333-201 Business Finance

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Lecture 22:
Introduction to Derivative Securities I

Introduction to Futures Contracts

- Examine what futures contracts are, how they are traded and their major weakness

- Examine how futures contracts are priced

- Analyze speculative and hedging strategies using futures contracts

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Overview of Derivatives Markets

- A derivative contract is an instrument whose value derives from that of an underlying product
  - The underlying product can be commodities, shares, market indices, interest rates, currencies, etc

- Forward and futures contracts are obligations to purchase or sell the underlying product at a prespecified price at a prespecified maturity (or expiration) date

- Option contracts are rights, but not obligations, to purchase or sell the underlying product at a prespecified price at, or before, a prespecified maturity (or expiration) date

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Overview of Derivatives Markets

• Since forward and futures contracts are obligations they protect the holder (or buyer) from losses but they also preclude any gains from favorable movements in the price of the underlying product

• Since option contracts are rights they give the holder (or buyer) the opportunity to gain from favorable price movements while protecting the holder from unfavorable price movements in the underlying product

  • However, this upside potential comes at a price!

• We examine forward and futures contracts in this lecture and option contracts in lectures 23 and 24

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Overview of Derivatives Markets

- Over-the-counter derivatives are traded privately between two parties with prices set by mutual negotiation

- Exchange traded derivatives are traded on a public exchange with prices set by a bidding process

- Derivatives markets dominated by the Chicago Mercantile Exchange (CME)
    - International Financial Futures Exchanges in London (LIFFE) and Tokyo (TIFFE) also important markets
    - The main market in Australia is the Sydney Futures Exchange (SFE)

Forward and Futures Contracts

- A forward contract is an agreement to buy or sell the underlying asset at a specified price on a specified future date
  - Note that it costs nothing to buy or sell a forward contract and there is no premium paid by one party to another

- Long versus short positions
  - The party who agrees to buy the underlying asset on a certain specified future date for the specified price is long a forward contract or has bought the forward contract
  - The party who agrees to sell the underlying asset on a certain specified future date for the specified price is short a forward contract or has sold the forward contract

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Forward and Futures Contracts

- Spot price
  - The price at which the underlying asset can be bought and sold in the spot market
- Delivery price
  - The specified delivery price on the forward contract
- Forward price
  - The forward price and the delivery price are equal at the time the contract is entered into
  - With the passage of time, the forward price will change while the delivery price remains fixed

Forward and Futures Contracts

- Maturity or delivery date
  - The specified date on which the contract is settled
  - The holder of the short position delivers the asset to the holder of the long position in return for the delivery price
  - Some contracts are settled in cash since it is either impossible or impractical to deliver the underlying asset

- Settlement
  - Physical delivery where the underlying security is exchanged for cash
  - Cash settlement where payment is made by the buyer to the seller of an amount equal to the forward price minus the market price at settlement multiplied by the number of units in the contract

Forwards Versus Futures Contracts

- Futures are standardized forward contracts
  - Contract is for the exchange of the underlying commodity or security at a future date, at a prespecified price
  - Contract is standardized in terms of size, maturity, quotations, settlement, delivery, etc

- Major differences in forwards and futures contracts - see next slide
  - Daily marking-to-market in futures contracts implies that a futures contract can be viewed of as a series of one-day forward contracts
  - Note that the standardization of futures contracts is also a major weakness of these contracts

Forwards Versus Futures Contracts

Feature	*Forward Contract*	*Futures Contract*
1. Type	Informal arrangements	Standardized by exchange
2. Maturity	Any maturity (usually multiples of 30 days)	Few, prespecified maturity dates
3. Contract size	Generally over $1,000,000	Smaller and prespecified
4. Security arrangements	Customers maintain minimum deposit with bank	Minimum margin deposits as a percent of contract's face value
5. Cash flows	None until delivery	Daily settlement from margin account
6. Final settlement	Majority settled by delivery	Delivery is rare - settlement through contract reversal
7. Default risk	Higher than futures	Minimal (exchange guarantee)
8. Commissions	Dealer's bid-ask spread	Floor traders, brokers pay and receive fees
9. Regulation	Self-regulated	External regulation

Sydney Futures Exchange

- Futures trading commenced in Australia in May 1960 at the Sydney Greasy Wool Exchange
  - Changed name to Sydney Futures Exchange in 1972
  - Electronic trading introduced in 1989 for overnight trading and trading floor closed in 1999
  - The first exchange outside the US to trade financial futures
  - The second largest futures and options exchange in the Asia Pacific region
  - The tenth largest futures and options exchange in the world

- SFE offers a wide range of futures contracts over various commodities and financial instruments (see next two slides)
  - SFE merged with the ASX in 2007
  - Responsibilities include regulation, administration, promotion and maintaining orderly conduct of the futures market

Sydney Futures Exchange Products

- Interest rate related products
  - 30 Day Interbank Cash Rate Futures
  - 90 Day Australian Bank Accepted Bill Futures and Options
  - 3 Year and 10 Year Australian Treasury Bond Futures and Options
  - Bond Index Futures
  - 3 Year and 10 Year Australian Interest Rate Swap Futures
  - 90 Day New Zealand Bank Bill Futures and Options
  - 3 Year and 10 Year New Zealand Government Stock Futures and Options

- Currency related products (until 2006)
  - AUD/USD Futures

Sydney Futures Exchange Products

- Equity related products
  - SFE SPI 200 Equity Index Futures and Options
  - SFE Listed Property Trust (LPT) Futures
  - Intra-Day Options on SFE SPI 200 Equity Index Futures
  - Australian Individual Share Futures

- Commodity related products
  - Wool Futures and Options
  - MLA/SFE Cattle Futures

- Web link for contract specifications and other details…
  - www.asx.com.au/products/futures_options/index.htm

Pricing of Forwards and Futures

- Forward and futures prices depend on the cost of carrying the underlying commodity to the delivery date
  - Storage costs
  - Insurance costs
  - Transportation costs
  - Financing costs

- The cost of carry model
  - $F_{0,t} = S_0 \times (1 + c)$
  - $F_{0,t}$ = Futures (or forward) price today for delivery at time t
  - S_0 = Spot price of underlying commodity today
  - c = Cost of carrying the underlying commodity to the settlement date as a fraction of the spot price

Pricing of Forwards and Futures

- Cost of carry arbitrage exists when: $F_{0,t} > S_0 \times (1 + c)$
- Reverse cost of carry arbitrage exists when: $F_{0,t} < S_0 \times (1 + c)$
- Cost of carry arbitrage: $F_{0,t} > S_0 \times (1 + c)$
  - Borrow funds
  - Buy spot now
  - Sell forward (or futures) contract
- Reverse cost of carry arbitrage: $F_{0,t} < S_0 \times (1 + c)$
  - Sell short spot
  - Lend funds
  - Buy forward (or futures) contract

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Pricing of Forwards and Futures

Example:

Suppose the price of an ounce of gold is USD 800 and the futures price for settlement in one year's time is USD 890. Assume no other costs other than financing costs and a borrowing and lending rate of 10% p.a. What will traders do?

What will they do if the price of gold is USD 820? What will happen in equilibrium?

Pricing of Forwards and Futures

Case 1:

Cost of carry arbitrage opportunity exists…

$F_{0,t} > S_0 \times (1 + c)$

$890 > 800 \times (1 + 0.10) = 880$

Time 0	
Borrow $800 for 1 year	+800
Buy an ounce of gold	-800
Sell a futures contract	0
Net amount	0
Time 1	
Remove gold from storage	0
Deliver gold against futures contract	+890
Repay loan with interest	-880
Net profit	+10

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Pricing of Forwards and Futures

Case 2:

Reverse cost of carry arbitrage opportunity exists…

$F_{0,t} < S_0 \times (1 + c)$

$890 < 820 \times (1 + 0.10) = 902$

Time 0	
Sell short an ounce of gold	+820
Lend $820 for 1 year	-820
Buy a futures contract	0
Net amount	0
Time 1	
Collect proceeds from the loan	+902
Accept delivery on futures contract	-890
Use gold to cover short sale	0
Net profit	+12

Speculating and Hedging with Futures

- A speculator trades in a futures contract based on expectations and has no direct interest in the asset underlying the futures contract
  - A speculator is affected by the futures price (but not the spot price) of the underlying asset
  - By trading in futures contracts, the speculator is exposed to the risks of changes in the futures price

- A hedger has an exposure to underlying asset (or commodity) and wishes to minimize or eliminate this exposure
  - Examples: A jeweler with an exposure to the price of gold or a short term borrower with an exposure to changes in the interest rate

- Our focus here is on hedgers

Hedging with Futures

A short hedger is someone who hedges by selling (or going short in) futures contracts today

	If prices rise…	If prices fall…
Short futures contract	Loss	Gain
Underlying spot	Gain	Loss
Net outcome	≈ 0	≈ 0

A long hedger is someone who hedges by buying (or going long in) futures contracts today

	If prices rise…	If prices fall…
Long futures contract	Gain	Loss
Underlying spot	Loss	Gain
Net outcome	≈ 0	≈ 0

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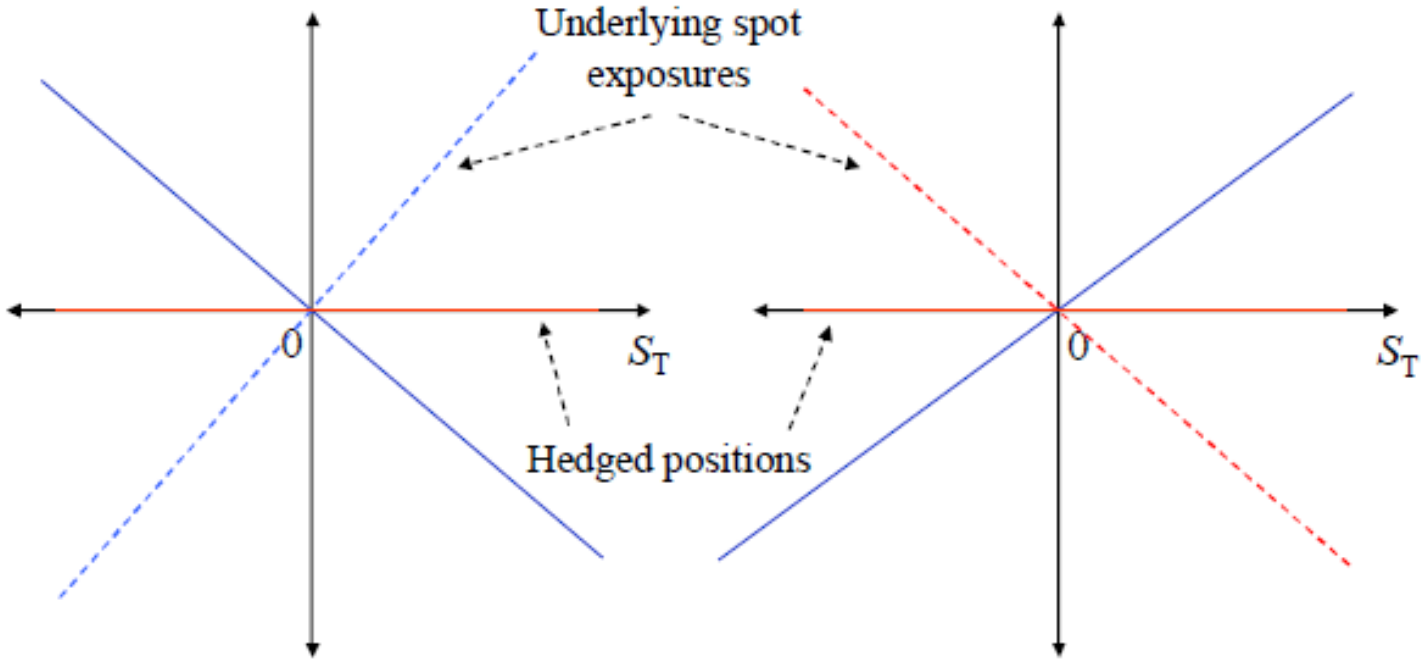
Hedging with Futures



Short forward hedge

Long forward hedge

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Futures Hedging is Not Perfect

- Specification differences
  - The specifications on the underlying commodity or security may differ from what an entity may wish to hedge

- Imperfect convergence
  - The price of a futures contract at maturity should be equal to the spot price at that time
  - In practice the futures price can be slightly different from the spot price - There is imperfect convergence between the spot and futures price at the maturity date
  - Note that this does not necessarily imply an arbitrage opportunity due to the existence of transaction costs

Futures Hedging is Not Perfect

- Basis risk
  - Futures contracts specify a limited number of maturity dates
  - A hedger will plan to transact in the spot market at some future date but the date of the planned spot transaction may not coincide with the maturity date of a futures contract
  - The hedger would need to reverse out of the futures contract before it matures and would face basis risk
    - Basis at time t, $B_t = S_t - F_t$

- Example: A short hedger owns gold and sells a gold futures contract now (t = 0). If the hedger reverses his position at t = 1 what is his gain or loss?

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Futures Hedging is Not Perfect

- Hedger is long spot gold…
  - Gain/Loss on the spot gold = $S_1 - S_0$
- Hedger is short gold futures contract…
  - Gain/Loss on the gold futures contract = $F_0 - F_1$
- Net gain/loss to hedger…
  - Net gain/loss = $(S_1 - S_0) + (F_0 - F_1)$
  - Net gain/loss = $(S_1 - F_1) - (S_0 - F_0)$
  - So, net gain/loss = $B_1 - B_0$
- The hedger's hedge will not be perfect if there is basis risk and changes in this basis risk determine the hedgers net gain or loss on the hedge

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90 Day Bank Bill Futures Contract

•The contract unit is a 90-day bank accepted bill with a face value of $1,000,000

•The delivery months are March, June, September, December up to 3 years out

• Quotations are 100 minus annual percentage yield to two decimal places

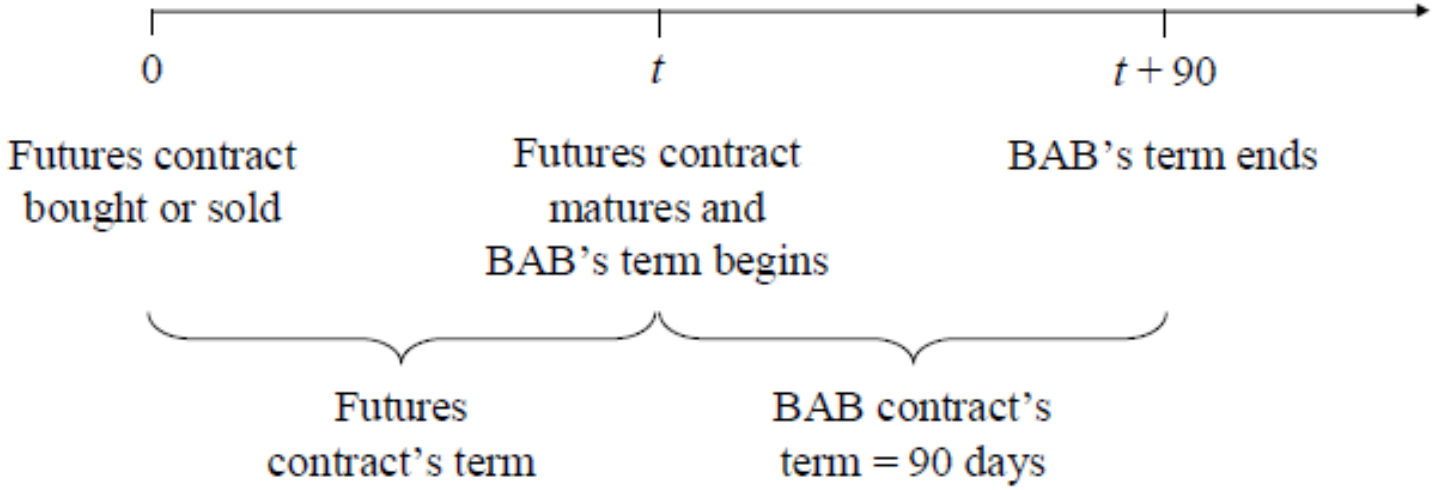
• Settlement is via cash (most common) or physical settlement

• Settlement date is the second Friday of the delivery month

• Note that a long (short) position in a 90-day BAB futures contract implies the obligation to purchase (sell) a 90-day BAB when the contract matures

90 Day Bank Bill Futures Contract

A long position in a 90-day BAB futures contract implies the obligation to purchase a 90-day BAB when the contract matures



90 Day Bank Bill Futures Quotes

90 day bank bill futures (100 minus yield % p.a.)

	Previous price	High price	Low price	Settlement price	Change	Volume (1000s)
Dec 08	95.19	95.28	95.12	95.27	+0.08	27499
Mar 09	95.28	95.49	95.25	95.45	+0.17	17243
Jun 09	95.06	95.30	95.03	95.25	+0.19	10024
Sep 09	94.65	94.91	94.65	94.89	+0.24	6823
Dec 09	94.32	94.58	94.35	94.54	+0.22	4458

Source: Adapted from the *Australian Financial Review*, October 16, 2008

- Note that the yield is based on the settlement price
- Dec 08 contract yield, $f = 100 - 95.27 = 4.73\%$ p.a.

90 Day Bank Bill Futures Quotes

- Using the settlement price, the dollar price implicit in the futures contract can be obtained as…

- Futures contract value = 1000000/[1 + f (90/365)]

- Example: Consider the December 2008 BAB futures contract with a settlement (or quoted) price of 95.27. What is the dollar price implicit in this futures contract? What has been the change in the price compared with the previous closing price of 95.19?