Value and Risk Management
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0. The Plan

1. Background

2. Options

3. Forwards and Futures

4. Applications

5. Dangers

6. Derivatives Policy
1. Background

- Goals of Derivatives
  - Risk reduction
  - Risk elimination
  - Strategic positioning
  - Enhanced managerial incentives

- The Problems
  - Currency Risk
  - Interest Rate Risk
  - Production Input Risk
Call Options

A Call Option is a contract giving its owner the right to buy a fixed amount of a specified underlying asset at a fixed price. The option has a fixed expiration date on which it is either exercised or dies.

Options can be contracted between individuals and/or institutions (over-the-counter options).

Standard options can be bought or sold on options exchanges.

Strike Price

The Strike Price or Exercise Price is the specified price at which the purchaser of the call option has the "right" to buy.
Risk Management Through Derivatives

1. Background

- Expiration Date

European Options are exercised on the expiration date.

American Options can be exercised any time on or before the expiration date.

- Contract Size

For stock options, the typical contract size is 100 shares. For other commodities, the contract may be different. For example, the Eurodollar option is on $1,000,000 worth of certificates of deposit.
1. Background

- Option Premium

The option premium is the price of the option. We usually think of "premium" in the context of insurance. We will see that this is an appropriate analogy.

2. Options

- Example: IBM/Dec/70

The buyer of the call option has the right to purchase 100 shares of stock at $70 on or before the third Friday in December. Suppose the current stock price is $68.

If the stock price rises to $75, the option would be exercised at a profit of $5.

If the stock price stays at $68, the option will not be exercised. [Why pay $70 for an asset worth only $68!]
- IBM/Dec/70

Note: Payoff kinks upward at $70. Above $70, the stock and option move one for one.

- Put Options

A Put Option is a contract giving its owner the right to sell a fixed amount of a specified underlying asset at a fixed price. The option has a fixed expiration date on which it is either exercised or dies.
Example: IBM/Dec/70

The buyer of the put option has the right to sell 100 shares of stock at $70 on or before the third Friday in December. Suppose the current price is $68.

If the stock price rises to $75, the option would be not be exercised [Why sell for $70 when asset worth $68!]

If the stock price stays at $68, the option will be exercised with a $2 profit [$200 on contract].

IBM/Dec/70

Note: Payoff kinks to left at $70. Below $70, the stock and option move one for one.
- Other Assets: S&P100/Dec/450

The call option purchaser has the right to buy 100 times the S&P 100 index at 450. This option is settled for cash. Suppose the current index level is 450.

If the stock index rises to 500, the option would be exercised (cash exchanged). The payoff would be $100 \times 50 = 5000$.

If the index falls, the option is not exercised.

- S&P100/Dec/450

Note: Payoff kinks upward at 450.
2. Options

- Other Assets: Treasury Bond/Dec/90

The call option purchaser has the right to buy a $100,000 face value Treasury bond (with 8% coupon and 15-20 years to maturity) for $90,000. Suppose the current bond price is $89. [Quoted as $100 face.]

If interest rates rise and bond price falls to $85. The option is not exercised.

If interest rates fall and the bond price rises to $100, option exercised for a $10 profit [$10,000 per contract].

- TBond/Dec/90

Note: Payoff kinks upward at $90.

Interest rate rise hurts call options.

Falling interest rates help call options.
2. Options

- Other Assets: Deutschemark/Dec/$0.70

The call option purchaser has the right to buy 125,000 DM at $0.70 per DM.

If dollar appreciates (fewer US$ needed to purchase DM), call loses value.

If dollar depreciates (more US$ needed to purchase DM), call gains value.

- DM/Dec/$0.70

Note: Payoff kinks upward at $0.70.

Dollar depreciation enhances value of call.
- DM/Dec/.70

Note: Payoff increases when price < $0.70.

Dollar appreciation enhances value of put.

- Net and Gross Payoffs

So far we have only considered the gross payoffs from options. That is, we have not taken the option premium into consideration.

For most hedging applications, we must consider the net payoff (gross payoff minus price).
- Example: IBM/Dec/70

Given a current stock price of $68, the call price should be about $5* ($500 per contract) which has a strike price of $70 and five months to expiration.

Hence, the stock price must rise above $75 for the option to produce a net profit.

*Topic of another session. The pricing formula determines the probability the call will be exercised.

- IBM/Dec/70 Call

Note: Net profit not attained until price > $75.
- IBM/Dec/70 Put

Note: Put option premium is $3. Net profit not attained until price falls below $67.

- Option purchaser has limited liability

The maximum loss that the purchaser of the call or put option is exposed to is the price paid for the option.

Call purchaser has the "right" to buy not an obligation.

Put purchaser has the "right" to sell but is has the "option" not to.
- Option seller (writer) has different liability

The writer must fulfill the contract given to the purchaser. The call writer faces unlimited liability.

That is, if IBM rises from $68 to $200, the call writer must sell the purchaser the stock for $70 -- a loss of $130 ($13,000 per contract).

- IBM/Dec/70 Call

Note: Losses potentially unlimited as price goes up.
- **IBM/Dec/70 Put**

  Note: The maximum liability that the put writer faces is the value of the underlying stock.

- **Portfolio Insurance**

  You have large holdings of IBM. You want to participate in the upside potential gains -- but want to be shielded from the downside.

  Buy put option. Sometimes referred to as a "protective put option".
2. Options: Applications

- Portfolio Insurance

Note 1: Downside losses are limited by protective put.

Note 2: Portfolio Insurance costs some of the upside.

- Interest Rate Hedging

Your company's net worth is hurt when interest rates rise. [E.g. a bank: must pay more to depositors and loans are worth less when rates go up.]

Initiate an options position which pays off when bond prices fall.

Purchase put options.
2. Options: Applications

- Foreign Exchange Hedging

Your company receives a substantial amount of revenue from Germany in DM. P&L is hurt if DM depreciates (or equivalently if $ appreciates) i.e. DM revenues translate into fewer dollars.

Buy put option. You will be selling DM. You need protection if price moves down.

- Foreign Exchange Hedging 2

Your company will be purchasing machine parts from Germany three months from now. P&L is hurt if DM appreciates (or equivalently dollar depreciates), i.e., it takes more dollars to purchase a fixed amount of DM.

Buy call option. You will be buying DM. You need protection if price moves up.
Buy-writing

Suppose you own an underlying asset and you decide to write a call option. This is referred to as a covered call.

When you do not own the underlying asset, it is referred to as a naked call.

With a covered call, your liability is limited because you own the underlying asset.

Note 1: Downside losses damped by call premium.

Note 2: All of the upside disappears.
Risk Management Through Derivatives

2. Options: Applications

- Lesson 1:
  - Bought put does not equal written call

Remember, written call has potentially unlimited liability whereas a purchased put's maximum liability is the price of the put.

- Short Call is not a Long Put

Note 1: Totally different payoffs.

Note 2: Some similarity in the middle range.
Lesson 2:
- Purchased call does not equal written put.

Remember, written put has maximum liability equal to the stock price whereas a purchased call's maximum liability is the price of the call.

Short Put is not a Long Call

Note 1: Totally different payoffs.

Note 2: Some similarity in the middle range.
Lesson 3:

- For hedging, we should buy options.

Buying options limits our liability. Eliminates the possibility of nightmare scenario where huge losses are declared because of derivative positions.

Don't let any salesperson try to spin a story that a written call is the same as a protective put -- it isn't!

Forward Contracts

A contract which obliges the buyer and seller to transact a fixed price on the underlying asset on a particular future date.

Example:

- Farmer agrees to sell 5,000 bushels of corn at $2.30 per bushel at the end of October. [Sell Forward]

- Kellogg's agrees to buy 5,000 bushels of corn at $2.30 per bushel at the end of October. [Buy Forward]
Risk Management Through Derivatives

3. Forwards and Futures

- Forward Contracts

Forward contracts are not options.

There is an obligation to fulfill the terms of the forward contract. With the option, the purchaser can always walk away.

- If the farmer buys a put option with a strike price $2.30 and the price of corn rises to $4.00 by the end of October, the farmer lets the option expire and sells the corn crop for $4.00 per bushel.

- If the farmer agrees to a forward contract, the corn must be sold for $2.30 (even though the market price is much greater).
Forward Contracts

- If Kellogg's buys a call option with a strike price $2.30 and the price of corn falls to $1.00 by the end of October, they can let their option expire and purchase the corn crop in the open-market for $1.00 per bushel.

- If Kellogg's agrees to a forward contract, the corn must be bought for $2.30 (even though the market price is much lower).

Farmer: Crop + Put Option

Note 1: Put option costs $0.25 per bushel.

Note 2: Option hedge eliminates downside and allows for some upside.
Risk Management Through Derivatives
3. Forwards and Futures

- Farmer: Crop + Forward Sale
  
  Farmer's Forward Hedge  
  Agree to sell at $2.30
  
  Payoff
  
  Crop value
  
  Hedged position
  
  Sell forward
  
  Note 1: Forward contract has no cost.
  
  Note 2: Forward hedge eliminates downside and upside.

- Corp: DM Revenue + Forward Sale
  
  Corporation's Forward Hedge  
  Agree to Sell at $0.70=DM
  
  Payoff
  
  Revenue value
  
  Hedged position
  
  Sell forward
  
  Note 1: Forward contract has no cost.
  
  Note 2: Forward hedge locks in exchange rate.
3. Forwards and Futures

- Why isn't there a premium for Forwards?

- Option protects downside and allows for upside gains. You pay a premium for this type of protection.

- Forward protects downside and eliminates all upside gains. There is no option feature -- hence no premium.

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3. Forwards and Futures

- Futures vs. forwards

Same idea as forward. Contract involves an obligation not an option.

One difference:

→ Contract price is rewritten every day.
Risk Management Through Derivatives

3. Forwards and Futures

- Farmer: Selling Futures

<table>
<thead>
<tr>
<th>Day</th>
<th>Contract Price</th>
<th>Daily Settlement</th>
<th>Cumulative P&amp;L</th>
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<td>0.00</td>
<td>-0.00</td>
</tr>
<tr>
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<td>-0.10</td>
<td>-0.10</td>
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<td>-0.40</td>
<td>-0.50</td>
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</tr>
<tr>
<td>7</td>
<td>1.70</td>
<td>+0.10</td>
<td>+0.60</td>
</tr>
</tbody>
</table>

Same protection as forward contract.

- Why use Futures rather than Forwards?
  
  > Futures very liquid. Easy to get in and out.
  
  > You can always eliminate the contract by taking the opposite side. E.g. farmer agrees to sell at $2.30 and then agrees to buy at $2.30 (cancels the contract).
  
  > Daily settling up reduces the chance of default.
FX Hedging

- Hedging foreign currency revenue

1. Estimate foreign revenue flows and timing.

2. Either sell forward or purchase put options on estimated flows.

3. Hedge will not be perfect if you misestimate the timing and/or the magnitude of the FX flows.

FX Hedging

- Hedging foreign currency expenses

1. Estimate foreign expense flows and timing.

2. Either buy forward or purchase call options on estimated flows.

3. Hedge will not be perfect if you misestimate the timing and/or the magnitude of the FX flows.
4. Applications

- FX Hedging
  
  - Alternatives

  1. Use futures market (not really necessary because interbank forward market is very liquid).

  2. Use FX swap. [Topic of another session].

- Interest Rate Management

  - Financial Institutions

  Cash out for banks or S&Ls are deposit rates and CDs. Cash in is from loan revenue.

  If rates go up, bank must pay extra to depositors. However, loan revenue will not move up in proportion.
4. Applications

- Interest Rate Management
  
  - Financial Institutions

Hedging Plan:

(1) Identify interest rate sensitivity of all asset and liability classes, i.e., what is the reduction in net worth if rates move up 1%.
(2) Initiate a futures based hedge that pays off an equal amount if rates up 1%.

- Interest Rate Management
  
  - Floating Rate Debt Control

Many corporations obtain variable-rate financing. Fluctuations in the interest cash flows can be controlled:

- Interest rate cap
- Short futures position
- Purchasing put options
- Interest rate swap
5. Dangers

- Dangers in Hedging with Derivatives

1. If derivative strategies used, demand to see the downside analysis.

2. Do not rely on marketing information.

3. Avoid writing options.

4. Careful cost/benefit analysis of options versus forwards. The premium for the option may be too expensive.

5. Beware of over and underhedging. Get the hedge ratio right.

6. Hedges almost always imperfect.
5. Dangers

- Dangers in Hedging with Derivatives

7. Portfolio considerations. If you have substantial DM revenues and approximately equal SF expenses, then it is not clear you need to hedge. [Changes in the DM and SF are 90% correlated].

6. Policy

- Setting the Rules
  
  - Board of Directors must develop Policy Guidelines
  
  - Derivatives should be used to reduce risk (hedging) rather than speculation.
  
  - Adhere to predetermined position limits
  
  - Critical staff should be trained. Staff must know as much as the derivatives salesperson.
6. Policy

- Setting the Rules

  - Compensation policies must be designed so staff have incentives to hedge -- rather than speculate.

  - Positions must be monitored (at least monthly) with a quarterly or semiannual Board review.

  - Impartial review and valuation of derivatives positions.