Managing Risk

- Much of finance is about the trade-off between risk and return
  - we are aware that risks come in two fundamental forms
    - risks that are common (correlated) across all assets
      - we call these risks market risk or systematic risk
      - these are the risks one receives compensation for bearing
        - you earn the risk free rate plus a return premium on the expected future cash flows for bearing this risk
    - risks that are unique (uncorrelated) across assets
      - we call these unique risks or diversifiable risks
      - these are risks for which one does not receive compensation
        - you earn the risk free rate on the expected cash flows for bearing this risk
Non Market Risks

- Most risks that firms face are not market risks
  - they are non-market risks related to unique features of the firm
    - these risks can affect cash flows, but are not systematically correlated with other events
      - these risks may be financial
        » exchange rate, interest rate, commodity price
        » these forms of risk have both upside and downside CF impacts
      - these risks may be non-financial
        » disaster risk such as fire, earthquake, flood, weather, theft, legal actions, worker health disability, etc
        » these risks mostly have negative impacts on realized cash flows
  - these risk are often managed by firms using
    - insurance
      » transferring the risk to some other party better suited to bearing it
    - hedging
      » actively taking an offsetting (opposite) risky position

Impact of Managing Non Market Risks

- In a Modigliani and Miller world, management of these risks does not add value to the firm
  - the price of non-market risks has to be the PV (at the risk free rate) of the expected cash flow effect
    - you have to pay the PV of the expected gain or loss to eliminate the risk
      » just like any other financial security, risk management contracts are zero NPV (if no transaction costs)
    - even if you don’t eliminate the risk, the firm’s expected cash flows will be affected by the cash flow impact of the risk
  - but valuation of firm should take into account these expected cash flow effects when determining the original NPV
    » regardless of whether the firm pays them to some one else or bears the risk itself
  - since, by definition, these risks do not affect the discount rate, the NPV of the firms is the same whether you manage or not
- then why is risk management such a big deal?
Reasons Why Firms Manage Risk

- In a non-M&M world we can identify several reasons why reducing cash flow risk might be beneficial to firms
  - reduce possibility of bad event resulting in financial distress
    - avoid costs of financial distress or near distress
    - can also lower borrowing costs for a given level of leverage
  - to make future cash flow planning easier
    - reduces likelihood of having to change investment plans or go to outside creditors for cash to fund investments
  - improves true performance evaluation of managers
    - makes it easier to determine if managers effort is responsible for good performance
    - even if risk transfer was zero NPV (or small negative NPV)
      - these advantages may make risk management a value enhancing idea

Instruments for Risk Management

- Insurance
  - firms often buy insurance against identifiable events
    - insurance contract transfers risk to party able to bear it at lower cost than the firm can
    - reasons insurance firm able to bear risk at lower cost
      - more experience in estimating probabilities and losses
      - knowledge about actions to reduce the risk
      - ability to pool risks—fully diversify
    - these all suggest firm better off transferring risk
  - problems insurance firm faces in bearing risk
    - administrative costs of handling policy and disputes over claims
    - adverse selection
      - riskier than average agents more likely to seek insurance
    - moral hazard
      - once risk is insured, the asset owner less careful
    - these suggest that insurance may be small negative NPV
Firms and Insurance Policies

- Many large firms are able to diversify everyday risks with predictable losses
  - example: health insurance, fire, worker compensation
  - these firms prefer to "self insure" the risks
  - cover losses from savings of not paying premiums to others
  - Instead, they insure against large risks
    - ones that cannot be self-insured as event would cause serious damage to firm’s health and ability to operate

- British Petroleum takes alternative view
  - every day risks are fairly priced and insurance firms are better at administrative aspects of policies
  - low probability, high impact events are "over priced"
    - given their huge equity capital and diversified operations (globally as well as industrially) they decided to self-insure these events

- some firms considering integrated risk management
  - look at pool of all non-market risks when creating insurance
    - combine financial and non-financial unique risks in single policy

Using Capital Markets for Insurance

- Increasingly the capital markets are being used to insure large risks
  - capital in the bond and equity markets is 1000 times larger than the capital in the insurance industry
    - should be better able to handle risk

- development of catastrophe (CAT) bonds
  - these are bond instruments that transfer risk of large losses partially from the firm onto bondholders
    - allow the financial markets to provide conditional risk capital
  - CAT bonds are structured such that the firms do not fully repay in the event of catastrophe
    - Typically, investor is offered full repayment with attractive interest rate if no event occurs
    - if trigger event occurs, the bond holders are guaranteed only 80% of initial investment
Using Capital Markets for Insurance

- Capital markets can also provide insurance capital via the equity market
  - the old fashion way to insure against risk was to have a lot of capital and sit on it, waiting for event to occur
    - this is expensive in that this capital brings down the firm’s ROA
    - an alternative way to insure against big risks is to have contingent capital
  - one way to do this is for a firm to buy put options from outside investors that are triggered by a bad event
    - these are known as CatEPut
      - short for Catastrophe Equity Put Option
  - this is a derivative contract giving the insured the right to sell new shares at a fixed price, with the investor pledging to buy them in the event of a catastrophe

Financial Risk Management

- Financial derivatives
  - while insurance is largely used to provide protection against non-financial risk, firms use financial derivatives to managing financial price risks
  - derivatives are instruments whose value is derived from underlying assets
    - forward contracts
      - tailor made contract to eliminate risk from some form of price uncertainty
    - futures contracts
      - standardized versions of forward contracts that are actively traded on exchanges
    - swaps
      - package of forward contracts all simultaneously arranged
    - options
      - the financial market equivalent of an insurance policy
  - all are zero NPV contracts when purchased whose values change in a direct way with the underlying financial price
    - these contracts allow people to bet on future price or take positions to offset impact of price changes on another position (hedging)
Forward Contracts

- Forward contracts
  - simple privately arranged contracts that specify a price for a transaction in the future
  - largest forward markets are in FX
    - financial institutions offer contracts to buy or sell FC for USD (or sometime other FC) at pre-specified price at specific future date
    - example: FX forward contract to exchange 1 FC into USD in 90 days (FC → USD )
      - Spot price S(USD/FC)_t = 1.00, spot price today in that 1 FC will trade for USD 1.00
      - F(USD/FC)_{t,90} = 1.01, 90 day forward price today in that price today for transaction in 90 days to trade FC 1 for USD 1.01
      - USD 1.01 / FC is the price you lock in today for transaction in 90 days
    - although this contract (price and quantity) is agreed to today the actual exchange will not take place for 90 days

Forward Exchange Rate Pricing

- Forward prices have two requirements
  - they must be the risk neutral expectation of the spot rate in the future
    - this is to prevent speculative arbitrage and rational expectations
      - if risk neutral investors thought that the actual spot price in the future was going to be significantly different that the forward price (for a transaction in the future) there would be a speculative arbitrage
  - they must not allow arbitrage with respect to current securities
    - this is to maintain the law of one price
      - using risk free rates and price for spot transaction
  - consider replicating a sale of FC1 into USD in 90 days through a forward contract with price F(USD/FC)_{t,90}

\[
\begin{align*}
\text{USD} & \quad \text{now} \quad x \left(1 + r_{\text{USD}90}\right) \quad \text{90 days} \\
\text{FC} & \quad x S(\text{USD/FC}) \quad \div \left(1 + r_{\text{FC}90}\right) \\
\text{B} & \quad + F(\text{USD/FC})_{t,90} \\
\text{A} & \quad \downarrow \\
\end{align*}
\]
Forward Contract Pricing

Consider replicating a forward contract for USD/FC forward rate in 90 days, if $F_{USD/FC,t,90} = \$1.01$

1. Suppose you borrow PV of FC 1 for 90 days (FV owed = FC1)
   - borrow $\frac{FC1}{1 + 0.02/(360/90)} = FC0.995$ today

2. Convert FC into USD at spot rate today of $USD1/FC = USD0.995$

3. Invest this amount at USD risk-free rate for 90 days at $r_{USD}^{USD}$
   - invest $USD 0.995 \times (1 + 0.06/(360/90)) = USD1.01$

Thus using these three transactions we can take FC1 in 90 days and risklessly convert it into USD1.01 in 90 days

- If the forward price for doing this today did not exactly match FC1 = USD1.01 in 90 days, there would be an arbitrage opportunity
  - Such a money machine cannot exist in efficient markets

- Forward exchange rates are set on basis of spot rate and comparable risk-free interest rates for the 2 currencies

Hedging

- Hedging is the practice of taking an offsetting position to reduce the uncertainty of a payoff
  - Together the underlying exposure and the hedge are set up to change value in opposite directions as price changes, thus preserving total value

- The most common form of hedging is foreign currency hedging using forward contracts
  - Firms use forwards to hedge their foreign currency transactions
    - The forward contract locks in an exchange rate in the future at which a transaction will occur
    - This eliminates the uncertainty in the payoff
  - The same thing can be done with futures contracts
    - However, the likelihood of getting an exactly offsetting futures position (both size and maturity) is less likely
Example of Hedging with Forward

- You are to receive 1M Mexican Peso in 90 days
  - spot exchange rate = USD 0.10 /MXP
  - expected value of exchange rate in 90 days = 0.095 USD/MXP
- thus, the expected value of payment in 90 days is MXP 1 million x USD 0.095 / MXP = USD95,000
- however, the actual USD value you will receive from this payment is random due to exchange rate variability
  - for every USD 0.001 the MXP ends up below (above) this expected XR, the payment is worth $1,000 less (more)
- to eliminate this randomness we can take an offsetting position that loses value when the USD/MXP rate rises
  - to hedge we enter a forward contract to sell MXP1 million in 90 days for USD at the forward rate of USD 0.095 /MXP
  - you pay nothing today to enter into this forward contract, but for every USD 0.001 the peso ends up below (above) the expected XR, I gain (pay) USD1,000
- this forward contract is a hedge of the underlying position
  - the value of the portfolio of the underlying position and the hedge are insensitive to the USD/MXP exchange rate

Futures Contracts

- Futures Contract
  - a contract similar to a forward contract, except there is an intermediary (an exchange) that creates a standardized contract
  - the counter-parties don’t have to negotiate terms of the contract
  - this standardization allows futures to be publicly traded
- active futures markets exist for many financial and commodity prices
  - Chicago was origin of commodity futures
  - financial futures are traded on exchanges in most major financial centers (London, NY, etc)
  - when you buy or sell a futures, the price for future delivery or purchase is fixed today
    - but payment is not made until later
    - both buyer and seller must post a margin with exchange
    - margin is cash or safe securities, typically around 15% of contract value
  - futures contract is marked to market daily
    - gain or loss is credited or debited to margin account
    - failure to maintain a minimum margin results in closing of position
Futures Prices on Financial Contracts

- Financial futures are like forward prices in that they are risk neutral expected future spot prices
  - replicating portfolios and arbitrage pricing
  \[
  \text{futures price}/(1+r_i) = \text{spot price} - \text{PV(forgone cash flow)}
  \]
- example: price for a 90 day futures contract on FC 1
  - this is a contract that specified a USD price to buy FC 1 in the future
  \[
  \text{FP(USD/FC)} / (1+r_{USD}) = \text{spot XR} - \text{PV USD(lost interest on 1 FC)}
  \]
  - spot XR = USD 1.00 / FC
  - \( r_f \) interest on 1 FC @ 2% (APR) => 0.5% for 90 days = FC 0.005
  - \( r_f \) interest rate on USD = 6% (APR) => 1.5% for 90 days
  \[
  \text{FP} / (1.015) = \text{USD1.00} - [(\text{FC0.005} \times \text{FP})/1.015]
  \]
  \[
  1.005 \text{ FP} / (1.015) = \text{USD1} \Rightarrow 1.005 \text{ FP} = \text{USD1.015}
  \]
  \[
  \text{FP(USD/FC)}_{t+90} = (\text{USD1.015} / 1.005) = \text{USD 1.0100}
  \]
  - this is same as the forward price
  - futures price reflects risk neutral pricing of expected future spot price as well as link to today’s price

Commodity Futures

- Commodity futures are a little different
  - arbitrage is buying today and storing commodity until future
  \[
  \text{futures price}/(1+r_i) = \text{spot price} + \text{PV(storage costs)} - \text{PV(convenience yield)}
  \]
  - storage cost = the costs of storing the physical good
    - owning the commodity means having to store it somewhere
    - this is a cost associated with the physical good
  - convenience yield = the benefit (value) of having the real good
    - having the commodity physically in hand has some value
      - the physical commodity can provide some services that the futures contract cannot
    - for example, you can eat wheat you own, but cannot eat the futures contract
      - gold is more enjoyable to look at than a futures contract on gold
  - the PV price of owning the commodity in the future must be the spot price plus the PV of the costs of storing it less the benefit of having access to the physical good
Commodity Future

- Problem: we generally do not separately observe PV(storage cost) and PV(convenience yield)
  - together these combine to a net convenience yield
    - net convenience yield = (conv yield) - stor cost)
- thus the formula for commodity futures becomes
  \[ \text{future price} / (1+r_f) = \text{spot price} - \text{PV net convenience yield} \]
  - example: wheat futures
    - current spot price = $3.00/bu
    - futures price for 6 months = $3.10
    - risk free rate = 5% (APR)
  - Futures price / (1+r_f) = $3.10 / 1.025 = $3.024
    - implies that the net convenience yield is negative
      \[ \text{PV net convenience yield} = \text{current spot price} - \text{futures price} \]
      \[ = (3.00 - 3.024) / (1+r_f) \]
      - this suggests that the storage costs are greater than the benefit of having the good on hand

Options

- Financial options can be used as a hedge
  - options are the financial market equivalent of insurance contracts
    - they payoff only if certain events occur
    - they require an upfront premium payment
    - you can decide how much loss you wish to bear relative to the expected price of the asset
  - example:
    - you have a EUR1 million payment to be received in 2 years
    - you would buy a EUR1 million put option on euros to protect against downside loss (right to sell at pre-set price)
  - suppose the current exchange rate (XR) is USD1.45/EUR
    - you buy a EUR1 million put option with a exercise price of USD1.40/EUR with a maturity date of the payment
      - this is an out-of-the-money option as it provides you protection below the current rate of USD1.45/EUR
      - the option will cost you a premium, say USD0.035/EUR = USD35,000
Options as Financial Insurance

- What happens?
  - option is insurance against XR below USD1.40/EUR
    - at maturity (in one year)
      - if USD/EUR rate is below 1.40, you exercise option and sell EUR1 million payment at exercise price of USD1.40/EUR
        » provides worst case cash flow
      - if USD/EUR rate is above 1.40, you let option expire and sell EUR€1 million payment at market exchange rate
        » insured event (XR < USD1.40/EUR) did not occur
        » you paid a premium for protection you did not need, but that is what insurance is all about
  - the premium you paid for this option is just like an insurance premium
    - it is not really an expense, just the PV of expected payoff
      » recall as a financial instrument the option is a zero NPV
    - if the premium was too high, then reduce level of insurance
      - take more risk yourself with exercise price of USD 1.30/EUR

Swaps

- Swaps are packages of forward contracts over time
  - they are generally used to alter the structure of a firm’s liabilities
  - as a set of forward contracts, the swaps involve trades of one cash flow for another
    - the PV of these cash flows are equal at initiation
      » thus, a swap is a zero NPV contract
  - the most common swap is an interest rate swap
    - a firm/ bank trades a set cash flows of cash flows set at some fixed interest rate over time for an alternative set of cash flows that will be determined by actual short term spot interest rates
      - firm pays
        \[ F \quad F \quad F \quad F \quad F \quad F \quad F \quad \text{time} \]
      - other side of swap is variable payments \( V \) based upon notional principal and a variable interest rate
      - firm receives
        \[ V \quad V \quad V \quad V \quad V \quad V \quad V \quad \text{time} \]
Interest Rate Swap

- The payments are set based upon a common principal (or notional) value for the swap, \( N \)
  - though this principal is not exchanged
  - the floating interest rates are short term rates
    - at initiation of the swap they are estimated using the Expectation theory of the Term Structure (forward rates, \( r_f \))
      - these expectations for the future short term interest rates times the notional value of the swap, \( N \), determine the estimates of the floating rate payments \( V \)
      - the "price" of the swap is set by a fixed interest rate, \( r_n \), that determines the fixed interest rate payments, \( F \), each period
    - the fixed interest rate at the beginning of the swap relative to the expected short term rates such that the swap’s NPV = 0
      - the PV(floating rate payments) = PV (fixed rate payments)
      - after issuance, the value of the swap can change over time as future short term rates change relative to expectations
  - the pricing of swaps rates is also restricted by arbitrage from do-it-yourself versions

Swap Example

- A bank makes loan to an industrial firm for $50M @8% for 5 years
  - many bank assets are this sort of fixed rate loans that they would prefer were floating
    - this loan provides bank $4M per year for 5 years
  - banks prefer to hold floating rate assets to match their liabilities (cash deposits that they pay market interest rates on)
    - the matching helps reduce the interest rate risk the bank would face if interest rates were to change
      - an increase in interest rates costs their cost of funds (rate they pay on deposits) to rise, but income from loan remains at $4m due to fixed rate
  - they would like to convert fixed rate asset to floating rate asset
    - can use an interest rate swap or do-it-themselves and replicate swap
  - how does bank convert of $4m per year into floating rate asset?
    - would like to enter a situation that obligates bank to pay $4m each year for 5 years and receive in return annual floating payments
      - it can do this directly with a swap or can enter a set of transaction on its own to create this situation
Do-It-Yourself Swap

- To replicate a swap, the bank will simultaneously borrow and lend a notional amount
  - notional amount is amount that costs them $4m/yr to borrow
  - if bank can borrow at 6% then this amount is $4m/.06 = $66.7m
  1. bank borrows $66.7m today and pay 6% fixed APR for 5 years
     - receive $66.7 today, pay of $4m per year and repay $66.7m at end
  2. bank invests $66.7m at LIBOR, L0, (ST floating rate today)
     - assume LIBOR now is 5% but future rates are expected higher

- let’s look at cash flows to this strategy

<table>
<thead>
<tr>
<th>Year</th>
<th>BANK'S CFs</th>
<th>BANK'S CFs</th>
<th>NET CF</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>($66.7 x 6%) = 66.7</td>
<td>(.05 x 66.7) = 3.33</td>
<td>0 -0.66m</td>
</tr>
<tr>
<td>1</td>
<td>-4</td>
<td>L1 x 66.7</td>
<td>-4 +</td>
</tr>
<tr>
<td>2</td>
<td>-4</td>
<td>L2 x 66.7</td>
<td>-4 +</td>
</tr>
<tr>
<td>3</td>
<td>-4</td>
<td>L3 x 66.7</td>
<td>-4 +</td>
</tr>
<tr>
<td>4</td>
<td>-4</td>
<td>L4 x 66.7</td>
<td>-4 +</td>
</tr>
<tr>
<td>5</td>
<td>-4</td>
<td>L5 x 66.7</td>
<td>-4 +</td>
</tr>
</tbody>
</table>

Swap Example

- The net cash flows to the position each period t is
  - $4m outflow and (Lt-1 x $66.7m) inflow
    - when combined with the cash flows from the loan to the firm, (+$4m) the bank is now on net receiving (Lt-1 x $66.7m)
    - this simultaneous borrow/lend activity transformed its fixed rate interest annuity from the firm into a floating rate annuity
  - rather than do-it-yourself, the bank could just purchase a 5-year fixed-to-LIBOR swap from another party
    - notional principal of $66.7m
    - the cash flows to this swap are as follows
      - current LIBOR is still 5%

<table>
<thead>
<tr>
<th>Year</th>
<th>SWAP CF</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>-4</td>
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<tr>
<td>2</td>
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<tr>
<td>4</td>
<td>-4</td>
</tr>
<tr>
<td>5</td>
<td>-4</td>
</tr>
</tbody>
</table>

0.05x66.7 = -0.67 x66.67 x66.67 x66.67 x66.67

- these are the same CFs as the do-it-yourself swap
Swap Example

- At initiation, swap rates are such that the PV of the total cash flows is zero
  - the year 1 net cash flow is negative (the bank owes $0.67m),
    - this suggests that later payments will be positive
      » LIBOR is expected to rise over the next 4 years
  - consider cash flow in year 2
    - just suppose LIBOR1 rises to 5.5%
      » CF in year 2 = -$4 + (0.055 x $66.67) = -$0.33m
    - if instead LIBOR1 had risen to 6%, CF in year 2 = $0
- what happens if interest rates rise more than expected?
  - if so, then current rates (both short and long term are higher)
    - the bank receiving higher floating payments in swap and making same fixed payments at the old (low) fixed rate so it gains on swap
      » this offsets any loss on the underlying loan to the industrial firm
  - if interest rates rise less than expected (both floating and long term rates are lower than expected)
    - the bank suffers loss on swap as it is stuck paying the original (higher) fixed rate and receiving the now lower floating rate

Determining Change in Value of Swap

- How much will bank gain?
  - the original swap still has 3 years of payments on it
    - assume rates rise at year 2 so the 3-year fixed rate is now 7%
      - there are still 3 years of cash flows on the swap
  - we can determine the value of the swap in two ways:
    - we determine the PV of the remaining CFs on the original swap plus the PV of the notional value at maturity at the new fixed rate
      \[ PV = \frac{4}{1.07} + \frac{4}{1.07^2} + (4 + 66.67)/1.07^3 = 64.92 \]
    - we then subtract this from the notional value of the swap (which is also the value of the remaining floating side of the swap)
    - thus the swap is now worth
      \[ 66.67 - 64.92 = 1.75m \text{ to the bank} \]
    - the banks gains the 1.75m on the swap due to the interest rate rise
Swap Example

- Or we can value the swap by arbitrage
  - measure "close-out value" by using an offsetting swap
    - "pretend" the bank now enters into a "new" 3 year swap for the same notional value, $66.7m, but in the opposite direction
    - the bank pays floating (LIBOR) and receives fixed (@ new rate 7%)

<table>
<thead>
<tr>
<th>(period of old swap)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLD SWAP</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>NPV = ???</td>
<td></td>
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<tr>
<td>+ NEW 3Y SWAP</td>
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</tr>
<tr>
<td>NPV = 0</td>
<td></td>
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<tr>
<td>EQUALS</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>NPV of Old Swap</td>
<td></td>
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</tr>
</tbody>
</table>

- the floating rate cash flows can cancel out leaving net CF of $0.67m each year to the bank (discounted at new fixed rate)
  - PV of Net CF: \[ PV = \frac{0.67}{1.07} + \frac{0.67}{1.07^2} + \frac{0.67}{1.07^3} + \frac{0.67}{1.07^4} = 1.75 \text{m} \]

Currency Swaps

- Another form of swap is a currency swap
  - a firm trades a specified set of cash flows in one currency for a specified set of cash flows in an other currency
    - these also involve interest rates, either fixed rate over life of swap of short term (floating) interest rates that that are yet to be determine by market conditions over life of the swap
      - can exchange fixed or floating payment in one currency for fixed payments or floating payments in another currency
      - interest rate expectations for future short term rates are taken using Expectation Theory of the Term Structure
  - example
    - firm exchanges a set amount of one currency, say US$, for an equal amount of FC (at current spot price) at initiation
    - in subsequent future periods the firm makes fixed FC payments in return for fixed US$ payments
    - then at maturity, the initial payments are returned
    - often these cash flows are in the form of loans with large principal payments at each end and smaller interest payments in between
Diagram of FC Currency Swap

- firm receives cash flows
- firm pays cash flows
- firm's total flows from swap

Foreign Currency Debt and Swap

- Firm starts with foreign currency debt
- then adds a long position in a FC Swap
- together this creates cash flows equivalent to having $ debt
Pricing Currency Swaps

- Currency swaps are priced using forward rates and expected interest rates such that the NPV of the swap = 0
  - note with currency swaps we must include the exchange of principals at each end
    - note initial principals are always set to that they are equal at current spot rate
  - when interest rates or exchange rates (or both) change after swap is agreed to the value can change
- we can determine the value of a currency swap in the same fashions as we did with interest rate swaps
  - often easier to use the close out swap method
    - use the new swap to eliminate the floating interest rate currency of the interest rate that did not change
      - be sure to recognize the impact of the exchange rate on the principals
- see the class note on the web for examples of pricing various forms of currency swaps

Summary

- Risk management
  - in addition to maximizing value, firms should manage risks
  - market risks directly affect value of firm, but most risks of firm are idiosyncratic (or diversifiable)
    - these identifiable risks are generally fairly priced in the market
    - firms can obtain some benefits from removing these fairly priced risks
- instruments for risk management
  - insurance - payment for PV(expected loss)
  - derivatives
    - forwards - contracts for future transactions
    - futures - exchange traded forward contracts
    - swaps - combinations of forward contracts
      - pricing of currency swaps and interest rate swaps
  - setting up hedges
    - direct off-setting positions using derivatives
    - hedging through liability management - duration