

**Derivatives & Risk Management**

- Main themes – Options
  - option pricing (microstructure & investments)
  - hedging & real options (corporate)
- This & next weeks’ lectures
  - Part IV: Option Fundamentals
    » payoffs & trading
    » option strategies
    » option-like securities

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**Introduction**

**The Nature of Derivatives**

- **Definition**
  - A derivative
    - is a financial instrument
    - whose value depends on
    - the values of other more basic underlying variables
- **Examples**
  - Forward & Futures Contracts
  - Swaps
  - Options

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**Part IV: Option Fundamentals**

**Options**

- **Definitions**
  - basic idea, call vs. put, European vs. American, etc.
- Payoffs at maturity
  - naked European positions
  - trading strategies
- Market microstructure
  - OTC vs. exchange-traded options

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**Definitions**

- A call is an option to BUY a certain asset by a certain date for a certain price that is fixed today
- A put is an option to SELL a certain asset by a certain date for a certain price that is fixed today
**Terminology**

- The party that has agreed to:
  - **BUY**
    - has what is termed a *LONG* position
  - **SELL**
    - has what is termed a *SHORT* position

**Ways Derivatives (options) are Used**

- Invest or speculate
- Hedge risks / change nature of asset or liability
  - Contingent exposure
- To infer views about…
  - … future direction of the market
  - … forward-looking uncertainty
- To lock in arbitrage profits

**Ways Derivatives are Used 2**

- Types of Traders
  - Hedgers
    - want to reduce risk of existing assets or liabilities
  - Speculators
    - willing to take risk based on their forecasts
  - Arbitrageurs
    - use risk-free trading strategies
    - to exploit asset mispricings

**Option Terminology**

- Call vs. Put
  - right to buy vs. right to sell (bullish view vs. bearish view)
- Buying vs. Writing (= selling)
- American vs. European
  - strike by a given date vs. strike at a given date
- Option premium vs. Exercise price
  - price of the option vs. price at which buyer strikes

**Option Terminology 2**

- Moneyness (Investor’s possible situations)
  - *in-the money*
    - calls: $S_T > X$
    - puts: $S_T < X$
  - *at-the money*
    - $S_T = X$
  - *out-of-the-money*
    - calls: $S_T < X$
    - puts: $S_T > X$

**Option Payoffs at Maturity**

- Naked European positions
  - buyer
    - calls: $\max[0, S_T - X] - c$
    - puts: $\max[0, X - S_T] - p$
  - writer
    - calls: $\min[0, X - S_T] + c$
    - puts: $\min[0, S_T - X] + p$
- Realism?
  - Time value of money? Brokerage fees (buy & strike)
Option Payoffs at Maturity 2
• Profit from Long naked Call on IBM
  (buy an IBM European call option; price = $5, strike = $100)

Option Payoffs at Maturity 3
• Profit from Short naked Call on IBM
  (write an IBM European call option; price = $5, strike = $100)

Option Payoffs at Maturity 4
• Profit from Long naked Put on Enron
  (buy an Enron European put option; price = $7, strike = $70)

Option Payoffs at Maturity 5
• Profit from Short naked Put on Enron
  (write an Enron European put option; price = $7, strike = $70)

Option Payoffs at Maturity Payoffs 6
• Summary (Fig.8.5): $X$ = Strike price; $S_T$ = Price of asset at maturity

Options vs. Forwards
• A forward contract gives each party the obligation to buy or sell at a certain price
• An option contract gives the buyer the right (but not the obligation) to buy or sell at a certain price
Profit from a \textit{LONG} Naked Forward Position (Fig 1.2)

Profit from a \textit{SHORT} Naked Forward Position (Fig 1.2)

Options, Forwards and Futures

\textit{Customized} \quad \textit{Standardized}

\textit{right} \quad \text{OTC option} \quad \text{exchange-traded option}

\textit{obligation} \quad \text{forward} \quad \text{futures}

Trading Strategies Involving Options

- Covered position
  - Position involves the option and the underlying

- Spread
  - Position involves 2 or more options of the same type

- Combination
  - Position involves mixture of calls and puts
  - Straddles, strips, and straps, strangles

Trading Strategies Involving Options 2: Covered Positions

- Protective put (Hull, Fig. 10.1c)
  - what?
    - buy stock + buy put \textit{(a.k.a. as a “married put”)}
  - why?
    - portfolio insurance
    - comparative payoffs
  - protective put vs. stop-loss order
    - right to sell vs. obligation to sell
    - execution price guarantee vs. “who knows?”

Trading Strategies Involving Options 3

- Covered call (Hull, Fig. 10.1a)
  - what?
    - buy stock + write call
    - cover + naked sale
  - why?
    - central banks (gold reserves)
    - mutual funds & other investors
      - enforces discipline
      - while boosting cash
Trading Strategies Involving Options 4

- Option & Underlying (Fig. 10.1)

(a: covered call)

(b)

(c: protect. put)

(d)

Multi-Option Strategies

- Spreads: Speculation with Limited Downside
  - Money spreads
    - Price bet:
      » Bull (Underlying Up); Bear (Underlying Down)
    - Volatility bet:
      » Butterfly (Underlying Flat)
  - Calendar spreads

- Combinations: Two-sided volatility bets
  - Straddles, strangles, strips, straps

Trading Strategies Involving Options 5: Spreads

- What?
  - buy and sell options
    - of the same type but with different attributes
  - Time spread vs. money spread
    - different expiration dates vs. different strike prices
  - Example: bullish spread
    - buy call with low strike + sell option with high strike
    - payoffs (Hull Fig. 10.2-10.9)

Trading Strategies Involving Options 6

- Bull Spread w/ Calls (Fig. 10.2)

Trading Strategies Involving Options 7

- Bull Spread w/Puts (Fig. 10.3)

Trading Strategies Involving Options 8

- Bear Spread w/Puts (Fig. 10.4)
Trading Strategies Involving Options 9

- Bear Spread w/Calls (Fig. 10.5)

![Diagram of a Bear Spread]

Trading Strategies Involving Options 10

- Butterfly Spread w/Calls (Fig. 10.6)

![Diagram of a Butterfly Spread]

Trading Strategies Involving Options 11

- Butterfly Spread w/Puts (Fig. 10.7)

![Diagram of a Butterfly Spread]

Trading Strategies Involving Options 12

- Calendar Spread w/Calls (Fig. 10.8)

![Diagram of a Calendar Spread]

Trading Strategies Involving Options 13

- Calendar Spread w/Puts (Fig. 10.9)

![Diagram of a Calendar Spread]

Spreads – Numerical Examples

<table>
<thead>
<tr>
<th>Strike Price ($S$)</th>
<th>European Put (premium, $)</th>
<th>European Call (premium, $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>5.23</td>
<td>0.96</td>
</tr>
<tr>
<td>60</td>
<td>9.46</td>
<td>0.26</td>
</tr>
</tbody>
</table>

- Cost of a bull spread?
  - Calls 50:70; Puts: minus 54.23 (why?)

- Which is more speculative? $S<55$? 55<$S<$60 $S>60$?
  - Bull spread vs. Bear spread?
Trading Strategies Involving Options 14: Combinations

• What?
  • Mixtures of calls & puts

• Examples
  • straddles
    » buy call + buy put – Fig. 10.10
  • strips (2 puts, 1 call) vs. straps (2 calls, 1 put) – Fig. 10.11

• Why?
  • bets on volatility (do prices already include the volatility?)
    » buyer: lots of volatility, but unsure about direction
    » seller: low volatility

Trading Strategies Involving Options 15

• Straddle Combination (Fig. 10.10)

Trading Strategies Involving Options 16

• Strip & Strap (Fig. 10.11)

Trading Strategies Involving Options 17

• Strangle Combination (Fig. 10.12)

Trading Strategies Involving Options 18: Collars

• What? write call, buy stock & buy a put
  → zero cost collar:
    • buy a protective put and write out-of-the-money call
    • choose strike prices so the call premium = put premium

• Why? ensure return and low downside risk

• Who? investors with target wealth level

• Similar to?
  » Bull spread

Conclusion

• Full Flexibility
  • virtually any pay-off at maturity
  • can be obtained
    by combining options.

• Narrow butterfly spreads
  • fundamental building block of pay-off functions
Option Market Microstructure

• Exchange trading vs. OTC
  • standardized vs. customized
  • tailoring vs. market liquidity & depth
  • risk control
    » “my word is my bond” vs. clearing house

• Our focus
  • exchange-traded options
    » why?

Market Microstructure 2

• Major option exchanges
  • United States
    » 6 “exchanges”
      - CBOT, BOX, NYSE/Arca EuroNext (formerly AMEX), ISE, Nasdaq OMX BX/PHLX (ret’d Dec. ‘08), BATS (since Feb. ‘10)
    » regulation
      - SEC vs. CFTC
      » multiple option listings
  • Canada
    » TMX Group (Toronto & Montreal), Vancouver
  • Other countries

Market Microstructure 3

• Electronic trading is growing very fast (ISE, Eurex)
• Floor exchange participants (NOT Exam Material)
  • market makers (bid-asked)
    » vs. specialist
  • floor brokers
    » trade execution
    » broker compensation
      - commission vs. salary
      - open (fixed+%) + close (id.) + exercise (cf. underlying)
  • order book officials (= board broker)
    » limit orders

Market Microstructure 4

• Types of options (underlying assets)
  • stock options
  • index options (Hull Tables 8.1 & 14.1)
    » most traded: S&P 100 (American) and S&P 500 (European)
    » what about dividends?
    » cash settlement
      - $100 x (value of index - strike value of index)
  • currency (FX) options
  • futures options
  • interest rate options
    - Treasuries, CD’s, agency issues, etc.

Market Microstructure 5

• Specifications
  • idea
    » standardize option features
  • terminology
    » option class (all puts or calls on the same underlying asset)
    » vs. option series (within a class, same strike and expiration)
  • examples
    » American or European, Call or Put
    » trading cycle (Last day of trading vs. Expiration date)
    » strike price and price intervals
    » position limits vs. exercise limits

Market Microstructure 6

• Cycles
  • 3-month cycles
    » January vs. February vs. March cycles
    » LEAPS (Long Term Equity AnticiPation Securities)
      - all expire in January
  • plus 2 near-months

• Maturity dates
  • most options
    - 10.59 PM CT, Saturday after 3rd Friday of the month
  • end-of-the-month (“EOM”) options
    - 10.59 PM CT, Saturday after last Friday of the month
Market Microstructure 7

• Last day of trading
  • date
    » Most stock options
    » EOM options
  • exercise notice
    » customer
    » broker

Market Microstructure 8

• Reading stock option quotes (Hull Table 8.1 & 14.1)
  • quotes are for American options
    » exceptions (FX; some stock market indices)
  • option price (per share) vs. option contract (round lot)
  • strike price intervals
    » stock options
      » $10
      » $5 (typically, 30<S<100)
      » $2.50 (typically, S<$30)

Dividends & Stock Splits

• Stock splits
  • Suppose
    » you own N options with a strike price of X
    » there is an n-for-m stock split
  • strike price
    » reduced to mX/n
  • number of options
    » increased to nN/m

Dividends & Stock Splits 2

• Example
  • Call option to buy 100 FourSeas shares @ $30 per share.
  Suppose FourSeas makes a 2-for-1 stock split.
  What are the new call option terms?
  – Answer: 200 shares @ $15 a share

Dividends & Stock Splits 3

• Dividends
  • cash dividends
    » NO adjustments are made to the option terms (OTC?)
  • stock dividends
    » handled in a manner similar to stock splits (caveat)
• Examples
  • Consider a call option to BUY 100 shares for $20/share
    » How should the terms be adjusted:
      » for a 2-for-1 stock split?
      » for a 5% stock dividend?

Dividends & Stock Splits 4

• Call option to buy 100 FourSeas shares @ $30 per share.
  Suppose FourSeas makes a 2-for-1 stock split.
  What are the new call option terms?
  – Answer: 200 @ $15

• Put to sell 100 Borders shares @ $15 per share.
  Suppose Borders declares a 25% stock dividend.
  What are the new put option terms?
  – Answer: 125@$12
Risk Control through Clearing House

• **What?**
  - US: Options Clearing Corporation (OCC)
    - owned jointly by all US options exchanges
  - Canada: TransCanada Options Inc. (TCO)
    - owned by TMX (Montreal-Toronto) & Vancouver

• **Why?**
  - market liquidity vs. knowing counterparts
  - margin posts and calls vs. “word is bond”

Risk Control through Clearing Houses 2

• **How?**
  - effective buyer and seller of all options
    - counter-party to all trades
    - guarantees execution
    - “open interest”
  - in practice
    - reversing trades
    - how do option strikes get carried out? (random pick)
  - risk for the clearing house
    - writers default

Risk Control through Clearing Houses 3

• **How? (continued)**
  - risk control
    - margins and margin calls
    - for writers (why not for buyers?)
  - margin determinants
    - volatility of underlying asset
    - extent of “in-the-moneyness”
    - naked or covered position

Risk Control through Clearing Houses 4

• **Margin computation (NOT Exam Material)**
  - naked option writer
    - margin is the greater of:
      - 100% of the proceeds of the sale
      - plus 20% of the underlying share price
      - less amount (if any) by which the option is out of the money
    - or
      - 100% of the proceeds of the sale
      - plus 10% of underlying share price (call) or strike price (put)
  - other trading strategies
    - special rules

Option-like Securities (NOT Exam Material)

• **Callable/puttable bonds**
  - time value of option
    - smooth curve (BKM Fig. 20.13)

• **Warrants**
  - differences with options

• **Convertible securities**
  - bonds

Warrants

• **What?**
  - options that are issued ("written")
  - by a corporation or a financial institution

• **Number of warrants outstanding**
  - size of the original issue
    - changes?
      - warrants are exercised
      - or warrants expire
    - contrast with options
Warrants 2

- Trading
  - similar to stocks

- Settlement
  - the issuer settles up with the holder
  - when a warrant is exercised
  - call warrants
    - issued by a corporation on its own stock
    - exercise leads to new treasury stock being issued

- Optimal exercise strategy
  - advantage of monopolistic behavior (options?)
  - Spatt and Sterbenz, JF 89 (LP)

Convertible Bonds

- What?
  - Convertibles =
    - regular bonds that can be exchanged for new equity
    - at certain times in the future
    - according to a predetermined exchange ratio

- Special features
  - often callable
    - why? (force conversion)

- Default risk
  - curvature (BKM4 Fig. 20.16)