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: \( S_t > X \)
    - 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: \( \text{Max}(0, S_T - X) - c \)
    - puts: \( \text{Max}(0, X - S_T) - p \)
  - writer
    - calls: \( \text{Min}(0, X - S_T) + c \)
    - puts: \( \text{Min}(0, S_T - X) + p \)
- 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

- Profit from Short naked Put on Enron
  (write an Enron European put option; price = $7, strike = $70)

Option Payoffs at Maturity

- 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)

Profit

Price of Underlying at Maturity

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

Profit

Price of Underlying at Maturity

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

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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?”

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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)

\[ S \]
\[ X \]
\[ S_f \]

(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)

[Diagram showing profit graph with X1, X2, and S_T]

Trading Strategies Involving Options 7

- Bull Spread w/ Puts (Fig. 10.3)

[Diagram showing profit graph with X1, X2, and S_T]

Trading Strategies Involving Options 8

- Bear Spread w/ Puts (Fig. 10.4)

[Diagram showing profit graph with X1, X2, and S_T]
Trading Strategies Involving Options 9

- Bear Spread w/ Calls (Fig. 10.5)

\[ X_1 \quad X_2 \quad S_T \]

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: $0.70; Puts: minus $4.23 (why?)
- Which is more speculative? $S<55? \quad 55<S<60? \quad S>60?$
  - Bull spread vs. Bear spread?

Trading Strategies Involving Options 10

- Butterfly Spread w/ Calls (Fig. 10.6)

\[ X_1 \quad X_2 \quad X_3 \quad S_T \]
Trading Strategies Involving Options 11

- Butterfly Spread w/ Puts (Fig. 10.7)

Trading Strategies Involving Options 12

- Calendar Spread w/ Calls (Fig. 10.8)

Trading Strategies Involving Options 13

- Calendar Spread w/ Puts (Fig. 10.9)
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

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Trading Strategies Involving Options 15

• Straddle Combination
  (Fig. 10.10)

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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<$/100)
      - vs. $ 2.50 (typically, $<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

- 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 (BK/M 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)

Convertible Bonds

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

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

• Default risk
  • curvature (BKM4 Fig. 20.16)