CFA Level II Review
Study Session 17: Futures/Swaps

USC/LASFA CFA Review Program

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SESSION OVERVIEW

I. Futures Pricing

- **A. Futures Prices**
- **B. Interest Rate Futures: Introduction**
- **C. Stock Index Futures: Introduction**
- **D. Foreign Exchange Futures**

II. Risk Management With Futures

- **A. Using Futures Markets**
- **B. Interest Rate Futures: Introduction**
- **C. Stock Index Futures: Introduction**
- **D. Foreign Exchange Futures**

III. Swaps

- **A. The Swaps Market: Introduction**
- **B. The Swaps Market: Refinements**

FUTURES PRICING

Futures Pricing

LOS 1A a) Open Interest (Kolb pp. 46-47)

	Futures Trading and Open Interest	
	Buy to Open	**Buy to Close**
Sell to Open	Increase Open Interest	Unchanged Open Interest
Sell to Close	Unchanged Open Interest	Decrease Open Interest

NOTE: ALL Trading Increases Volume!!

Futures Pricing

LOS 1A a) Open Interest (Kolb pp. 46-47)

Calculating Open Interest: Example

The bond futures pit just opened - there has been no trading yet. Open interest in the June contract is 200,000 contracts at the end of the prior trading day. The following are the first transactions of the current day. Calculate volume and open interest following these transactions:

(a) Mr. X trims his 10 long June futures position down to 8 by trading with Mr. Y, who initiates a new long position in 2 contracts.

(b) Mr. A and Mr. B both decide to get into futures trading for the first time - Mr. A goes long 5 June bonds, Mr. B does the opposite.

(c) Colonel Mustard is currently long 27 June bond futures, while professor Plum is short 14. Mustard trims his position down to 13 long contracts, while Plum closes out his shorts.

Futures Pricing

LOS 1A a) Open Interest (Kolb pp. 46-47)

Calculating Open Interest: Answer

Volume occurs whether traders are going long, going short, opening new positions, or closing out positions - just sum it up:

VOLUME = 2 + 5 + 14 = 21

Open interest depends on the type of trade:

(a) open interest unchanged (2 sell-to-close, 2 buy-to-open)

(b) open interest increases 5 (5 buy-to-open, 5 sell-to-open)

(c) open interest falls by 14 (14 sell-to-close, 14 buy-to-close)

OPEN INTEREST = 200,000 + 0 + 5 - 14 = 199,991

Futures Pricing

LOS 1A b) The Basis (Kolb pp. 49)

Cash (Spot) Price = Price of the Underlying Commodity at time 0 for delivery at time 0

= $\mathbf{S_0}$

Futures Price = Price of the Underlying Commodity at time 0 for delivery at time t

= $\mathbf{F_{0,t}}$

Basis = Cash Price - Futures Price

= $\mathbf{S_0 - F_{0,t}}$

Futures Pricing

LOS 1A c) Convergence (Kolb pp. 50-51)

At Expiration: Futures Delivery is for time 0

At Expiration: A Futures Contract is a Spot Contract

At Expiration: The Futures Price is a Spot Price ($F_{0,0} = S_0$)

<u>CONVERGENCE</u>

Basis MUST go to Zero at Expiration

$$S_0 = F_{0,0} \quad \Rightarrow \quad S_0 - F_{0,0} = 0$$

Futures Pricing

LOS 1A d) Cost of Carry Model (Kolb p. 50-53)

Cost of Carry

The total cost to maintain ownership of and control over an asset through time

Components of the Cost of Carry until time t

- ☞ **Storage Costs** = storing the asset until time t
- ☞ **Insurance Costs** = insuring against damage until time t
- ☞ **Transportation Costs** = delivering asset at time t
- ☞ **Financing Costs** = borrowing purchase money until time t

Futures Pricing

LOS 1A d) Cost of Carry Model (Kolb pp. 58-64)

Cost of Carry Theorem

Under perfect market conditions, the price for future delivery of a commodity ($F_{0,t}$) should equal the current spot price of the commodity (S_0) plus the cost of carry (C).

Arbitrage Corollary

If the futures price is greater or less than the current spot price plus the cost of carry, a riskless (arbitrage) profit is available.

Futures Pricing

LOS 1A d) Cost of Carry Model (Kolb pp. 54-60)

Cost of Carry Formula

$F_{0,t} = S_0 + \text{Carry Cost}$

$= S_0 + (\text{Storage} + \text{Insurance} + \text{Transport} + \text{Financing})$

For CFA II assume only financing cost (C) is relevant, so

$$F_{0,t} = S_0 + \text{Carry Cost} = S_0(1+C)$$

where:

C = the cost of carry, as a fraction of S_0

Futures Pricing

LOS 1A e) Cash and Carry Arbitrage (Kolb pp. 55)

Conditions for Cash and Carry Arbitrage

If $F_{0,t} > S_0(1+C)$ then Cash and Carry Arbitrage is possible.

Cash and Carry Arbitrage Profit Potential

Arbitrage Profit per Contract = $F_{0,t} - S_0(1+C)$

Steps in a Cash and Carry Arbitrage

	Time 0	**Time t**
Step 1:	Borrow money	Repay Loan
Step 2:	Buy/Hold Asset	Deliver Asset into Future
Step 3:	Short a Futures Contract	Collect Profit

Futures Pricing

LOS 1A e) Cash and Carry Arbitrage (Kolb pp. 55)

Cash and Carry Arbitrage Example: A commodity currently sells for $100 and a 1 year futures contract on that commodity can be bought or sold for $120. One year interest for lending or borrowing money is 10%. Do a Cash and Carry Arbitrage.

Cash and Carry Arbitrage Example Solution

At Time 0:

Step 1: Borrow $100 cash for one year

Step 2: Buy the commodity "spot" (i.e., right now) for $100

Step 3: Agree to sell the commodity in 1 year via futures for $120

At the end of one Year:

Step 4: Deliver the commodity via futures, receive $120

Step 5: Repay the $100 loan plus $10 interest (10% for 1 year)

Step 6: Collect arbitrage profit of $120 - $110 = **$10**.

Futures Pricing

LOS 1A e) Reverse Cash and Carry (Kolb pp. 56)

Conditions for Reverse Cash and Carry Arbitrage

If $F_{0,t} < S_0(1+C)$ then Reverse Cash and Carry Arbitrage is possible.

Reverse Cash and Carry Arbitrage Profit Potential

Arbitrage Profit = $S_0(1+C) - F_{0,t}$

Steps in a Reverse Cash and Carry Arbitrage

	Time 0	**Time t**
Step 1:	Sell Commodity Short	Collect Loan Proceeds
Step 2:	Lend Proceeds from Short	Take Futures Delivery
Step 3:	Go Long a Futures Contract	Repay Short Sale

Futures Pricing

LOS 1A e) Reverse Cash and Carry (Kolb pp. 56)

Reverse Cash and Carry Arbitrage Example: A commodity sells for $150 and a 1 year commodity futures contract can be bought or sold for $155. Interest on 1 year lending or borrowing is 5%. Set up a Reverse Cash and Carry Arbitrage.

Reverse Cash and Carry Arbitrage Example Solution

At Time 0:

Step 1: Sell commodity short, receive $150 from short sale.

Step 2: Lend $150 for one year at 5% interest.

Step 3: Agree to buy the commodity in 1 year via futures for $155

At the end of one Year:

Step 4: Receive loan proceeds, $150 + $7.50 interest = $157.50

Step 5: Take delivery of commodity via futures, pay $155.

Step 6: Buy back short commodity, keep $157.50-$155 = $2.50

Futures Pricing

LOS 1A f) Implied Repo Rate (Kolb p. 59-60)

Definition of

IMPLIED REPO RATE (C_i)

$$C_i = F_{0,t}/S_0 - 1$$

Futures Pricing

LOS 1A f) Implied Repo Rate (Kolb p. 54-60)

Borrowing

If $F_{0,t} > S_0(1+C)$ then by Cash & Carry a profit exists

$$\mathbf{F_{0,t}/S_0 - 1 = C_i > C_{Borrow}}$$

So borrow at C, lend into the Cash & Carry, and make an arbitrage profit.

Lending

If $F_{0,t} < S_0(1+C)$ then by Reverse C&C a profit exists

$$\mathbf{F_{0,t}/S_0 - 1 = C_i < C_{Lend}}$$

So borrow with the Reverse C&C, lend at C, and make an arbitrage profit.

So if the NO-ARBITRAGE condition exists:

$$\mathbf{C_{Lend} = C_{Borrow} = C = C_i}$$

Futures Prices

LOS 1A g) Compute the Implied Repo Rate (Kolb p. 59)

<u>Example of an IMPLIED REPO RATE (C_i)</u>

Assume a three month futures contract is selling at 114 and the underlying spot price is 112. What is the implied repo?

$$C_i = F_{0,t}/S_0 - 1 = 114/112 - 1 = 1.79\%$$

At an annualized rate the implied repo is:

$$(1.0179)^4 - 1 = 7.34\%$$

Futures Pricing

LOS 1A h) Perfect vs. Imperfect Markets (Kolb p. 60-67)

PERFECT MARKET ASSUMPTIONS

1. **No trader faces TRANSACTION COSTS.**
2. **BORROWING AND LENDING RATES are equal.**
3. **There are no restrictions on SHORT SELLING**
4. **There are no limitations on STORAGE.**

Futures Pricing

LOS 1A h) Impact of Imperfect Markets (Kolb pp. 60-67)

TYPICAL IMPERFECT MARKET VIOLATIONS

1. **Traders face Transaction Costs (T) and a Bid-Ask Spread.**

   $$\text{Bid Price} = S_0(1-T) < S_0(1+T) = \text{Ask Price}$$

2. **Borrowing Rates exceed Lending Rates.**

   $$(1+C_L) < (1+C_B)$$

3. **Brokers restrict use of cash from short selling with Margin Rules.**

   $$(1+fC_L) < (1+C_B) \quad f = \text{percent of usable funds from short sales}$$

4. **Storage costs are non-zero.**

   $$\text{Insurance} + \text{Transportation} + \text{Storage} > 0$$

Futures Pricing

LOS 1A h) Upper/Lower No-Arb Bounds (Kolb p. 65-66)

Finding Fair Value with PERFECT Markets

$$F_{0,t} = S_0 + \text{Carry Cost} = S_0(1+C)$$

Finding Fair Value BOUNDS in IMPERFECT Markets

$$S_0\,(1-T)(1+fC_L) < F_{0,t} < S_0\,(1+T)(1+C_B)$$

Futures Pricing

LOS 1A i) Traders vs. Imperfections (Kolb p. 67-68)

<u>How do Traders Deal With Market Imperfections</u>

1. Small Traders Face:

High transactions costs

Wide Bid-Ask Spread

Insurmountable restrictions on short selling

2. Large Traders avoid this by:

Setting up their own trading desk

Maintaining inventories of the underlying asset

Actively hedging their inventories

Futures Pricing

LOS 1A j) Market Backwardation (Kolb pp. 69-70)

Market Backwardation - When the spot (cash) price exceeds the first futures price, and/or when nearby futures prices exceed out-month futures prices

Convenience Yield - The premium a market sometimes offers for simply owning the underlying commodity

Market Backwardation/Convenience Yield Relationship

When a positive convenience yield exists futures prices are below their perfect-market “full carry” price, and may even fall below the cash price, causing market backwardation.

Futures Pricing

LOS 1A k) Backwardation & Arbitrage (Kolb p. 70)

Causes of a Convenience Yield

1. Underlying commodity may be highly perishable
2. Underlying commodity may be in great demand
3. No one wants to short (lend) the underlying commodity

<u>Impact of Backwardation on Arbitrage Opportunities</u>

Backwardation does NOT automatically lead to reverse cash and carry arbitrage opportunities. Backwardation stems from imperfect market conditions, which widen the bounds within which the "No Arbitrage" principle holds. This is primarily because reverse C&C requires traders to be able to go short.

Futures Pricing

LOS 1A l) Mkt vs. Normal Backwardation (Kolb p. 70)

The Theory of Normal Backwardation

The theory of normal backwardation says that all other things equal, futures prices will tend to rise over time as a compensation for the risk taken by futures market speculators who tend to be net long the futures market (because hedgers as a group tend to be net short in futures).

Normal Backwardation vs. Market Backwardation

MARKET backwardation is a condition that occurs at a point in time due to the nature of the commodity (i.e., a premium for the commodity discourages short selling).

NORMAL Backwardation is a condition that occurs over time due to the nature of the players in the market (i.e., hedgers seek to reduce risk and are net short, speculators are net long and need to be compensated).

Futures Pricing

LOS 1A m) Backwardation vs. Contango (Kolb p. 75)

<u>Contango</u>

The theory of contango says that all other things equal, futures prices will tend to fall over time as a compensation for the risk taken by futures market speculators when they tend to be net short in the futures market.

<u>Normal Backwardation vs. Contango</u>

1. Contango is the opposite of Normal Backwardation

2. Contango is NOT the opposite of Market Backwardation, and is not related to it.

3. Contango assumes speculators are net short, hedgers are net long (which could happen if hedgers were anticipatory buyers).

Futures Pricing

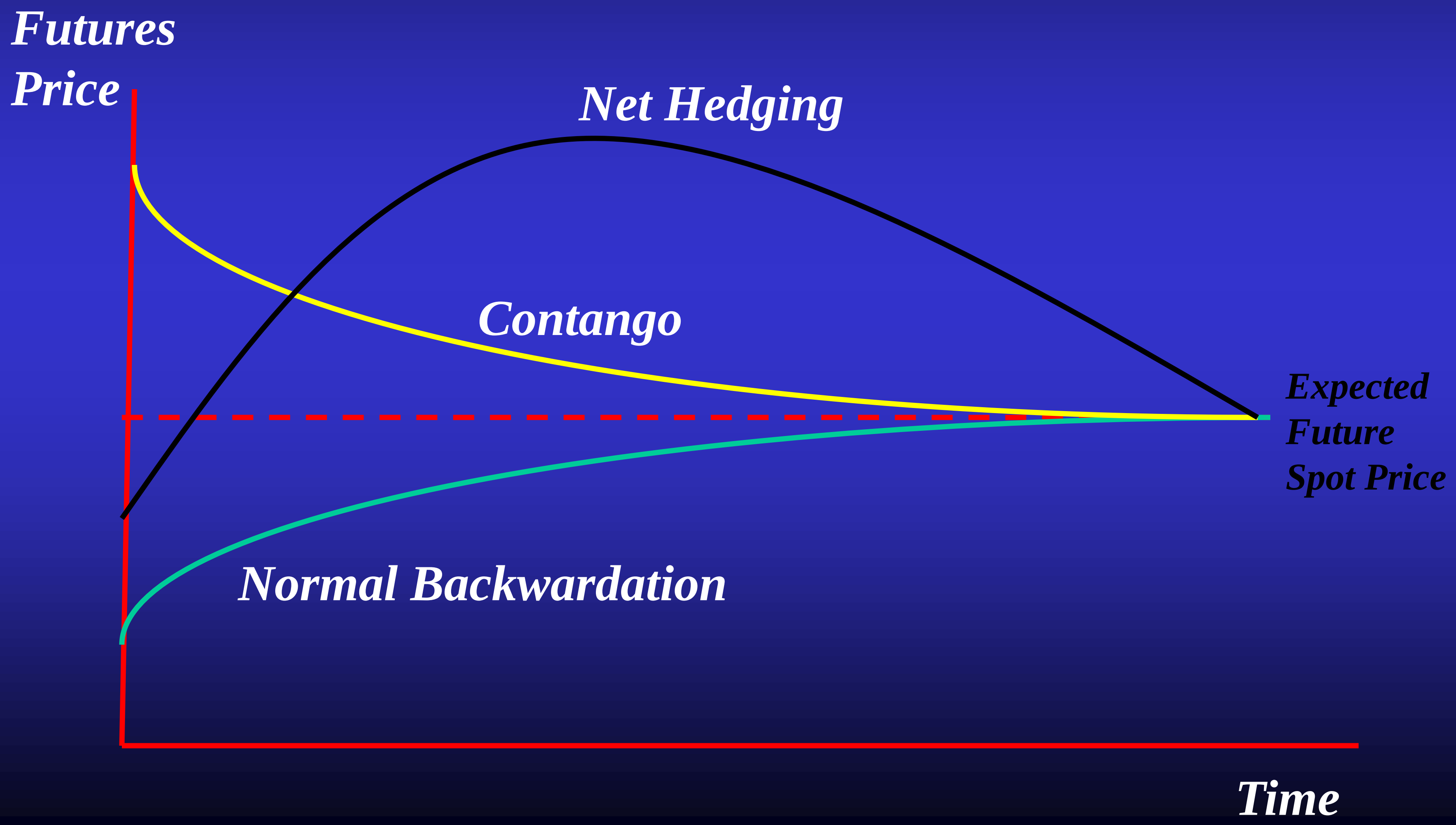
LOS 1A n) Net Hedging Hypothesis (Kolb p. 76)

Net Hedging Hypothesis

The Net Hedging Hypothesis says that futures prices can have a tendency to both rise over time and fall over time, always converging to the expected future asset price, if speculators alternatively switch from being net long to net short.

Futures Pricing

LOS 1A n) Net Hedging Hypothesis (Kolb p. 75-76)



INTEREST RATE FUTURES

Interest Rate Futures

LOS 1B a) Pricing T-Bill Futures (Kolb pp. 113-114)

Terms of a Treasury Bill Futures Contract

(1) Expiration Cycle - Mar, Jun, Sep, Dec

(2) Deliverable - $1 million par value 90-92 day US T-bills

(3) Quotation Method - IMM Index = 100.00 - Discount Yield

Example: Expected discount rate is 5.27%, so:

Bill Futures Price = IMM Index = 100.00 - 5.27 = 94.73

Interest Rate Futures

LOS 1B b) Pricing Eurodollar Futures (Kolb pp. 115-117)

Terms of a Eurodollar Futures Contract

(1) Expiration Cycle - Mar, Jun, Sep, Dec, out for 10 years

(2) Notional - a $1 million 3 month Eurodollar deposit

(3) Deliverable - None. Cash settled each day at $25 per tick.

(4) Quotation Method - IMM Index = 100.00 - LIBOR Yield

Example: Expected LIBOR yield at Settlement is 5.55%, so:

Euro$ Futures Price = IMM Index = 100.00 - 5.55 = 94.45

Interest Rate Futures

LOS 1B c) Pricing T-Bill Futures (Kolb pp. 114-115)

Treasury Bill Pricing Formula

$$\text{Price} = \text{Par} - \left[\frac{DY \times \text{Par} \times DTM}{360} \right]$$

Where:

- **Par = Face value of T-bills**
- **DY = Quoted Discount Yield**
- **DTM = Days to Maturity**

Interest Rate Futures

LOS 1B c) T-Bill Futures Invoice Price (Kolb p. 114-115)

Treasury Bill Futures Invoice Amount: Example

You go long the June T-bill futures contract at 95.62. If you take delivery, what will you pay?

$$\text{DY} = 100.00 - 95.62 = 4.38\%$$

$$\text{Invoice} = \text{Par} - \left[\frac{\text{DY} \times \text{Par} \times \text{DTM}}{360}\right]$$

$$= \$1{,}000{,}000 - \left[\frac{.0438 \times \$1{,}000{,}000 \times 90}{360}\right]$$

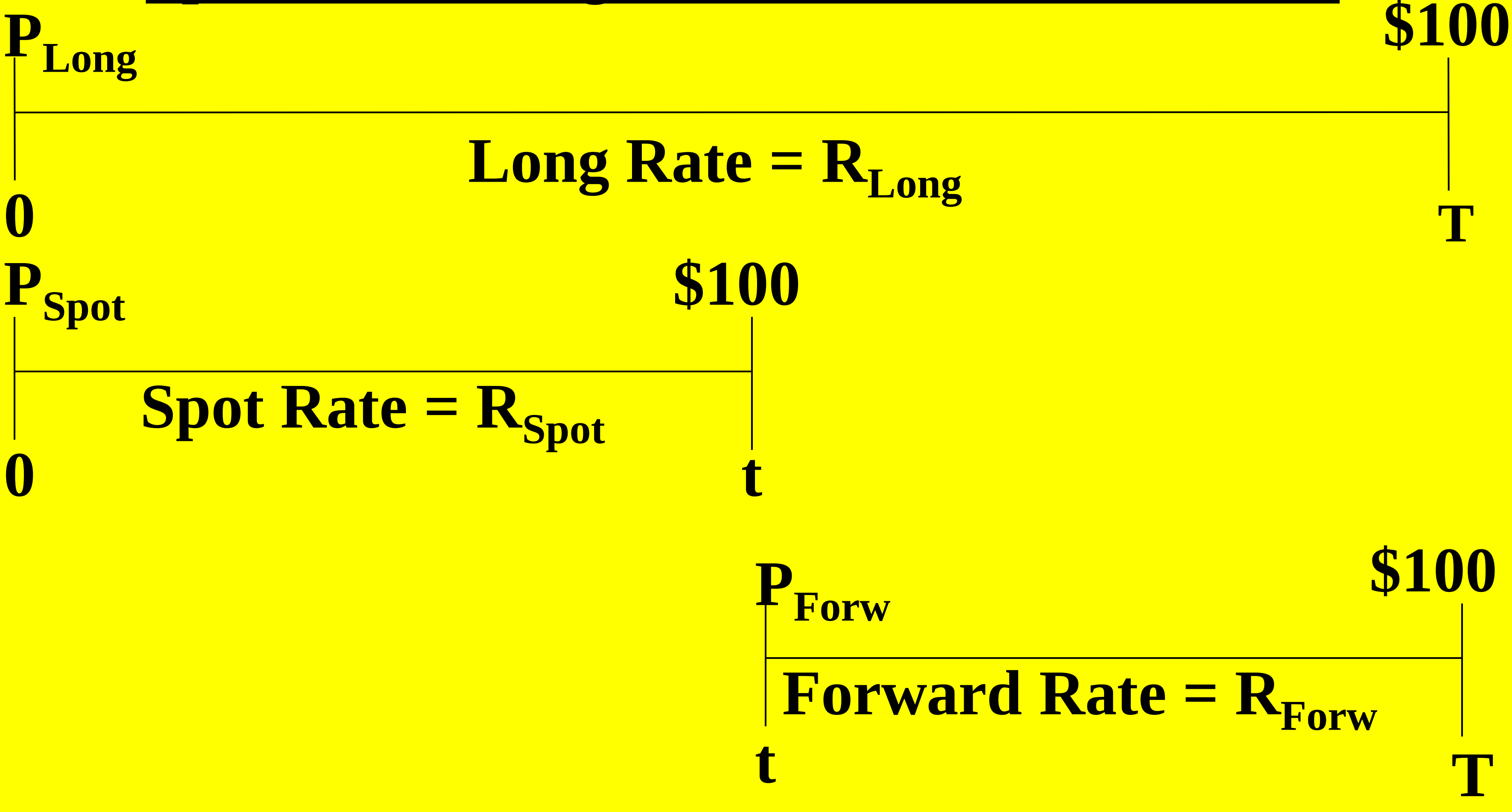
$$= \$1{,}000{,}000 - \$10{,}950$$

$$= \$989{,}050$$

Interest Rate Futures

LOS 1B d) Identifying Rate Arbitrage (Kolb pp. 126-130)

Spot Rates, Long Rates, and Forward Rates



Interest Rate Futures

LOS 1B d) Identifying Rate Arbitrage (Kolb pp. 126-130)

Relationship of Forward Rates to Futures Contracts

A futures contract on a short-term interest rate instrument promises to deliver the forward instrument. Therefore, to avoid arbitrage:

$$P_{Futures} = P_{Forward} \qquad R_{Futures} = R_{Forward}$$

Conditions for Arbitrage in Interest Rate Futures

If $P_{Futr} > P_{Forw}$ and $R_{Futr} < R_{forw}$ then Cash and Carry

If $P_{Futr} < P_{Forw}$ and $R_{Futr} > R_{forw}$ then Reverse Cash and Carry

Interest Rate Futures

LOS 1B d) Identifying Rate Arbitrage (Kolb p. 130)

T-Bond vs. T-Bill Futures

The primary difference between a T-Bond Futures contract and a T-Bill Futures contract is that the T-Bond Futures contract has as its underlying asset a debt instrument that generates cash flows.

Adjustment to Cost of Carry Model for T-Bond Futures

If a bond pays interest the cost of carry model must be adjusted by adding to the price of the purchased bond the discounted present value of the accrued interest from purchase date of the bond to delivery date of the future.

Interest Rate Futures

LOS 1B e) Cash and Carry Arbitrage (Kolb pp. 126-130)

Example: Cash and Carry Arbitrage with Rate Futures

You can borrow for 30 days at 10%. A 120-day T-bill has a discount yield of 12%. There is a bill futures contract available that settles in 30 days to deliver a 90 day T-bill at that time and sells at 92-00. Do a cash and carry arbitrage.

At Time Period 0:

1. **Borrow** for 30 days enough money to buy the 120-day T-bill (see 2.)
2. **Buy** 1 120 day T-bill with a discount yield of 12%:

   Cost of 120-day T-Bill = $1MM-[$1MM x .12 x 120/360] = $960,000

3. **Sell** 1 futures contract at 92.00

Interest Rate Futures

LOS 1B e) Cash and Carry Arbitrage (Kolb pp. 126-130)

Example: Cash and Carry Arbitrage with Rate Futures

At the end of 30 days:

1. **Deliver** the bill (has 90 days left) into the futures contract (100-92=8)

Invoice Price = $1mln - [$1mln x .08 x 90/360] = $980,000

3. **Repay** borrowing ($960,000) plus interest ($7,655) = $967,655

$$\$967,655 = \$960,000 \times (1.10)^{30/360}$$

4. **Book Profit** of $980,000 - $967,655 = $12,345

Interest Rate Futures

LOS 1B e) Cash and Carry Arbitrage (Kolb pp. 126-130)

Example: Reverse Cash and Carry with Rate Futures

You can lend for 30 days at 10%. A 120-day T-bill has a discount yield of 12%. There is a bill futures contract available that settles in 30 days to deliver a 90 day T-bill at that time and sells at 85-00. Do a reverse cash and carry:

At Time Period 0:

1. **Sell** short a 120-day T-bill and receive $960,000
2. **Lend** proceeds from short sale for 30 days at 10%
3. **Buy** 1 bill futures contract at 85-00.

Interest Rate Futures

LOS 1B e) Cash and Carry Arbitrage (Kolb pp. 126-130)

Example: Reverse Cash and Carry with Rate Futures

At the end of 30 days:

1. **Receive** loan proceeds

   Proceeds = \$960,000 x $(1.10)^{30/360}$ = \$967,655

2. **Take Delivery** of futures T-bill (has 90 days left) at 100-85 15

   Invoice Price = \$1mln - [\$1mln x .15 x 90/360] = \$962,500

3. **Book Profit** of \$967,655 - \$962,500 = \$5,155

Interest Rate Futures

LOS 1B g) Calculate the Implied Repo (Kolb p. 129)

Implied Repo Rate for Interest Rate Futures

The implied repo formula for rate futures is

$$\text{Implied Repo Rate} = \frac{\text{Futures Market Cost of the Deliverable}}{\text{Cash Market Cost of the Deliverable}} - 1$$

Where:

Futures Cost = Cost of the bill priced at futures market discount rate

Market Cost = Cost of the bill priced at cash market discount rate.

Interest Rate Futures

LOS 1B g) Calculate the Implied Repo (Kolb p. 129)

Implied Repo Rate for Interest Rate Futures

Question: Find the implied repo rate if a 135 day bill has a discount rate of 5.72% and a bill future with 45 days til settlement is selling for 94.00.

Answer: Find cost of deliverable in futures & cash markets:

Cash Market Cost of T-Bill = \$978,500

Futures Market Cost of T-Bill = \$985,000

$REPO_{imp}$ = \$985,000/\$978,500 - 1 = 0.66%

Annualized Repo = $(1+0.66\%)^{(360/45)}$ = 5.40%

Interest Rate Futures

LOS 1B f) Arbitrage & Implied Repo (Kolb pp. 129-130)

Borrowing

If $F > S_0(1+C)$ then by Cash & Carry a profit exists

$$F/S_0 - 1 = C_i > C_{Borrow}$$

So borrow at C, lend into the Cash & Carry, and make an arbitrage profit.

Lending

If $F < S_0(1+C)$ then by Reverse C&C a profit exists

$$F/S_0 - 1 = C_i < C_{Lend}$$

So borrow with the Reverse C&C, lend at C, and make an arbitrage profit.

So if the NO-ARBITRAGE condition exists:

$$C_{Lend} = C_{Borrow} = C = C_i$$

STOCK INDEX FUTURES

Stock Index Futures

LOS 1C a) Mechanics of Index Futures (Kolb p. 202-203)

Stock Index Futures Contracts

1. **Index Based** - Future tracks a well known stock basket (e.g., SP500)
2. **Cash Settlement** - Future pays a cash value at expiration
3. **Price Return Only** - Future does not pay the index's dividends
4. **Settlement** - Index futures settle on 3rd Fri in Mar/Jun/Sep/ Dec
5. **Available Indexes** - Futures exist on S&P, DJIA, CAC, DAX, FTSE

Simple Example - S&P 500 Futures Contract

S&P 500 Index on April 1 is 1200. You go long one June Futures contract at 1250. At the June expiration date the S&P index is at 1300 (and thus so is the futures contract). Futures multiplier is $250.

Profit on one long contract is $250 x (1300-1250) = $12,500.

Stock Index Futures

LOS 1C a) Index Arbitrage (Kolb pp. 207-209)

Index Arbitrage

Either a cash and carry or a reverse cash and carry arbitrage strategy between an index of stocks and its associated stock index future.

Example: Cash and Carry Index Arbitrage

1. **Borrow** money at riskless rate to buy all stocks in an index
2. **Sell** the associated stock index futures contract
3. **Hold** stocks till expiration, **collect** dividends.
4. **Sell** stocks, use cash to **pay off** loan and futures profit/loss.

Program Trading

Computer assisted simultaneous buying or selling of all the stocks in an index - usually necessary to exploit an index arbitrage.

Stock Index Futures

LOS 1C b) Impact of Dividends (Kolb p. 204-207)

Dealing With Dividends

1. The stocks in a stock index pay dividends.
2. Stock index futures tracks only price, not dividends.
3. To prevent arbitrage, fair value formula must adjust for dividends.

Dividend Adjustment for Cost of Carry (Fair Value) Formula

$$F_{0,t} = S_0 + \text{Carry} - \text{Div} = S_0(1+C) - \Sigma[D_i(1+r_i)]$$

or, for a continuously paid dividend yield (D):

$$F_{0,t} = S_0 + \text{Carry} - \text{Div} = S_0(1+C-D)$$

Stock Index Futures

LOS 1C c) Fair Value Example (old exam questions)

<u>Example: Finding Fair Value (Continuous Dividend)</u>

A stock index sells at 1000 today. The index earns a 4% annualized dividend yield. Money can be borrowed or lent at 7% per year. Find the fair value of a stock index future that expires in 1 year.

Answer:

$F_{0,t} = S_0(1+C- D)$

$= 1000(1+.07 - .04)$

$= 1000(1.03)$

$= 1030.00$

Stock Index Futures

LOS 1C c) Impact of Dividends (Kolb p. 206)

Example: Finding Fair Value (Discrete Dividend)

A stock index sells at 500 today. At the end of 3 months the index will pay a $2.00 dividend, and at the end of 6 months it will pay a $3.00 dividend. Money can be borrowed or lent at 7% per year. Find the fair value of a stock index future that expires in 9 months.

Answer:

$$F_{0,t} = S_0(1+C_{0,t})^t - \Sigma[D_i(1+r_i)^t]$$

$$= 500(1+.07)^{9/12} - 2(1+.07)^{6/12} - 3(1+.07)^{3/12}$$

$$= 500(1.07)^{0.75} - 2(1.07)^{0.5} - 3(1.07)^{0.25}$$

$$= 526.03 - 2.07 - 3.05 = 520.91$$

Stock Index Futures

LOS 1C d) Index Arbitrage Difficulties (Kolb pp. 210-212)

<u>Difficulties in Implementing Index Arbitrage</u>

1. **Real-Time Calculating**

    (a) For the value of the equity index.
    (b) For the fair value of the futures contract.

2. **Simultaneous Trading** of all components stocks and the future

3. **Predicting Dividend Payouts**

    (a) Size of the payouts must be as predicted
    (b) Timing of the payouts must be as predicted
    (c) Reinvestment opportunities for the payouts as predicted

4. **Standard Market Imperfections**

FOREIGN EXCHANGE FUTURES

Foreign Exchange Futures

LOS 1D a) Interest Rate Parity (Kolb p. 262-264)

Interest Rate Parity

Theorem: Currency spot and forward markets will be priced so that risk-free investment opportunities with the same time to maturity are equivalent across two countries.

Interest Rate Parity Formula

$$F_{0,t}/S_0 = (1+R_{d,t})^t/(1+R_{f,t})^t$$

$R_{d,t}$ = Annualized risk-free rate till time t in domestic country

$R_{f,t}$ = Annualized risk-free rate till time t in foreign country

S_0, $F_{0,t}$ = spot, forward exchange rate in domestic units per one foreign

Foreign Exchange Futures

LOS 1D a) Covered Interest Arbitrage (Kolb p. 262-264)

Covered Interest Arbitrage

A 5-step process for exploiting currency arbitrage

Step 1: Borrow funds till time t at a domestic interest rate.

Step 2: Buy foreign currency with borrowed funds at the spot exchange rate.

Step 3: Lend foreign funds at foreign interest rate till time t.

Step 4: Sell foreign currency forward till time t.

Step 5: Unwind positions at time t, take profit.

Foreign Exchange Futures

LOS 1D a) Relationship to Futures (Kolb p. 262-264)

Interest Rate Parity = Cost of Carry Model

Rewriting the Interest Rate Parity formula we see Cost of Carry:

$$F_{0,t} = S_0[(1+R_{d,t})/(1+R_{f,t})]^t = S_0[(1+R_{d,t}-R_{f,t})]^t \approx S_0(1+C)^t$$

where: $C \approx R_{d,t}-R_{f,t}$

Covered Interest Arbitrage=Cash and Carry Arbitrage

1. Borrow domestically	**1. Finance long asset**
2. Buy FC, Lend at foreign rate	**2. Buy asset**
3. Sell currency forward	**3. Sell futures contract**

Foreign Exchange Futures

LOS 1D b) Identify Currency Arbitrage (Kolb p. 265-266)

<u>Identifying Overvalued Currency Futures</u>

If $F_{0,t} > S_0[(1+R_{d,t})/(1+R_{f,t})]^t$ then

Arbitrage Profit Exists; Sell Futures, Buy Spot, Finance

<u>Identifying Undervalued Currency Futures</u>

If $F_{0,t} < S_0[(1+R_{d,t})/(1+R_{f,t})]^t$ then

Arbitrage Profit Exists; Buy Futures, Sell Spot, Finance

Foreign Exchange Futures

LOS 1D b) Exploit Currency Arbitrage (Kolb p. 265-266)

Currency Futures Arbitrage: An Example

Problem: The spot Canadian dollar exchange rate is C$1.50 and the futures contract is at 0.6800. US 3 month rates are 4% while Canadian 3 month rates are 8%. Identify and exploit the arbitrage on US$10 mln.

Answer: Convert to domestic units per 1 foreign: C$1.50 = US$0.6667.

Compute fair value for the currency futures contract:

$$F_{0,t} = S_0[(1+R_{d,t})/(1+R_{f,t})]^t = 0.6667\,[(1.04)/(1.08)]^{.25}$$

$$= 0.6604 < 0.6800 \quad \Rightarrow \text{ Futures overvalued}$$

Conclusion: Exploit with a Cash and Carry Arbitrage

Foreign Exchange Futures

LOS 1D c) Identify Arbitrage Strategy (Kolb p. 265-266)

Steps for a Currency Futures Cash and Carry Arbitrage

Finance a no-money-down long position in the foreign currency by:

(1) **Borrowing** funds in the home country at domestic rate

(2) **Converting** borrowed funds into the foreign currency

(3) **Lending** foreign currency at the foreign interest rate

Commit to a no-money-down future sale of foreign currency via futures.

Deliver foreign currency at expiration of futures contract

Profit from the relative differences of:

(1) The net interest income on financing the currency position

(2) Less the cost of carry of the futures contract

Foreign Exchange Futures

LOS 1D d) Compute Arbitrage Profits (Kolb p. 265-266)

<u>Currency Futures Cash and Carry Arbitrage</u>

Continued:

(1) **Borrow** US$10 million for three months at 4%.

(2) **Buy** US$10 mln worth of Canadian = US$10 x 1.50 = C$15 mln

(3) **Lend** C$15 mln at 8% for 3 months

(4) **Commit** to future sale of Canadian dollars back to US at 0.6800.

(5) **Earn** C$15 mln x $(1.08)^{.25}$ = C$15,291,398

(6) **Convert** C$ to US$: C$15,291,398 x 0.6800 = US$10,398,150

(7) **Payoff** US borrowing: US$10 mln x $(1.04)^{.25}$ = US$10,098,534

(8) **Profit** of US$10,398,151 - US$10,098,534 = **US$299,617**

USING FUTURES MARKETS

Using Futures Markets

LOS 2A a) Constructing a Hedge (Kolb p. 98)

<u>The Theory of Futures Hedging</u>

1. Correlated Movement - Futures prices move broadly in the same direction as their underlying asset.

2. Use of Margin - Futures can be transacted “on margin”, so you can keep your current position in cash or assets and transact a future.

3. Market Exposure - Exposure to an asset can come from being long, being short, or from an upcoming need to be long or short.

THEREFORE

HEDGING involves taking an offsetting position in a futures contract in order to lower your market exposure to an asset.

Using Futures Markets

LOS 2A b) Long Hedges (Kolb p. 98-99)

<u>The Long Hedge</u>

1. Initiation of a Long Hedge

(a) Always involves "Going Long" the futures contract
(b) Always has a specific "Hedging Horizon"

2. Motivation for a Long Hedge

(a) An expected future need to own the underlying asset or
(b) A current short position in the underlying asset.

3. Conclusion of the Long Hedge

(a) Hedger executes a "Reversing Trade" or
(b) Hedger "Takes Delivery" of the underlying asset.

Using Futures Markets

LOS 2A b) Long Hedges (Kolb p. 98-99)

Example: Constructing a Long Hedge

1. **You know you will need to buy widgets in 3 months.**
2. **The current spot price of widgets is $75.**
3. **It would cost you $6 to store widgets for 3 months.**
4. **The 3-month widget futures contract is selling at $80.**

Assume that at expiration the widget spot price is $83. Calculate:

(1) Cost of waiting 3 months to buy widgets

(2) Cost of buying at spot and storing 3 months

(3) Cost of doing an anticipatory long hedge and taking delivery

Using Futures Markets

LOS 2A b) Long Hedges (Kolb p. 98-99)

<u>Answer: Constructing a Long Hedge</u>

(1) If you waited 3 months, you pay spot rate at 3 months: $83

(2) If you buy immediately at spot and store, you pay spot price ($75) and incur $6 of storage costs for a total cost of $81.

(3) If you buy a 3 month future, you agree to take delivery of your needed widgets after 3 months and pay the original agreed upon price of $80.

Conclusion: Lowest cost alternative was an anticipatory long hedge with widget futures and taking delivery after 3 months.

Using Futures Markets

LOS 2A b) Short Hedges (Kolb p. 99-100)

The Short Hedge

1. Initiation of a Short Hedge

(a) Always involves "Going Short" the futures contract
(b) Always has a specific "Hedging Horizon"

2. Motivation for a Short Hedge

(a) An expected future need to short the underlying asset or
(b) A current long position in the underlying asset.

3. Conclusion of the Short Hedge

(a) Hedger executes a "Reversing Trade" or
(b) Hedger "Makes Delivery" of the underlying asset.

Using Futures Markets

LOS 2A b) Short Hedges (Kolb p. 99-100)

Example: Constructing a Short Hedge

1. You are a grower of hemp. Your harvest will be ready for sale to your usual buyer (a rope company) in six months.

2. The current spot market price for hemp is $1500 a ton.

3. The 6-month hemp futures contract is selling at $1400.

Assume that at expiration of the future (same time as your harvest) the spot price for hemp will be either $1500 or $1300. Evaluate the pros and cons of engaging in a short hedge with hemp futures on your harvest.

Using Futures Markets

LOS 2A b) Short Hedges (Kolb p. 99-100)

Answer: Constructing a Short Hedge

If you hedge by selling your harvest in the futures market, you guarantee a sale price of $1400 per ton. On expiration, you may:

(1)Have an opportunity loss of $100 (if hemp is selling at $1500)

(2) Have an opportunity gain of $100 (if hemp is selling at $1300)

Conclusion: Engaging in a short hedge eliminates uncertainty, but it does not guarantee that you will earn the highest possible return. Short hedges are done for certainty, not highest profit.

Using Futures Markets

LOS 2A c) Deciding When to Hedge (Kolb p. 98-100)

	In Cash, Expecting to Short Asset	In Cash, Expecting to Buy Asset	Currently Long the Asset	Currently Short the Asset
Expect Market to Rise	No Hedge	Long Hedge	No Hedge	Long Hedge
Expect Market to Fall	Short Hedge	No Hedge	Short Hedge	No Hedge

Using Futures Markets

LOS 2A d) Cross -Hedging (Kolb p. 100-101)

Definition of Cross-Hedging

CROSS-HEDGING occurs when the characteristics of a futures contract used in a hedge do not perfectly match the characteristics of the position being hedged.

Reasons Why Cross-Hedging is Done

1. No Future Exists - The asset to be hedged has no futures contract

2. Different Maturity - Your hedging horizon differs from the settlement date of the futures contract.

3. Indivisibility - The value of the assets to be hedged is not an even multiple of the value of the applicable futures contracts.

Using Futures Markets

LOS 2A e) Calculating the Hedge Ratio (Kolb p. 101-105)

Definition of Notional Value

A futures contract's NOTIONAL VALUE is the dollar value of the underlying asset that the contract buyer agrees to deliver.

Definition of a Hedge Ratio

A HEDGE RATIO is used to find the number of futures contracts needed to hedge a given position in an asset.

$$\text{Number of Futures} = -\left(\text{Hedge Ratio}\right) \times \frac{\text{Value of Assets to be Hedged}}{\text{Notional Value of Futures Contract}}$$

Using Futures Markets

LOS 2A e) Calculating the Hedge Ratio (Kolb p. 101-105)

<u>Regression Approach to Finding a Hedge Ratio</u>

To find the REGRESSION-BASED hedge ratio, do a time series regression across a suitably chosen time period of the form:

$$S_t = \alpha + \beta F_t + \varepsilon_t \qquad \text{for } t = 1,\ldots,T$$

where:

S_t = the return on the spot price of the asset over time t

F_t = the return on the futures price over time t

ε_t = a regression error term, α = a regression intercept term

β = the estimated regression beta, as well as the HEDGE RATIO

Using Futures Markets

LOS 2A e) Calculating the Hedge Ratio (Kolb p. 101-105)

Simple Example of Calculating Number of Futures

You have 10,000 widgets in inventory worth $60 a piece. Widget futures deliver 2,000 widgets. You estimate the regression:

$$RET_W = -2.36 + 0.80\, RET_F \qquad R^2 = 0.88$$

The futures expiration matches your hedging horizon. How many futures do you need?

$$\text{Number of Futures} = \begin{pmatrix}\text{Hedge} \\ \text{Ratio}\end{pmatrix} \times \frac{\text{Value of Assets to be Hedged}}{\text{Notional Value of Futures Contract}}$$

$$N_F = (0.80) \times \frac{(10{,}000 \times \$60)}{(2{,}000 \times \$60)}$$

$$= 4.0 \text{ Widget Futures (Short)}$$

INTEREST RATE FUTURES

Interest Rate Futures

LOS 2B a) Mechanics of Rate Hedges (Kolb pp. 138-141)

Long and Short Interest Rate Hedges

Long Interest Rate Hedge - Buy an interest rate future to hedge against falling interest rates

Short Interest Rate Hedge - Sell an interest rate future to hedge against rising interest rates

IMPORTANT NOTE: When hedging with interest rate futures, the hedge is against interest rate movements, not movements in the price of short term instruments.

Interest Rate Futures

LOS 2B b) When to use Rate Hedges (Kolb pp. 138-141)

When Are Interest Rate Hedges Useful?

(1) Guaranteed Sale Price -You own a portfolio of short-term instruments and you fear rates will rise - **Short Hedge.**

(2) Target Borrowing Cost - You expect to issue commercial paper and you fear rates will rise - **Short Cross Hedge**

(3) Invest Future Cash - You anticipate a future receipt of money and you want to lock in a current rate **- Long Hedge**

(4) Unwind a Short - You are currently short t-bills and you want to guarantee a future repurchase price **- Long Hedge**

Interest Rate Futures

LOS 2B c) T-Bill Hedge Cash Flows (Kolb pp. 138-141)

Hedging With T-Bill Futures: Example

Problem: You own $10 million par value T-bills with 170 days to maturity. These bills currently sell at a discount yield of 5.50%. The front month T-bill futures contract settles in 80 days, and has a price of 94.30.

(1) If you wanted to hedge your current inventory of T-bills would you buy or sell futures? How many contracts?

(2) Calculate the invoice amount you would receive if you kept your hedge through futures settlement and made delivery.

(3) If 90 day bills are selling at a discount rate of 6.00% at futures expiration, calculate and compare unhedged to hedged cash flows.

Interest Rate Futures

LOS 2B c) T-Bill Hedge Cash Flows (Kolb pp. 138-141)

<u>Hedging With T-Bill Futures: Answer</u>

(1) If you own an asset and want to hedge it you do a Short Hedge.
$10 million / $1 million = 10 T-bill futures contracts (short)

(2) Discount yield = 100.00 - 94.30 = 5.70%
Invoice = 10 x {$1 mln - (.0570 x $1 mln x 90)/360} = **$9,857,500**

(3) Original bills (170 days, 5.50% yield) = **$9,740,278**.

Unhedged at expiration (90 days, 6.00%) = **$9,850,000**

Profit hedged = $9,857,500 - $9,740,278 = $117,222
Profit unhedged = $9,850,000 - $9,740,278 = $109,722

Interest Rate Futures

LOS 2B d) The Role of the Basis (Kolb pp. 138-141)

Definition of the Basis for Short Interest Rate Futures

Basis = Spot Yield - Futures Yield

Impact of the Basis While Hedging with Rate Futures

(1) Convergence - Interest rate futures basis converges to zero at expiration, just like any other future

(2) Irrelevance of Basis - Converging basis does not hamper rate hedging unless the forward rate changes

(3) Forwards are Key - Only the difference between the futures and the forwards, not the futures and the spot, matters

STOCK INDEX FUTURES

Stock Index Futures

LOS 2C a) Beta as a Hedge Ratio (Kolb p. 214-216)

Hedge Ratios for Stock Index Futures

Recall from general theory that the Hedge Ratio is found by:

$$\begin{matrix}\text{Number of}\\ \text{Futures}\end{matrix} = -\begin{pmatrix}\text{Hedge}\\ \text{Ratio}\end{pmatrix} \times \frac{\text{Value of Assets to be Hedged}}{\text{Notional Value of Futures Contract}}$$

For Stock Index Futures we adjust this formula to be:

$$\begin{matrix}\text{Number of}\\ \text{Index Futures}\end{matrix} = -\begin{pmatrix}\text{Portfolio}\\ \text{Beta}\end{pmatrix} \times \frac{\text{Value of Portfolio to be Hedged}}{(\text{Index Value}) \times (\text{Multiplier})}$$

Stock Index Futures

LOS 2C b) Determine Correct Hedge (Kolb p. 214-215)

Long vs. Short Hedging with Stock Index Futures

Long Hedge:

(1) Cover a short position in stocks

(2) Anticipate a future need to put cash into stocks (effectively converting cash exposure into stock)

Short Hedge:

(1) Cover a long position in stocks

(2) Anticipate a future need to liquidate stocks into cash (effectively converting stock exposure into cash)

Stock Index Futures

LOS 2C c) Index Futures & Short Hedges (Kolb p. 215-16)

<u>Example: Short Hedge with Stock Index Futures</u>

You manage a $100 million stock portfolio. Your portfolio has a beta of 0.85 relative to the S&P 500. The S&P 500 index is at 1150, the front month S&P future is at 1165. The S&P 500 futures contract multiplier is $250. How can you hedge your portfolio against an anticipated decline in the S&P 500 index?

$$\begin{matrix}\textbf{Number of} \\ \textbf{Index Futures}\end{matrix} = -\begin{pmatrix}\textbf{Portfolio} \\ \textbf{Beta}\end{pmatrix} \times \frac{\textbf{Value of Portfolio to be Hedged}}{(\textbf{Index Value}) \times (\textbf{Multiplier})}$$

$$= -(0.85) \times \frac{\$100{,}000{,}000}{(1{,}150) \times (\$250)} = -295.65$$

$$\Rightarrow \textbf{Sell 296 S\&P 500 Futures to Hedge}$$

Stock Index Futures

LOS 2C c) Index Futures & Long Hedges (Kolb p. 216)

Example: Long Hedge with Stock Index Futures

A pension plan has allocated $1 billion to active stock managers. These stock managers hold an average of 5% of plan assets in cash. The plan foresees a strong rally in the S&P 500 from current levels at 1200, and wishes to "equitize the cash" of its managers with a long hedge. How many futures do they need?

$$\begin{array}{c}\text{Number of}\\ \text{Index Futures}\end{array} = \begin{pmatrix}\text{Portfolio}\\ \text{Beta}\end{pmatrix} \times \frac{\text{Value of Portfolio to be Hedged}}{(\text{Index Value}) \times (\text{Multiplier})}$$

$$= (1.00) \times \frac{.05 \times \$1{,}000{,}000{,}000}{(1{,}200) \times (\$250)} = 166.67$$

$$\Rightarrow \text{Buy 167 S\&P 500 Futures to Equitize Cash}$$

Stock Index Futures

LOS 2C d) Hedged vs. Unhedged Flows (Kolb p. 215)

Cash Flows for Hedged vs. Unhedged Portfolios

Assume: all the numbers from the previous Short Hedge example, calculate the dollar gains/losses on both a hedged and unhedged portfolio if the S&P 500 Index stands at 1050 at the expiration of the front month futures contract. You ignore the impact of dividends.

Unhedged: The market falls from 1150 to 1050, an 8.696% loss. With a beta of 0.85, the portfolio return would be 0.85 x (-8.696%), or -7.392%. This translates to a dollar loss of ($7,392,000).

Hedged: You still suffer the $7,392,000 loss above because you still have the portfolio. However, your 296 short S&P 500 futures earned (-296) x (1050-1165) x $250 = $8,510,000, for a net portfolio profit of $8,510,000 - $7,392,000 = $1,118,000

FOREIGN EXCHANGE FUTURES

Foreign Exchange Futures

LOS 2D a) Types of Currency Exposure (Kolb p. 273)

Transaction Exposure

Definition: The risk that comes from an anticipated future need to transact in the foreign exchange markets.

Example: A PC manufacturer anticipates a need in three months to pay 5 billion yen in payment to a Japanese parts supplier.

Translation Exposure

Definition: The risk that comes from a need to restate one foreign currency into another for accounting purposes, without actually exchanging currencies.

Example: A US-based multinational firm receives revenues from its German operations but wants to restate those revenues in US dollars.

Foreign Exchange Futures

LOS 2D b) Long vs. Short Hedges (Kolb p. 274-277)

<u>Long vs. Short Hedges with Foreign Exchange Futures</u>

Long Hedge (importer, or company with forex liabilities):

(1) Cover a current short position in foreign currency

(2) Anticipate a future need to pay out foreign currency

Short Hedge (exporter, or company with forex revenues):

(1) Cover a current long position in foreign currency

(2) Anticipate a future need to receive foreign currency

Foreign Exchange Futures

LOS 2D b) Hedged Currency Exposure (Kolb pp. 274-275)

Currency Hedging Example

Problem: The Hertz Corp. expects to take delivery of 2000 BMWs in Germany in June for eventual delivery to US rental agents. Each BMW will cost 15,000 German Marks. The current spot rate is 1.60 German Marks per dollar. The June Dmark futures contract is selling for 0.6500. Evaluate the decisions to hedge or not to hedge the BMW purchase if the spot rate is 1.50 Marks per dollar at the futures contract's expiration. A Dmark futures contract is for the delivery of 125,000 Dmarks.

Foreign Exchange Futures

LOS 2D b) Hedged Currency Exposure (Kolb pp. 274-275)

Answer: Currency Hedging Example

(1) Put everything in same terms. Current spot rate is 1/DM1.60 = US$0.6250. Current futures contract is US$0.6300. Spot rate at the time of futures expiration will be 1/DM1.50 = US$0.6667.

(2) Calculate number of futures contracts needed. 2,000 cars times 15,000 DM per car represents a need to pay DM 30,000,000 for the cars in June. Based on the DM contract size, we would need to go long (assume the hedge ratio is 1.0):

DM30,000,000/125,000 => buy 240 DM Futures Contracts

Foreign Exchange Futures

LOS 2D c) Hedging Currency Exposure (Kolb p. 274-76)

<u>Cash Flows with and without Currency Hedging</u>

3) Calculate unhedged gain/loss: If DM30,000,000 were bought today, it would cost 0.6250 times 30,000,000 = $18,750,000.

If we wait until expiration, it will cost 0.6667 x 30,000,000 = $20,000,000, representing an opportunity loss of $1,250,000 by waiting.

(4) Calculate hedged gain/loss: We still incur the opportunity loss of $1,250,000 on the spot move. We earn $1,100,000 on the futures from: (0.6667 - 0.6300) X 240 long contracts X 125,000 DM = $1,100,000, which limits the loss to (1,100,000 - $1,250,000) = -$150,000.

Foreign Exchange Futures

LOS 2D d) Currency Cross-Hedging (Kolb p. 275)

Tricks to Answering A Currency Cross-Hedge Problem

(1) Cross-hedge won't mean different currencies - too difficult

(2) Look for the needed currency futures to be uneven

93,000,000 Yen / 12,500,000 Yen = 7.44 Yen Futures Contracts

(3) Look for expirations to be longer than your hedge horizon

- **(a) Convergence is not assured**
- **(b) The problem will give you the unwinding futures price**

(4) Look for the hedge to be only partially effective because

- **(a) You had to round off the number of futures contracts**
- **(b) You didn't have convergence work in your favor**

THE

SWAPS

MARKETS

The Swaps Market

LOS 3A a) Basic Ideas of a Swap (Kolb p. 608-609)

Definition of a Swap Contract

A Swap is an agreement between two or more "counterparties" to exchange a sequence of cash flows over a period in the future.

Types of Basic Swap Contracts

A basic, or "plain vanilla" swap contract is defined by whether the counterparties tie themselves to a debt instrument (interest rate swaps) or the value of a foreign currency (foreign currency swaps).

Motivation to Engage in a Swap

Businesses engage in swaps in order to shape and manage the interest rate and/or foreign currency risk inherent in their commercial operations.

The Swaps Market

LOS 3A a) Characteristics of Swaps (Kolb p. 610)

Characteristics of a Swap Contract

1) **Notional Principal** - The reference amount that scales the swap

2) **Tenor** - The agreed-upon time period, or maturity, of the swap

3) **Payment Patterns** - Fixed and floating interest rate payments

4) **Reference Rate** - The floating interest rate (usually "LIBOR flat")

5) **Payment Timing** - Payments calculated "in advance" or "in arrears"

6) **Netting** - Payments are "netted out" each period for rate swaps, but not for currency swaps

7) **Exchange of Principal** - Never on interest rate swaps, Beginning and end of currency swaps.

The Swaps Market

LOS 3A a) Swaps vs. Futures (Kolb p. 610)

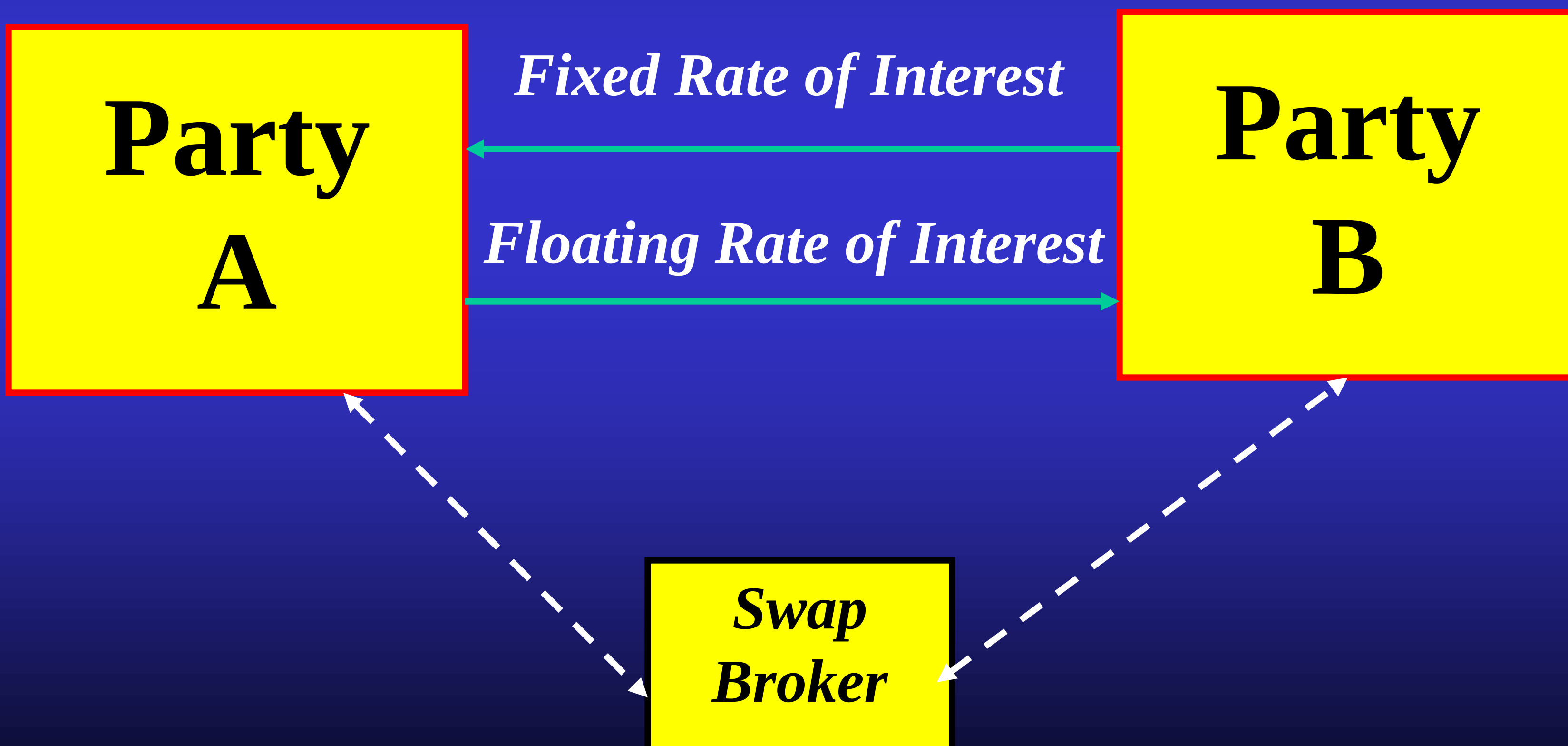
Differences Between Swaps and Futures

1) **Noncentral Markets** - Futures trade on exchanges, swaps are OTC
2) **Anonymity -** Swaps are very anonymous, futures trades can be seen
3) **Counterparty Risk -** Swaps have it, futures guaranteed by exchange
4) **Mark to Market** - Futures are marked daily, swaps only at reset date
5) **Standard vs. Custom** - Futures are standardized, swaps customized
6) **Time Horizon** - Futures are limited to < 2 years, swaps are unlimited
7) **Regulation** - Futures have gov't regulation, swaps are self-regulated
8) **Secondary Trading** - Futures can be traded, swaps must be held

The Swaps Market

LOS 3A b) Swap Cash Flow Diagram (Kolb p. 611-614)

Plain Vanilla Interest Rate Swap, No Intermediary



The Swaps Market

LOS 3A c) Swap Cash Flows (Kolb p. 612-613)

Plain Vanilla Rate Swap Cash Flows

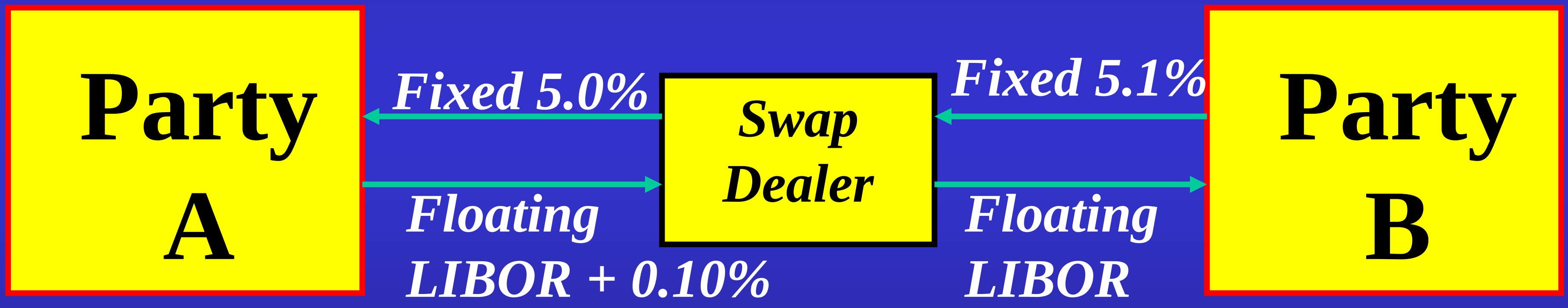
Example: Party A wishes to pay Party B a 5% fixed rate, annually, for 4 years. Party B wishes to pay LIBOR annually to Party A. Notional amount is $50,000,000.

Year	Fixed Rate	LIBOR Rate	Fixed Flow	Float Flow	Net Flow to A
0	5.0%	5.2%	N/A	N/A	N/A
1	5.0%	5.4%	$2,500,000	$2,600,000	$100,000
2	5.0%	5.0%	$2,500,000	$2,700,000	$200,000
3	5.0%	4.5%	$2,500,000	$2,500,000	$ 0
4	5.0%	4.2%	$2,500,000	$2,250,000	($250,000)

The Swaps Market

LOS 3A b) Swap with an Intermediary (Kolb p. 623-625)

Plain Vanilla Interest Rate Swap, With Intermediary



The Swaps Market

LOS 3A c) Swap Cash Flows (Kolb pp. 623-625)

Plain Vanilla Rate Swap Cash Flows, with Intermediary

Example: Party A wishes to pay a 5% fixed rate, annually, for 3 years and receive LIBOR. Party B wishes to pay LIBOR in exchange for a fixed payment. A swap dealer arranges the swap, and takes 10 basis points annually from the fixed flow for his fee. The notional amount is $10,000,000.

Create a table of the cash flows, indicating rates and dollars paid and received. Include the swap dealer.

The Swaps Market

LOS 3A c) Swap Cash Flows (Kolb p. 623-625)

Payment	Year 0	Year 1	Year 2	Year 3
Interest Rates Paid				
- From A to Dealer	N/A	5.0%	5.0%	5.0%
- From Dealer to B	N/A	4.9%	4.9%	4.9%
- From B to Dealer	N/A	4.8%	5.5%	5.0%
- From Dealer to A	N/A	4.8%	5.5%	5.0%
Cash Flows				
- From A to Dealer	N/A	$500,000	$500,000	$500,000
- From Dealer to B	N/A	$490,000	$490,000	$490,000
- From B to Dealer	N/A	$480,000	$550,000	$510,000
- From Dealer to A	N/A	$480,000	$550,000	$510,000
Net to Dealer	N/A	$10,000	$10,000	$10,000
Net to Party A	N/A	($20,000)	$50,000	$10,000
Net to Party B	N/A	$10,000	($60,000)	($20,000)

The Swaps Market

LOS 3A b), d) Currency Swaps (Kolb p. 614-616)

<u>Basic Currency Swaps</u>

1) Initiation at time 0 - Exchange principal by exchanging currencies at spot foreign exchange rates

2) Interest Payment Structure (payments are NOT netted)

(a) Pay fixed domestic, receive fixed foreign
(b) Pay floating domestic, receive fixed foreign (plain vanilla)
(c) Pay fixed domestic, receive floating foreign
(d) Pay floating domestic, receive floating foreign

3) Conclusion at time T - Reverse the original exchange of principal at the original exchange rate

The Swaps Market

LOS 3A b) Currency Swap Diagram (Kolb p. 614-616)

The Swaps Market

LOS 3A c) Currency Swap Cash Flows (Kolb p. 614-616)

Fixed-for-Floating Currency Swap Cash Flows

Example: Party A wishes to pay Party B a floating rate in US dollars for 3 years, party B wishes to pay Party A in pounds at a 6% fixed rate. The notional principal is agreed to be 10 Mln pounds. The Pound/$ exchange rate is 1.60.

Year	USD Rate	GBP Rate	Party A Pays	Party A Receives
0	6.0%	8.0%	£10,000,000	$16,000,000
1	6.5%	8.0%	$ 960,000	£ 800,000
2	5.0%	8.0%	$ 1,040,000	£ 800,000
3	6.0%	8.0%	$16,800,000	£10,800,000

The Swaps Market

LOS 3A c) Currency Swap Cash Flows (Kolb p. 614-616)

Fixed-for-Fixed Currency Swap Cash Flows

Example: Party A wishes to pay Party B an 8% fixed rate in US dollars for 3 years on 10 Mln pounds. Party B wishes to pay Party A at 6% fixed. The Pound exchange rate is 1.60.

Year	USD Rate	GBP Rate	Party A Pays	Party A Receives
0	6.0%	8.0%	£10,000,000	$16,000,000
1	6.0%	8.0%	$ 960,000	£ 800,000
2	6.0%	8.0%	$ 960,000	£ 800,000
3	6.0%	8.0%	$16,960,000	£10,800,000

The Swap Markets

LOS 3A e) Net borrow/lend rate (Kolb p. ?????)

<u>Learning Outcome Statement 3 A (e)</u>

Illustrate the appropriate cash flow diagram for a swap and calculate the net borrowing/lending rate for the two swap counterparties

Answer: I have no idea what the LOS is asking - the concept is not mentioned anywhere in the reading. The closest I could find is the improved borrowing/lending rate that arises in a fixed-for-fixed currency swap when two equivalent borrowers have differential access to credit.

The Swaps Market

LOS 3A a), f) Motivations for Swaps (Kolb p. 618-619)

Reason #1 for Swaps: Comparative Advantage in Credit

FIRM	FIXED	FLOATING
AAA	7.50%	LIBOR + 25 BPs
BBB	9.00%	LIBOR + 75 BPs

The Swap:

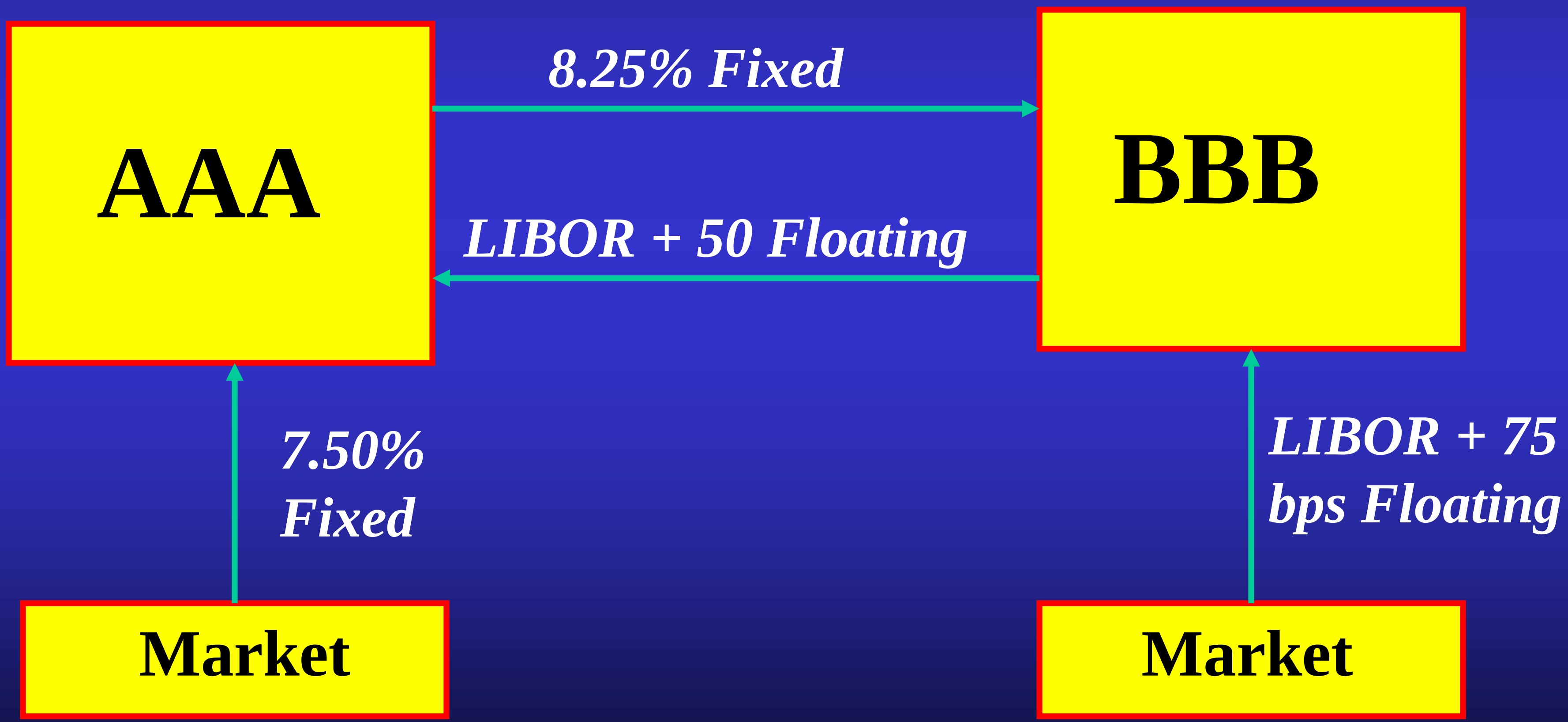
(1) Firm AAA borrows at 7.50% and lends to BBB at 8.25%.
(2) Firm BBB borrows at L+75 bps and lends to AAA at LIBOR+50

The Advantages:

(1) AAA borrows floating at 25 over market, but earns 75 bps on fixed loan, so they are 50 bps better off
(2) BBB borrows fixed for 75 bps less than market, loses 25 bps in floating rate pass-through, so they are 50 bps better off.

The Swaps Market

LOS 3A a), f) Motivations for Swaps (Kolb p. 618-619)



The Swaps Market

LOS 3A a) Motivations for Doing Swaps (Kolb p. 619-621)

<u>Reason #2 for Swaps: Asset/Liability Management</u>

The Problem

An S&L has floating rate liabilities (short term deposits), fixed rate assets (mortgage loans) and is exposed to rising interest rates.

The Swap

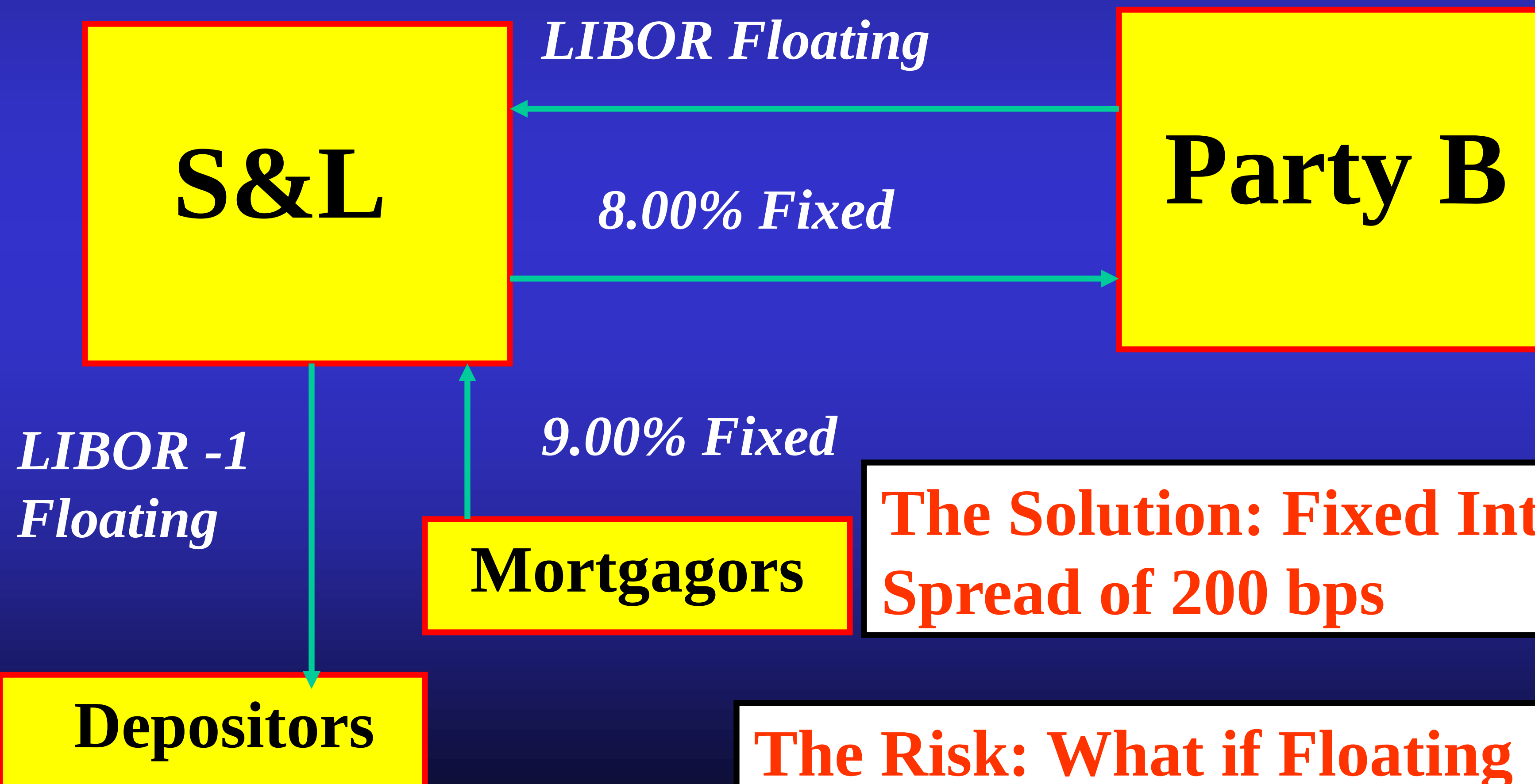
The S&L swaps its floating rate liability for a fixed rate liability.

The Advantages

(a) S&L fixes its interest (profit) margin
(b) S&L is insensitive to interest rate risk

The Swaps Market

LOS 3A a) Motivations for Doing Swaps (Kolb p. 619-621)



The Solution: Fixed Interest Spread of 200 bps

The Risk: What if Floating Rates Rise Above Fixed Rates?

The Swaps Market

LOS 3A a) Motivations for Doing Swaps (Kolb p. 621-623)

Reason #3 for Swaps: Debt Restructuring

The Problem

A corporate borrower has a floating rate bond outstanding and believes rates will rise. They want to call and reissue the bond but it is costly

The Swap

The corporation swaps its floating rate liability for a fixed rate liability.

The Advantages

(a) Corporation effectively has issued a fixed rate bond
(b) Corporation is not sensitive to rising borrowing rates
(c) Corporation has avoided reissuance costs

The Swaps Market

LOS 3A g) “Flavored” Rate Swaps (Kolb p. 633-635)

Variations of Interest Rate Swaps

1) Amortizing Swap - Swap where the notional principal declines over time, so payments decline over time. Used to manage risk of mortgages.

2) Accreting Swap - A swap in which the notional principal is designed to rise over time. Used to manage risks of balloon payments.

3) Seasonal Swap - A swap in which the notional principal rises and falls to accommodate seasonal cash needs, such as retail sales revenues.

4) Roller Coaster Swap - A swap in which the notional principal rises first and then amortizes to zero. Customizable to any financing need.

5) Off-the-Market Swap - A combination of a loan and a plain vanilla interest rate swap. An up-front loan is made in exchange for a higher than market interest rate payment.

The Swaps Market

LOS 3A g) “Flavored” Rate Swaps (Kolb p. 633-635)

Variations of Interest Rate Swaps

6) Forward Swap - A swap in which the terms of the swap begin at a later point in the future, rather than immediately.

7) Yield Curve Swap - A swap in which both parties pay a floating rate at different points on the yield curve, so one party benefits from a yield curve steepening, the other to a yield curve flattening.

8) Constant Maturity Swap - A yield curve swap in which one of the yield indices is the Treasury Constant Maturity yields from the FRB.

9) Basis Swap - A swap in which two different interest rate indices are used but a spread is added to one to make them equal at the start.

10) Diff Swap - A swap in which two different country’s interest rates are used, but one currency only is used to calculate cash payments.

The Swaps Market

LOS 3A h) Circus Swaps (Kolb p. 636-637)

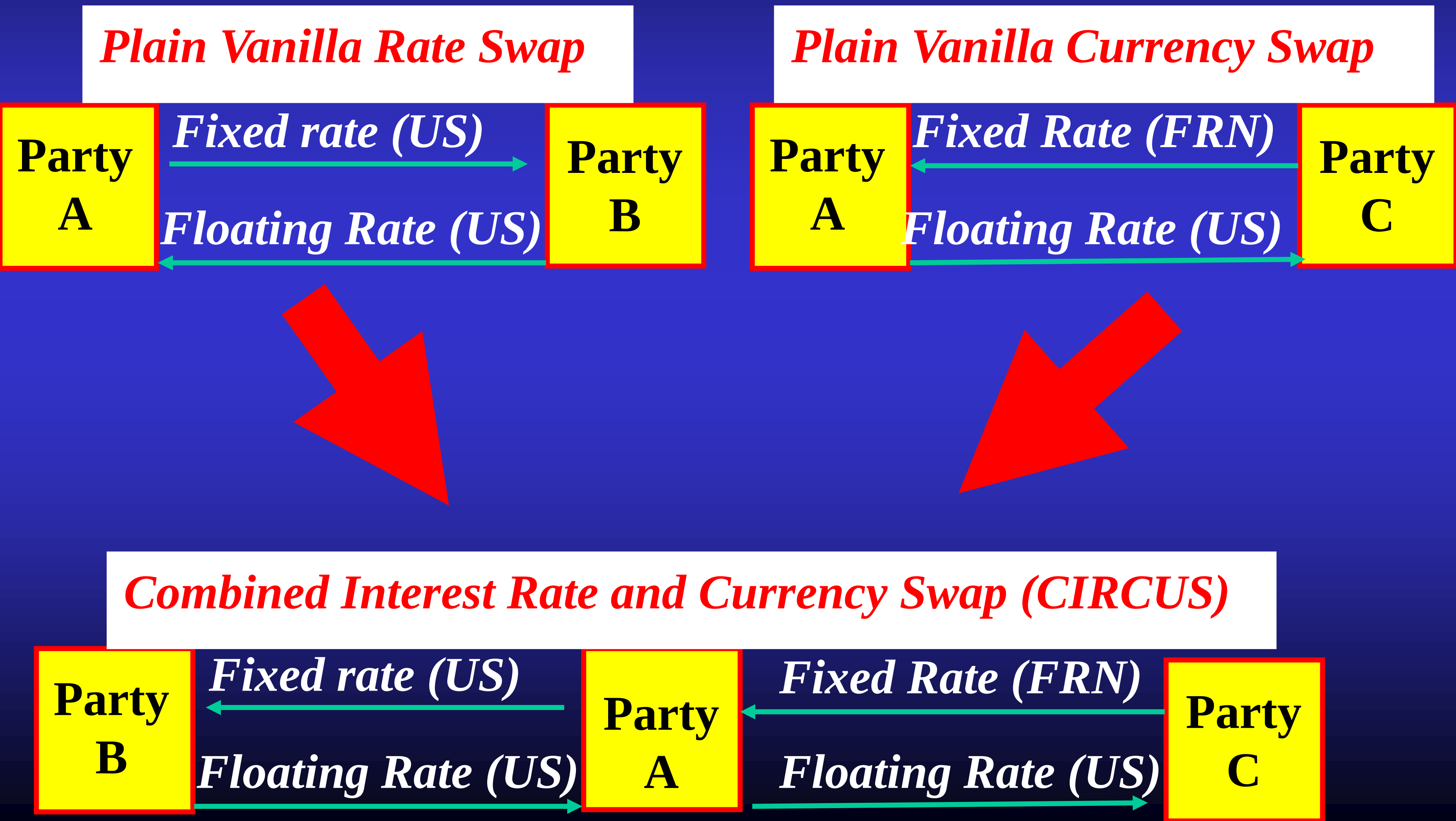
Combining Rate Swaps and Currency Swaps

You can convert a fixed-for-floating currency swap into a fixed-for-fixed currency swap by combining the fixed-for-floating currency swap with a plain vanilla (floating for fixed) interest rate swap.

The mechanics are illustrated on the following page.

The Swaps Market

LOS 3A h) Circus Swap (Kolb p. 636-637)



The Swaps Market

LOS 3A i) Equity Swaps (Kolb pp. 638-639)

<u>Equity vs. Interest Rate Swaps: Similarities</u>

1) **Notional Principal -** Both types fix an initial principal amount

2) **Tenor -** Both types have a fixed, agreed-upon time period

3) **Netting -** Both types net out periodic cash flows

4) **Exchange of Principal -** Neither type exchanges any principal

5) **Payment Patterns -** <u>Usually</u> equity has fixed and floating payments

The Swaps Market

LOS 3A i) Equity Swaps (Kolb pp. 638-639)

<u>Equity vs. Interest Rate Swaps: Differences</u>

1) **Reference Rate** - Typically an equity index (S&P 500), not LIBOR

2) **Notional Principal** - Can grow over time or stay fixed

3) **Fixed Rate -** Can be anything, even LIBOR or another equity index

4) **Payment Timing** - Generally has to be in arrears

The Swaps Market

LOS 3A j) Equity Swaps (Kolb p. 638-639)

<u>Mechanics of an Equity Swap</u>

In an equity swap, typically a portfolio manager that already controls an equity portfolio will agree to pay a counterparty the total return on an equity index in exchange for receiving a short-term cash return.

The typical use of an equity swap is for an equity portfolio manager to temporarily "go to cash" without having to sell any equities in the portfolio (and possibly trigger taxes and incur transactions costs).

The Swaps Market

LOS 3A j) Equity Swaps (Kolb pp. 638-639)

Equity Swap: Example

A portfolio manager wishes to swap the returns from her $10 mln S&P index portfolio for 3-mth LIBOR for the next 3 years. Assume the swap allows for the portfolio to grow, and that the portfolio's value grows unaffected by the cash flows of the swap. Calculate the netted cash flows of the swap given the data below. Assume LIBOR is a start-of-period rate and the S&P is end-of-period return. Calculate cash flows in arrears.

YEAR	0	1	2	3
LIBOR	5.0%	5.2%	5.4%	5.8%
S&P 500	N/A	10%	22%	-25%

The Swaps Market

LOS 3A j) Equity Swaps (Kolb pp. 638-639)

Equity Swap: Answer

YEAR	1	2	3
Get LIBOR	$500,000	$572,000	$724,680
Pay S&P 500	-$1,000,000	-$2,420,000	$3,355,000
Net to Manager	-$500,000	-$1,848,000	$4,079,680
Portfolio Value:			
Gross of Swap	$11,000,000	$13,420,000	$10,065,000
Net of Swap	$10,500,000	$11,572,000	$14,144,680

The Swaps Market

LOS 3A k) Characteristics of Swaptions (Kolb p. 639-641)

Distinguishing Features of Swaptions

1) **Receiver Swaption** - option to receive fixed rate, pay floating rate
2) **Payer Swaption** - Option to pay fixed rate, receive floating rate
3) **Strike Rate -** Rate at which option owner can exercise fixed rights
4) **Premium** - Price paid by swaption owner to have the fixed option, usually expressed as basis points on the notional amount.
5) **Expiration** - The time period over which the swaption owner has the right to exercise the option
6) **Swap Terms -** All the terms of a typical swap are set in theswaption, i.e, the floating rate, tenor, notional, and fixed rate.

The Swaps Market

LOS 3A l) Extendable/Cancelable Swap (Kolb p. 641-643)

Extendable & Cancelable Swaps

An Extendable Swap combines a regular swap with an embedded swaption of the same type, which extends the swap

A Cancelable Swap combines a regular swap with an embedded swaption of the opposite type, which cancels the swap.

The Connection to Swaps and Swaptions

Extendable Pay-Fixed = Pay Fixed Swap + Payer Swaption
Extendable Receive-Fixed = Receive Fixed Swap + Receiver Swaption
Cancelable Pay-Fixed = Pay Fixed Swap + Receiver Swaption
Cancelable Receive-Fixed = Receive Fixed Swap + Payer Swaption

The Swaps Market

LOS 3B a) Swaps and Bonds (Kolb p. 649-656)

Swaps as a Pair of Bond Transactions

Floating Rate Note (FRN): A bond in which the issuer agrees to pay interest payments based on a floating rate index (I.e., LIBOR), rather than a fixed rate coupon.

GENERAL RULE: Both interest rate and currency swaps can be viewed as the simultaneous purchase and issuance of two bonds.

The Swaps Market

LOS 3B a) Swaps and Bonds (Kolb p. 649-656)

Swaps as a Pair of Bond Transactions

SWAP TYPE	BOND PURCHASED	BOND ISSUED
Receive Fixed Rate	Fixed rate Bond	FRN
Pay Fixed Rate	FRN	Fixed Rate
Fixed DM for Fixed $	DM Fixed	Dollar Fixed
Fixed Yen for Floating $	Yen Fixed	Dollar FRN

The Swaps Market

LOS 3B b) Swaps and FRA's (Kolb p. 656-659)

Forward Rate Agreement (FRA)

A Forward Rate Agreement (FRA) is an agreement now between two parties to exchange fixed for floating interest rate payments based on a defined term that starts and ends at an agreed upon period in the future.

Determining FRA Cash Flows

In a FRA, the fixed rate is agreed to at time 0, the floating rate is established (and the associated exchange of payments occurs) at the agreed upon future date.

The Swaps Market

LOS 3B b) Swaps and FRA's (Kolb p. 656-659)

Example: Quoting a Forward Rate Agreement

Question: A Dealer offers to pay 5% in a 12 x 18 FRA with a notional of $100 million. What are the cash flows and when do they occur?

Answer: In 12 months the dealer agrees to pay the fixed rate:

5.0% per year times 6/12 years times $100 mln = $2,500,000

and receive the 6 month LIBOR rate (assume it is 5.5%)

5.5% per year times 6/12 years times $100 mln = $2,750,000

for a net cash inflow for the dealer of $250,000.

The Swaps Market

LOS 3B b) Swaps and FRA's (Kolb p. 656-659)

Relationship Between Swaps and FRA's

(1) One Period Swap - A Forward Rate Agreement is a one-period swap of fixed for floating interest rates.

(2) Portfolio of FRA's - A Swap is equivalent to a portfolio of (or more specifically, a strip of) FRA's.

(3) Pricing a Swap with FRA's - A Swap's fixed rate is a function of all the fixed rates of the FRA's that would be equivalent to the swap.

The Swaps Market

LOS 3B c) Swaps and Euro Futures (Kolb p. 665-666)

Relationship Between Swaps and Euro$ Futures

Since Eurodollar futures are simply exchange-traded FRA's, a strip of Eurodollar futures is equivalent to an interest rate swap.

BUT, there are some differences:

(1) Futures have limited maturity points

(2) Futures have daily settlement

(3) Futures can be easily bought and sold.

(4) Euro$ futures are only on US dollar-based 3 mth LIBOR.

The Swaps Market

LOS 3B d) FRA's and Rate Options (Kolb pp. 667-670)

Relationship Between FRA's and Rate Options

Interest Rate Option - A put or call option where:

- Underlying asset is a LIBOR interest rate
- Strike price is a fixed interest rate
- The LIBOR instrument has a fixed term and notional value
- The option itself has a fixed time to expiration

FRA Example: Take a pay-fixed 5% 12x18 FRA on $10 mln:

- Buy a rate call with 5% strike, 12 mths to expiration
- Sell a rate put with 5% strike, 12 mths to expiration
- Let both options be on 6 mth LIBOR for $10 million

The combination will be costless and equivalent to the FRA.

The Swaps Market

LOS 3B e) Swaps and Collars (Kolb pp. 669-671)

<u>Relationship Between Swaps and Collars</u>

Interest Rate Cap - A sequence of interest rate call options
Interest Rate Floor - A sequence of interest rate put options
Interest Rate Collar - a long cap and a short floor, each with the same notional, expiration points, and underlying LIBOR instrument, but different strike rates

Relationship of a Swap to a Collar:

(1) A swap is simply a sequence of FRA's
(2) FRA's are simply a single long call and single short put
(3) A swap is therefore a sequence of long calls (a CAP) and a sequence of short puts (a FLOOR), which is a RATE COLLAR.

The Swaps Market

LOS 3B f) Swaps as Option Portfolios (Kolb pp. 670-671)

A Swap as a Portfolio of Caps and Floors

1) **FRA as Option Combo -** Recall that an FRA can be formed by going long an interest rate call and short an interest rate put

2) **FRA Strip as Cap/Floor Portfolio -** A strip of FRA's out into the future can therefore be seen as a long position in a series of interest rate calls (a Cap) and a short position in a series of interest rate puts (a Floor).

3) **Swap as FRA Strip -** Since a swap is equivalent to a strip of FRA's, a swap can also be viewed as a portfolio of Caps and Floors