Options

Chapter 19
Charles P. Jones, Investments: Analysis and Management,
Ninth Edition, John Wiley & Sons
Why Options Markets?

• Financial derivative securities: derive all or part of their value from another (underlying) security

• Options are created by investors, sold to other investors

• Why trade these indirect claims?
  – Expand investment opportunities, lower cost, increase leverage
Options Terminology

• Call (Put): Buyer has the right but not the obligation to purchase (sell) a fixed quantity from (to) the seller at a fixed price before a certain date
  – Exercise (strike) price: “fixed price”
  – Expiration (maturity) date: “certain date”

• Option premium or price: paid by buyer to the seller to get the “right”
How Options Work

• Call buyer (seller) expects the price of the underlying security to increase (decrease or stay steady)
• Put buyer (seller) expects the price of the underlying security to decrease (increase or stay steady)
• At option maturity
  – Option may expire worthless, be exercised, or be sold
Options Trading

- Option exchanges are continuous primary and secondary markets
  - Chicago Board Options Exchange largest

- Standardized exercise dates, exercise prices, and quantities
  - Facilitates offsetting positions through Options Clearing Corporation
    - OCC is guarantor, handles deliveries
How does buying stock compare with buying a call option?
Payoff Diagram for Put Option

How does selling stock compare with buying a put option?
Covered Call Writing

Profit ($)

Purchased share

Combined

Stock Price at Expiration

Written call

23 25 27 29
Protective Put Buying

Profit ($)

Purchased share

Combined

Stock Price at Expiration

Purchased put

23 25 27 29

-4 0 4
Portfolio Insurance

- Hedging strategy that provides a minimum return on the portfolio while keeping upside potential
- Buy protective put that provides the minimum return
  - Put exercise price greater or less than the current portfolio value?
- Problems in matching risk with contracts
Portfolio Insurance

Profit ($) vs. Stock Price at Expiration

- Purchased share
- Combined
- Purchased put
Options Terminology

• In-the-money options have a positive cash flow if exercised immediately
  – Call options: $S > E$
  – Put options: $S < E$

• Out-of-the-money options should not be exercised immediately
  – Call options: $S < E$
  – Put options: $S > E$
Options Terminology

• Intrinsic value is the value realized from immediate exercise
  – Call options: maximum $(S_0-E \text{ or } 0)$
  – Put options: maximum $(E-S_0 \text{ or } 0)$

• Prior to option maturity, option premiums exceed intrinsic value
  – Time value = Option price - Intrinsic value
  – =seller compensation for risk
Should Options be Exercised Early?

• Exercise prior to maturity implies the option owner receives intrinsic value only, not time value
  – For call options, buy stock at below market price
    • Would more be earned by selling option?
  – For put options, receive cash from selling stock at above market price
    • Could cash be reinvested for a higher return?
Option Price Boundaries

- At maturity, option prices are intrinsic values
  - Intrinsic value is minimum price prior to maturity
- Maximum option prices prior to maturity
  - Call options: price of stock, $S_0$
  - Put options: exercise price, $E$
Option Price Boundaries

Call Prices

Put Prices

C = S

Stock Prices

Stock Prices
Black-Scholes Valuation

- Five variables needed to value a European call option on a non-dividend paying stock

\[
CP = CMP \times N(d_1) - \frac{EP}{e^{rt}} \times N(d_2)
\]

\[
d_1 = \frac{\ln \left( \frac{CMP}{EP} \right) + (r + .5s^2)t}{s \sqrt{t}}
\]

\[
d_2 = d_1 - s \sqrt{t}
\]
Put-Call Parity

- Black-Scholes valuation is for call options
- Put-call parity shows relationship between call and put options if riskless arbitrage is not possible
- Price of put \(=(EP/e^{rt}) - CMP + CP\)
- Put replicated by riskless lending, short sale of stock, purchased call
## Factors Affecting Prices

<table>
<thead>
<tr>
<th>Variable</th>
<th>Call</th>
<th>Put</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock Price</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Exercise Price</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Time to maturity</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Stock volatility</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Interest rates</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Cash dividends</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>
Riskless Hedging

• Options can be used to control the riskiness of common stocks
  – If stock owned, sell calls or buy puts
• Call or put option prices do not usually change the same dollar amount as the stock being hedged
  – Shares purchased per calls written = \( N(d_1) \)
  – Shares purchased per puts purchased = \( N(d_1) - 1 \)
Stock Index Options

• Options available on S&P 100 Index, S&P 500 Index, NYSE Index, others
• Bullish on capital markets implies buying calls or writing puts
• Bearish on capital markets implies buying puts or writing calls
• At maturity or upon exercise, cash settlement of position
Strategies with Stock Index Options

• Speculation opportunities similar to options on individual stocks
• Hedging opportunities permit the management of market risk
  – Well-diversified portfolio of stocks hedged by writing calls or buying puts on stock index
  – What return can investor expect?
END