle for swap contracts

Standardization - Swap contracts are highly flexible instruments which can have unique settlement date patterns. A drawback of using Eurodollar futures to hedge swap cash flows is their standardization. ED futures have specific quarterly maturity dates throughout the year. If the settlement dates on the swap to be hedged do not match the ED futures maturity dates, then you will not have a perfect hedge

derivatives

4. You own a $50 million notional principal, quarterly reset cap agreement with a strike rate of 6%. Assuming that LIBOR is 8% at the end of the next quarter, CALCULATE the net cash flow that the seller must pay

(.08 - .06)($50,000,000)(1/4) = $250,000

5. You own a $50 million notional principal, quarterly reset floor agreement with a strike rate of 6%. Assuming that LIBOR is 8% at the end of the next quarter, CALCULATE the net cash flow that the seller must pay

No cash flow is due, the floor is out-of-the-money

6. Louise Louie, a British investor, has entered into a 3-year equity swap with a major US-based investment bank. The swap calls for the investment bank to pay Louise the total return of the FTSE 100 plus a spread of 15 basis points. Louise agrees to pay the bank British pound-denominated LIBOR (assume that sterling-LIBOR is quoted using a 365 day count). The notional principal amount has been set to , 20,000,000 and is variable. The swap is to be reset every month (182 days). The following table illustrates the performance of the FTSE 100 and sterling-LIBOR over the first 2 years of the swap

Pymt. Period	6-mo US LIBOR	6-mo , LIBOR	FTSE 100 Index	,/$ Rate
Today	6.43%	8.54%	3100	.6760
1	6.60	8.34	3202	.6860
2	6.23	8.45	3150	.6430
3	7.20	8.23	3004	.6540
4	7.10	8.10	3250	.6430

A. COMPUTE the net payment to Louise at the end of the first payment period

Floating Rate Payment = (.0854)(182/365)(,20,000,000) = ,851,660
Equity Index Payment = [(3202 - 3100)/3100](,20,000,000) = ,658,065
Spread Payment = (.0015)(182/365)(,20,000,000) = ,14,959
Hence, the net payment is:

,658,065 + 14,959 - 851,660 = - ,178,636

Louise makes this payment to the investment bank. Notice that for the floating rte payment, we use the beginning of period rate

B. COMPUTE the net payment to Louise at the end of the second payment period

Since the notional principal is variable, after the first period, the notional principal will have grown to ,20,000,000 + ,658,065 = ,20,658,065
Floating Rate Payment = (.0834)(181/365)(,20,658,065) = ,859,081
Equity Index Payment = [(3150-3202)/3202](,20,658,065) = -,335,483
Spread Payment = (.0015)(182/365)(,20,658,065) = ,14,451
Hence, the net payment is:

-,335,483 + ,15,451 - ,859,081 = - ,1,179,113

Again, Louise makes this payment to the bank

derivatives

7. DEFINE an interest rate swaption. DESCRIBE 2 potential uses of interest rate swaptions
An interest rate swaption is an option to purchase an interest rate swap with pre-specified terms on or before a certain date. There are 2 types of swaptions:
- *Receiver's Swaption* = A receiver's swaption gives you the right to receive a fixed rate
- *Payer's Swaption* = Gives you the right to pay a fixed rate
A payer's swaption can be used to lock in a future fixed rate of interest. If you believe that interest rates might rise in the future and you need to issue debt in the future, you can protect yourself by buying a payer's swaption
Money managers can use a receiver's swaption to protect against a fall in interest rates. If interest rates fall, exercise the receiver's swaption and receive a higher fixed rate of interest

8. You are a portfolio manager that is currently holding a long position in a 2-year, 6% semi-annual pay bond. You believe that interest rates will rise substantially in the next month and remain high for the next two years. DESIGN an investment strategy that would capitalize on your interest rate expectations without physically trading your bond or using futures and options
Right now, you own a fixed rate bond. As interest rates rise, the price of your bond will fall. To protect yourself from rising rates, you would like to shorten the duration of your portfolio. To do this, enter into a 2-year semi-annual pay fixed, receive floating swap. The fixed-rate payments from the swap will cancel with the fixed rate receipts from the bonds you own. As interest rates rise, your floating rate receipts from the swap will also rise. By entering into this swap, you have effectively reduced the duration of your portfolio to the time to the next reset date on the floating rate side of the swap

9. You are in investor with a position in FRNs (floating rate notes). You expect that interest rates will fall over the next year. DESIGN a swap agreement that will capitalize on your interest rate expectations
You own floating rate notes and expect interest rates to fall. You can 'lock in' today's higher rates by receiving fixed and paying floating in a swap agreement. The floating rate receipts from your FRNs will cancel with the floating rate payments through the swap. You are left with receiving a high fixed rate over the life of the swap

10. Your firm has most of its liabilities in the form of floating rate notes with a maturity of 2-years and a quarterly reset. You are not concerned with interest rate movements over the next 4 quarters, but are concerned with potential movements after that. DESIGN a strategy that will allow you to hedge the expected changes in interest rates
Your firm is paying floating now, but may want to lock in a fixed rate of interest if interest rates rise one year from now. Hence, buy a swaption that allows you to be the fixed rate payer upon exercise. In other words, go long a payer's swaption with a one-year maturity

11. Your firm has borrowed FF 100 Million and would like to convert your French Franc interest expense exposure to US$ over the life of the loan. DESIGN a strategy to convert your interest expense exposure to US$
Right now, you are paying French Francs fixed. Since you want to pay dollars fixed, enter into a circus swap that allows you to pay dollars fixed and receive French francs fixed. There would be no exchange of principal values in this circus swap

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Minimizing Cash Drag

- Cash drag is the problem of having a significant portion of an equity portfolio invested in cash during a rising market. The two tools you have to manage cash drag are (a) synthetic equity exposure using S&P 500 futures contracts, and (b) investment in the S&P 500 Depositary Receipts (SPDRs)
- Be ready to compute the number of contracts necessary to equitize the cash portion of your portfolio using futures contracts. Memorize the following formula

  # = (Cash Value to Invest) / Value of a Futures Contract

- The differentiating factors between the futures and SPDRs are:
  - *Fees*: The futures are less expensive in terms of commissions and other fees. The SPDRs are a unit investment trust and have a small management fee that is not present with the futures
  - *Liquidity*: The futures are much more liquid than SPDRs
  - *Mispricing*: The futures tend to be mispriced more often and to a greater degree relative to the underlying index. This mis-pricing leads to Tracking Error. The Tracking Error of the futures relative to the cash S&P is higher than the tracking error that is observed with the SPDRs. Using historical data, the authors show that the annualized tracking error associated with futures is .83% v. .04% for the SPDRs per year
  - *Legal/Regulatory*: Some institutions may be restricted from investing in the futures because they are derivative instruments. In contrast, other institutions may be limited as to the amount of SPDRs that can be held due to restrictions on investments in the shares of another investment company
  - *Dividends*: With the SPDRs, dividends received by the trust from the underlying securities are accumulated and paid in a lump sum. Furthermore, this dividend payment cannot be immediately reinvested in the underlying securities. Instead, the dividend earns the risk-free rate of return until its payment date. Hence, in a rising market, the SPDRs contain their own little cash drag component. The result is that in a rising market, the returns to the SPDRs will be slightly lower than the cash S&P 500.
- Be able to compute the Cost of Cash and the Return pickup from cash management as follows:
  Cost of Cash = Cash Weight * (Equity Return - Cash Return)
  Return Pickup = Weight * (Synthetic Equity Return - Cash Return)

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1. You manage an equity portfolio with a total value of $400 million. Seven percent of your assets are kept in cash to meet portfolio withdrawal needs. DESIGN an appropriate cash management strategy to minimize the impact of your cash balance on portfolio returns.

Since you need these funds for cash withdrawal purposes, you should probably not suggest equitizing your cash position using the SPDRs since you have to physically purchase the unit trust shares with your excess cash. The futures are probably more appropriate here because you only have to post the margin with the futures and the remainder of your cash can remain in cash equivalents to meet portfolio withdrawals more efficiently

2. CONTRAST the tracking error attributes of the S&P 500 futures relative to the S&P 500 Depository Receipts

The tracking error of the futures relative to the cash S&P is higher than the tracking error that is observed with the SPDRs. Using historical data, the authors show that the annualized tracking error associated with the futures is .83% v. .04% for the SPDRs per year. The additional tracking error with the futures is mainly due to the relative mis-pricing of the futures v. the SPDRs

3. DISCUSS the evaluation of a cash management position using the S&P 500 futures

The evaluation of the futures will depend on the relative pricing of the futures. Our synthetic equity position will outperform if we purchased the futures cheap and sold them dear when we unwound our position. However, if the futures are expensive (dear) relative to the underlying index at the initiation date and turn cheap when we want to sell, our synthetic position will under-perform

4. Using the data in question 1 above, you have decided to implement a cash management strategy using futures contracts. The S&P 500 futures are currently trading at 1,100 and the risk-free rate of return is 6%. Compute the number of contracts necessary to construct your cash management position. BRIEFLY discuss the key consideration for the performance of your cash management strategy.

= Cash Value to Invest / Value of a Futures contract = 28,000,000 / (250)(1110) = 102 K
The key consideration is Tracking Error. Since the tracking error of the futures is relatively high, the potential for mis-pricing to affect the returns to your futures cash management strategy is also high

5. Suppose that you have a $500 million equity portfolio with a 5% cash position. The cash DJIA earns 10%, a synthetic DJIA position using futures earns 9.6%. The risk-free return is 4.5%. Compute the cash drag to your portfolio and compare it to the return pickup that could be achieved using a futures-based cash management strategy.

Cash Drag = (.05)(10%-4.5%) = .275%
Return Pickup Using Futures = (.05)(9.6%-4.5%) = .255%
The return pickup from our cash management program is close to, but does not exactly recoup the cash drag component of your portfolio

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Using Interest Rate Futures in Portfolio Management

flashcard concepts

- Buy T-Bond futures contracts to increase the duration of an existing portfolio and Sell T-Bond futures contracts to reduce the duration of a portfolio
- The Basis Point Value (BPV) is the dollar movement in your portfolio for a one basis point change in interest rates
- Memorize how to compute the BPV

   BPV = (Modified Duration)(Portfolio Market Value)(.0001)

- Memorize the formula for increasing or decreasing the duration of a portfolio. If the result is negative, sell futures. If the result is positive buy futures

   #K = [Target BPV - Current Portfolio BPV] / BPV Futures Contract

- The evaluation of duration increasing or decreasing strategies depend on (a) futures mis-pricing and (b) non-parallel yield curve shifts
- The asset allocation of an existing multi-asset class portfolio can be adjusted using futures contracts. To increase the portfolio's bond allocation and decrease the stock allocation, but bond futures and sell stock index futures
- The advantages of using futures to alter an asset allocation are (a) lower transaction costs, (b) less portfolio disruption, and (c) time savings
- The disadvantages of using futures to alter an asset allocation are (a) potential futures mis-pricing, (b) unfavorable correlation between the futures and the underlying in a cross-hedge, and (c) futures roll-over risk
- Dynamic hedging with futures is the process of a(a) setting a floor value for the portfolio (b) computing the option delta from a theoretical put option with the desired floor value characteristics, (c) investing 1 - $|\Delta_{put}|$ of the portfolio's assets in risk securities and putting the rest into cash and (d) periodically rebalancing the portfolio as the theoretical put option delta changes
- The evaluation of dynamic hedging with futures depends on (a) futures mis-pricing, (b) tracking error, (c) the tradeoff between rebalancing and transaction costs (d) model risk and (e) unreliability of option pricing parameters during 'market events'
- The support for dynamic hedging comes from the fact that relative to put options, the futures are (a) cheaper, (b) offer more flexibility and (c) are easier to roll over

Problem Set: Minimizing cash drag by hill & cheong
1. You manage a 60/40 stock/bond portfolio and expect stock prices to fall over the next quarter. DISCUSS the process you would follow to reduce the stock allocation and increase the bond allocation of your portfolio using futures
Since we are not given much information regarding the structure of the portfolio, you should simply say that you would sell stock index futures and simultaneously buy bond index futures in the appropriate amounts

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2. You have a current $200 million bond portfolio with a modified duration of 6 years and you would like to reduce that duration to 2 years to partially protect yourself from a rise in interest rates. If the BPV of the T-bond futures is $95, COMPUTE the number of futures contracts necessary to adjust your portfolio's duration

STEP 1: Compute the Current Portfolio BPV = (6)($200 million)(.0001) = $120,000
STEP 2: Compute the Desired Portfolio BPV = (2)($200 million)(.0001) = $ 40,000
STEP 3: Compute the Contracts = (40,000 - 120,000) / 95 = -842 → Sell 842 Contracts

3. You have a $100 million portfolio with a 40%/60% bonds/cash asset allocation. You would like to create a dynamic hedge to protect your portfolio relative to a floor portfolio value. The Δ of the appropriate put option is -.60. CONSTRUCT the appropriate dynamic hedging strategy using futures and DISCUSS the behavior of that hedge as interest rates rise or fall

Since the absolute value of the delta of the theoretical put is .60, your current asset allocation does not need to be adjusted because the delta says to have 60% of your assets in cash and 40% in risky bonds

As interest rates rise, bond prices will fall and the absolute value of the delta of the put will rise toward one. Hence, as interest rates rise, you will need to rebalance your dynamic hedge by selling T-bond futures contracts to lock in your portfolio's value at the pre-specified floor level

As interest rates fall, bond prices will rise and the absolute value of the put option delta will fall toward zero. In this case, you will rebalance by buying T-bond futures to participate in the bond market rally