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

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

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

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: \( S_t > X \)
    - put: \( S_t < X \)
  - *at-the-money*
    - \( S_t = X \)
  - *out-of-the-money*
    - calls: \( S_t < X \)
    - put: \( S_t > X \)

Option Payoffs at Maturity

- **Naked European positions**
  - **buyer**
    - calls: \( \max[0, S_T - X] - c \)
    - put: \( \max[0, X - S_T] - p \)
  - **writer**
    - calls: \( \min[0, X - S_T] + c \)
    - put: \( \min[0, S_T - X] + p \)

- **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

- **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 **LONG** Naked Forward Position (Fig1.2)

![Graph showing profit vs. price of underlying at maturity for a long position](image)

Profit from a **SHORT** Naked Forward Position (Fig1.2)

![Graph showing profit vs. price of underlying at maturity for a short position](image)
Options, Forwards and Futures

Customized  Standardized

right  OTC option  exchange-traded option

obligation  forward  futures

Trading Strategies Involving Options

• Covered position
  • Position involves the option & the underlying

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

• Combination
  • Position involves mixture of calls & puts
  • Straddles, strips & straps, strangles
Trading Strategies Involving Options 2: Covered Positions

• Protective put (Hull, Fig. 10.1c)
  - what?
    » buy stock + buy put \((a.k.a.\) 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)

![Diagrams showing different trading strategies involving options.](image)

(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*)

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Trading Strategies Involving Options 6

- **Bull Spread w/ Calls** (*Fig.10.2*)

  ![Diagram](attachment:image.png)
Trading Strategies Involving Options

• Bull Spread w/Puts (Fig. 10.3)

Trading Strategies Involving Options

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

- Bear Spread w/Calls (Fig. 10.5)

Spreads – Numerical Examples

<table>
<thead>
<tr>
<th>Strike Price ($)</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: $0.70; Puts: minus $4.23  (why?)
- Which is more speculative? $<55? 55<$60? $>60?
  - Bull spread vs. Bear spread?
• Butterfly Spread w/ Calls (Fig. 10.6)

\[ X_1 \quad X_2 \quad X_3 \quad S_T \]

Profit

• Butterfly Spread w/ Puts (Fig. 10.7)

\[ X_1 \quad X_2 \quad X_3 \quad S_T \]

Profit
Trading Strategies Involving Options 12

- Calendar Spread w/ Calls
  (Fig. 10.8)

Profit

\[ X \]

\[ S_T \]

Trading Strategies Involving Options 13

- Calendar Spread w/ Puts
  (Fig. 10.9)

Profit

\[ X \]

\[ S_T \]
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*)

![Straddle Combination Diagram](image-url)
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”
      - CBOE, 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
    » exception – flex options
  • 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
      - 3rd Friday of the maturity month
    » EOM options
      - last Friday of the maturity month

- exercise notice
  » customer
    - notifies broker by Friday at 4.30PM
  » broker
    - notifies exchange by 10.59PM CT the next Saturday

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
      - vs. $5 (typically, 30<S<100)
      - vs. $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 (*BKM4 Fig. 20.15*)
- 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)

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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*)