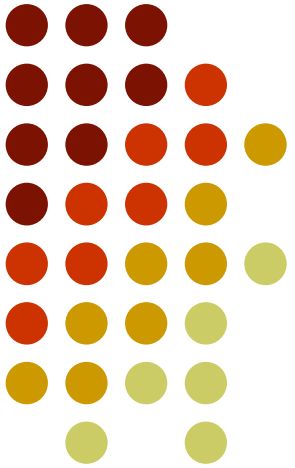
Introduction

Chapter 1



Risk vs Return

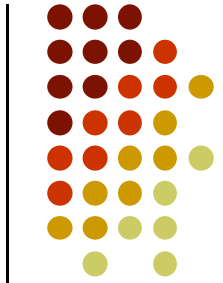
- There is a trade off between risk and expected return
- The higher the risk, the higher the expected return

Example (Table 1.1, page 2)

Suppose Treasuries yield 5% and the returns for an equity investment are:

Probability	Return
0.05	+50%
0.25	+30%
0.40	+10%
0.25	–10%
0.05	–30%

Example continued



- We can characterize investments by their expected return and standard deviation of return
- For the equity investment:
  - Expected return =10%
  - Standard deviation of return =18.97%

Combining Two Risky Investments (page 5)

$$\mu_P = w_1\mu_1 + w_2\mu_2 \qquad \sigma_P = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2\rho w_1 w_2 \sigma_1 \sigma_2}$$

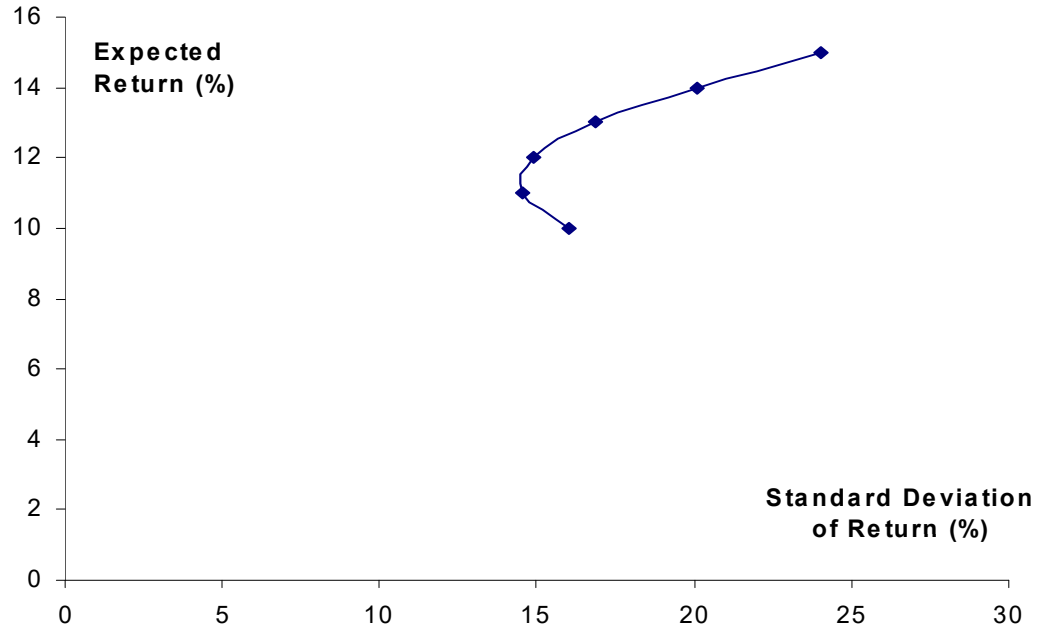
$\mu_1 = 10\%$

$\mu_2 = 15\%$

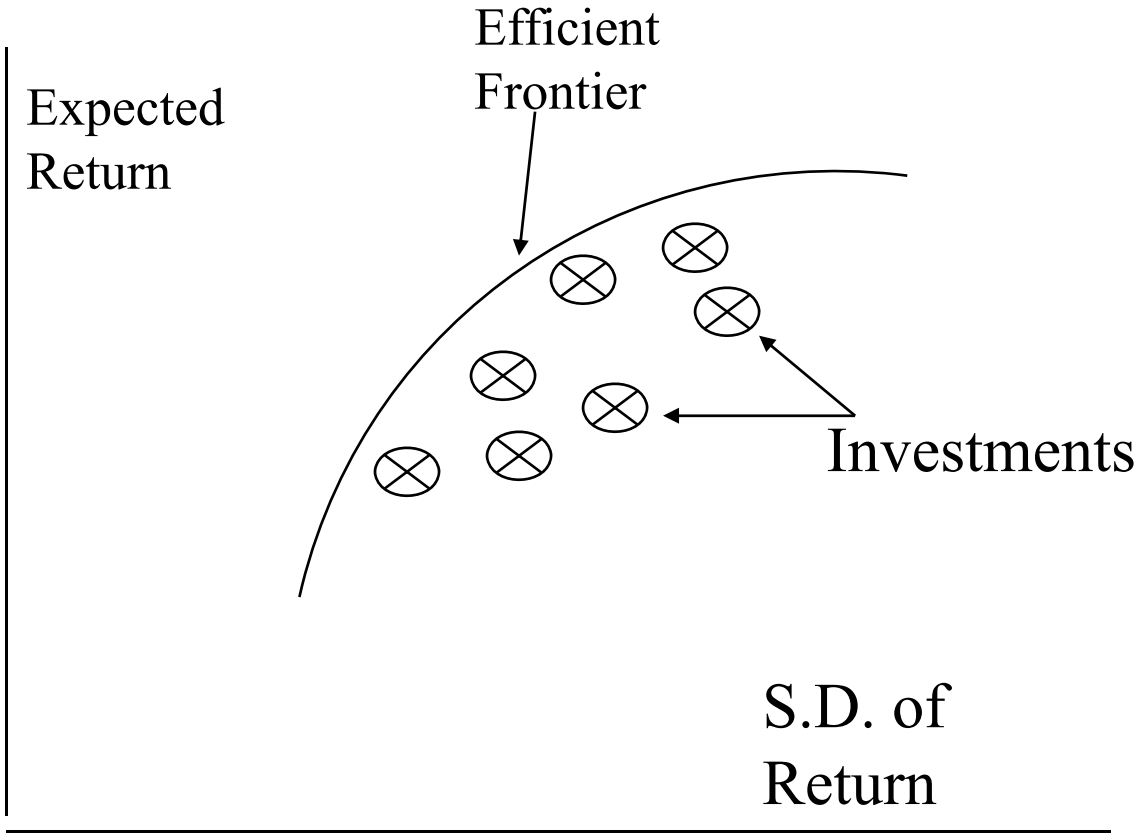
$\sigma_1 = 16\%$

$\sigma_2 = 24\%$

$\rho = 0.2$

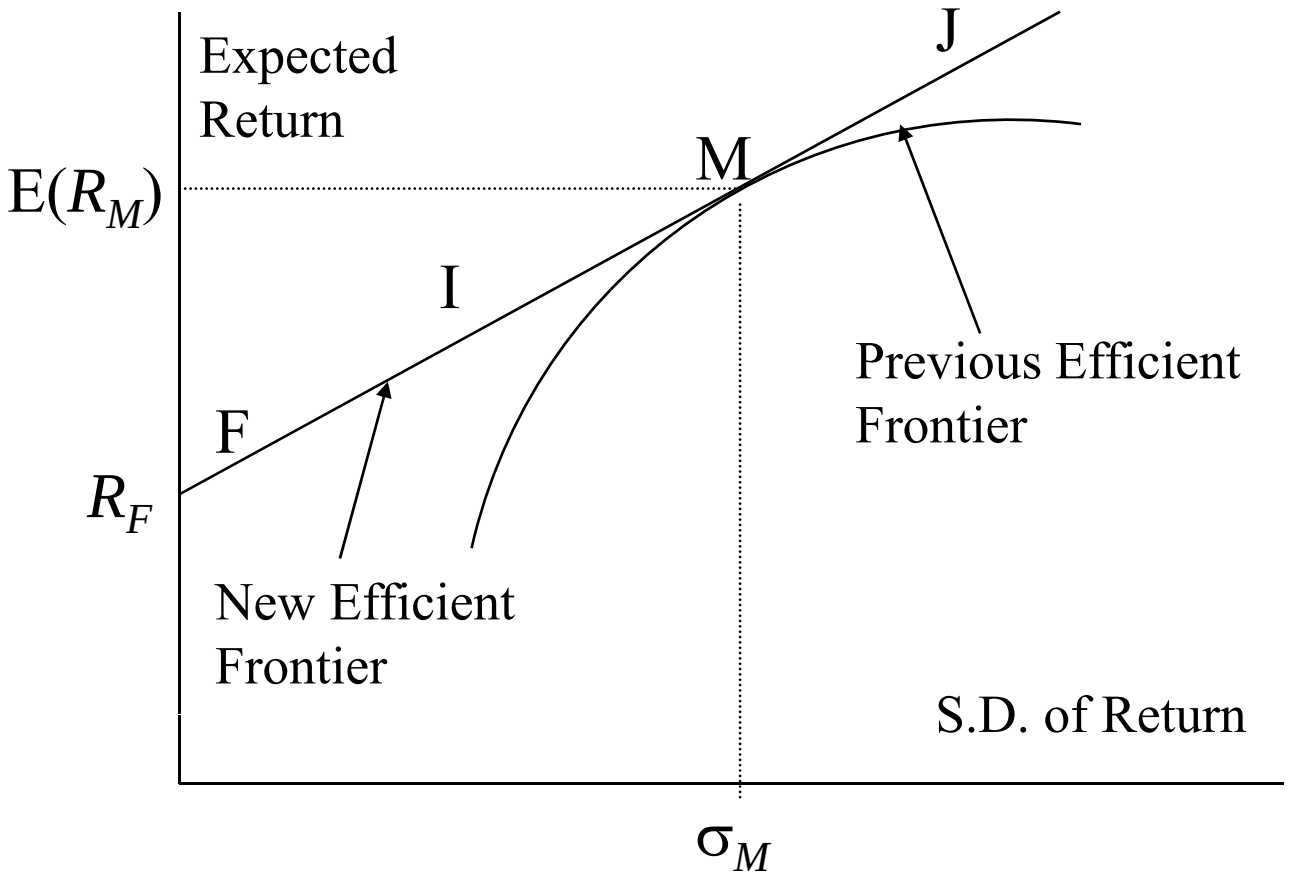


Efficient Frontier of Risky Investments (Figure 1.3, page 6)



Efficient Frontier of All Investments

(Figure 1.4, page 6)



Systematic vs Non-Systematic Risk

(equation 1.3, page 8)

We can calculate the best fit linear relationship between return from investment and return from market

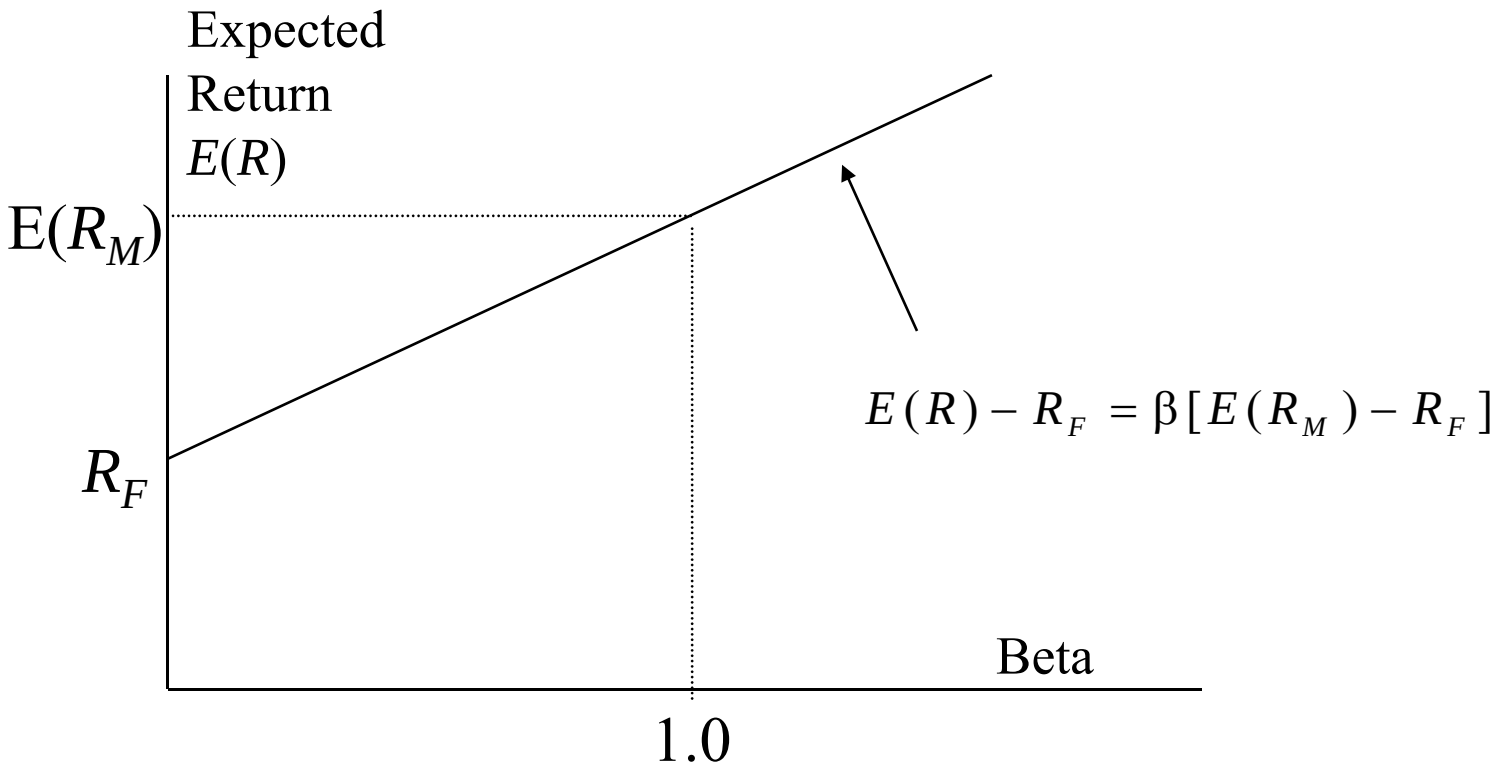
$$R = a + \beta R_M + \varepsilon$$

Systematic Risk
(non-diversifiable)

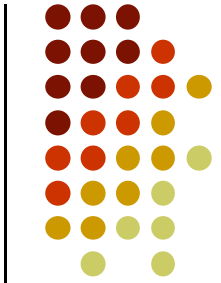
Non-systematic risk
(diversifiable)

The Capital Asset Pricing Model

(Figure 1.5, page 9)

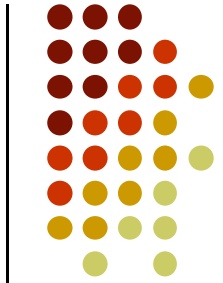


Assumptions



- Investors care only about expected return and SD of return
- The ε's of different investments are independent
- Investors focus on returns over one period
- All investors can borrow or lend at the same risk-free rate
- Tax does not influence investment decisions
- All investors make the same estimates of μ's, σ's and ρ's.

Alpha



- Alpha measure the extra return on a portfolio in excess of that predicted by CAPM

$$E(R_P) = R_F + \beta(R_M - R_F)$$

so that

$$\alpha = R_P - R_F - \beta(R_M - R_F)$$

Arbitrage Pricing Theory

- Returns depend on several factors
- We can form portfolios to eliminate the dependence on the factors
- This leads to result that expected return is linearly dependent on the realization of the factors

Risk vs Return for Companies

- If shareholders care only about systematic risk, should the same be true of company managers?
- In practice companies are concerned about total risk
- Earnings stability and company survival are important managerial objectives
- The regulators of financial institutions are primarily interested in total risk
- "Bankruptcy costs" arguments show that that managers may be acting in the best interests of shareholders when they consider total risk

What Are Bankruptcy Costs?

(Business Snapshot 1.1, page 15)

- Lost sales (There is a reluctance to buy from a bankrupt company.)
- Key employees leave
- Legal and accounting costs

Approaches to Bank Risk Management

- Risk aggregation: aims to get rid of non-systematic risks with diversification
- Risk decomposition: tackles risks one by one
- In practice banks use both approaches

Credit Ratings

Moody's	S&P and Fitch
Aaa	AAA
Aa	AA
A	A
Baa	BBB
Ba	BB
B	B
Caa	CCC
Ca	CC
C	C

Investment grade bonds

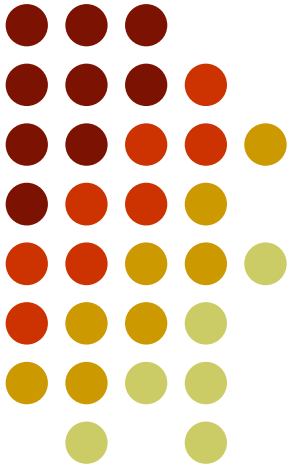
Non-investment grade bonds

Subdivisions

- Moody's divides Aa into Aa1, Aa2, Aa3.
- S&P and Fitch divide AA into AA+, AA, and AA−
- Other rating categories are subdivided similarly except AAA (Aaa) and the two lowest categories.

Banks

Chapter 2



Nature of Banking

- Commercial banking
  - Taking deposits, making loans (wholesale or retail)
  - Money center banks operate in the wholesale market and often fund themselves by borrowing
- Investment banking
  - Raising debt and equity for companies; advice on mergers and acquisitions, restructurings, trading, etc

Structure of Banking in the US

- Large international banks (small number)
- Regional banks (several hundred)
- Small community banks (several thousand)

History of Bank Regulation in US
(page 27)

- McFadden Act (1927, 1933)
- Douglas Amendment (1956)
- Bank Holding Companies Act (1970)
- Riegel-Neal Interstate Banking and Branching Efficiency Act (1994)

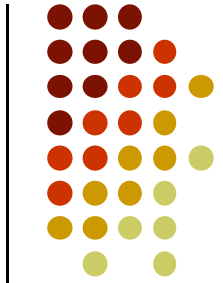
Example of Simple Bank Balance Sheet: End 2015 (Table 2.2, page 28)

Assets		Liabilities	
Cash	5	Deposits	90
Marketable Securities	10	Subord L.T. Debt	5
Loans	80	Equity Capital	5
Fixed Assets	5		
Total	100	Total	100

Income Statement: 2015 (Table 2.3, page 29)

Net Interest Income	3.00
Provision for Loan Losses	(0.80)
Non-Interest Income	0.90
Non-Interest Expense	(2.50)
Pre-Tax Operating Income	0.60

Year 2016



- What happens in year 2016 if it is the same as year 2015 except that provision for loan losses is 4.0 instead of 0.8?

What if Balance Sheet Had Been More Aggressive?

Assets		Liabilities	
Cash	5	Deposits	94
Marketable Securities	10	Subord L.T. Debt	5
Loans	80	Equity Capital	1
Fixed Assets	5		
Total	100	Total	100

Regulation

- Regulators set minimum levels for the capital a bank is required to keep
- Equity is an example of Tier 1 capital
- Subordinated long term debt is an example of Tier 2 capital

Deposit Insurance (pages 30-31)

- Most countries have deposit insurance programs that insure depositors against losses up to a certain level
- In the US the FDIC has provided protection for depositors since 1933
- The amount insured was $2,500 in 1933
- It has been increased several times
- Following the credit crisis it was increased from $100,000 to $250,000 in October 2008.
- Why might deposit insurance encourage a bank to take risks?

Investment Banking

- Methods of raising debt or equity
  - Public offering
  - Private placement
  - Best efforts
  - Firm commitment

Best Efforts vs Firm Commitment
(page 32)

- 50 million shares are to be issued and target price is $30 per share
- Best efforts would lead to a fee of 30 cents per share; firm commitment leads to bank buying the shares at $30 per share

	Best efforts	Firm Commitment
Can sell at $29	+$15 million	−$50 million
Can sell at $32	+$15 million	+$100 million

Initial Public Offering (IPO)

- Usually on a best efforts basis
- Bank will set offering price sufficiently low that shares are almost certain to be sold
- Often price rises immediately after IPO
- Banks often offer shares only to fund managers and their best customers

Dutch Auction IPO

- Individuals and companies bid by indicating the number of shares they want and the price they are prepared to pay
- The price paid is the lowest bid that leads to all the shares being sold

Example: How are 1 million shares allocated in this situation?

Bidder	Number of Shares	Price
A	100,000	$30.00
B	200,000	$28.00
C	50,000	$33.00
D	300,000	$29.00
E	150,000	$30.50
F	300,000	$31.50
G	400,000	$25.00
H	200,000	$30.25

Google's IPO in 2004 (Business Snapshot 2.1, page 35)

- A Dutch Auction where Google retained the right to change the number of shares that would be issued and the percentage allocated to each bidder
- Investors who bid $85 or more obtained 74.2% of the shares they had bid for

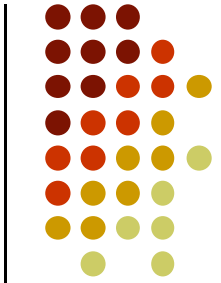
Securities Trading

- Exchange-traded vs OTC
- Why do banks trade?
- Brokerage services
  - Full service
  - Discount
  - On line

Potential Conflicts of Interest

- Bank recommends securities investment bank is trying to sell
- Commercial bank passes confidential information on a client to investment bank
- Stock recommended as a “buy” to please company’s management in order to get investment banking business
- Investment bank sell securities for a company so that commercial bank can get rid of a loan

Accounting (page 39)



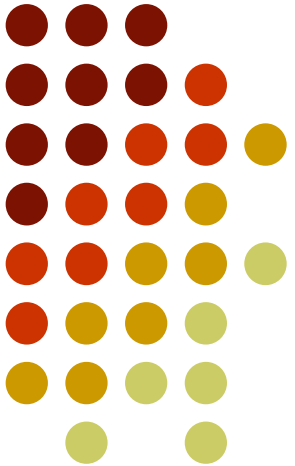
- Banking book vs trading book
- Nonperforming loans are loans where interest is not accrued. Typically, payments from the borrower are more than 90 days overdue.
- When it becomes clear that payments will not be made, there is a loan loss
- A bank creates a reserve for loan losses

The Originate-to-Distribute Model

- Very popular way of handling mortgages during the 2000 to 2007 period
- Banks originated loans and then packaged them into products that were sold to investors
- This frees up funds to make more loans

Insurance Companies and Pension Plans

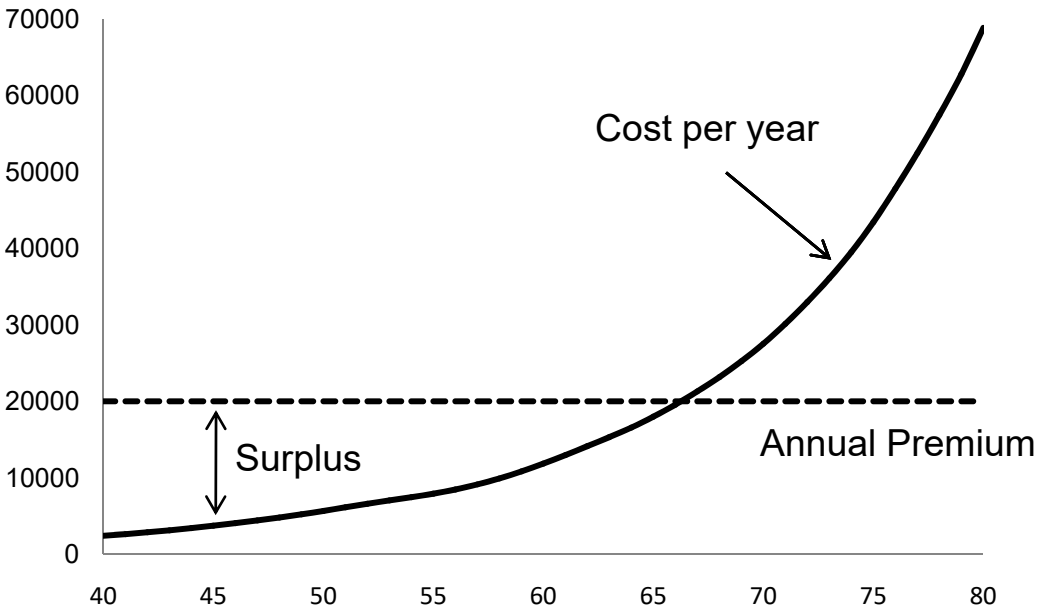
Chapter 3



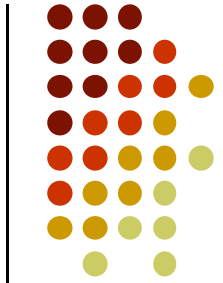
Types of Life Insurance (pages 45-49)

- Term life
- Whole life
- Variable life
- Universal life
- Endowment life
- Group life

Cost of Whole Life Insurance Compared with Annual Premium (Figure 3.1)



Investment of Surplus



- Some contracts allow the policyholder to choose how the surplus is invested
- There are tax deferral advantages compared with a regular investment and in some jurisdictions the beneficiary of a life insurance policy does not have to pay any tax

Annuity Contracts (pages 49-50)

- Typically a lump sum payment is used to buy a life-time annuity
- Annuity can start immediately or be deferred
- Accumulation value can depend in a complicated way on the performance of stock indices
- There may be penalty-free withdrawals

Extract from US Mortality Tables (2009): Male

Age	Prob. death within one year	Prob. Survival	Life expectancy (yrs)
30	0.001419	0.97372	47.52
31	0.001445	0.97234	46.59
32	0.001478	0.97093	45.65
33	0.001519	0.96950	44.72

Extract from US Mortality Tables (2009): Female

Age	Prob. death within one year	Prob. Survival	Life expectancy (yrs)
30	0.000662	0.98551	51.82
31	0.000699	0.98486	50.86
32	0.000739	0.98417	49.89
33	0.000780	0.98344	48.93

How Tables Are Used In Pricing Life Insurance

- Consider a female aged 30
- Probability of death during first year is 0.000662
- Probability of death during second year is

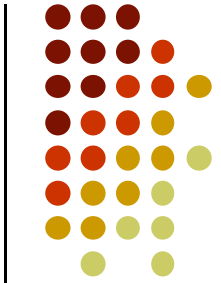
  $(1-0.000662) \times 0.000699$
- Probability of death during third year is

  $(1-0.000662) \times (1-0.000699) \times 0.000739$
- etc
- Minimum premium is such that present value of inflows equals present value of outflows.

Longevity Derivatives (page 54)

- Used by life insurance companies and pension funds
- A population is defined and coupon on a bond depends on the number of members of the population still alive

Property-Casualty Insurance



- Property insurance is concerned with loss or damage to property from fire, theft, etc
- Casualty insurance is concerned legal liability exposures
- What are the biggest risks facing property-casualty insurers?

CAT Bonds (page 55-56)

- CAT bonds are an alternative to traditional reinsurance
- This is a bond issued by a subsidiary of an insurance company that pays a higher-than-normal interest rate.
- If claims of a certain type are above a certain level, the interest and possibly the principal on the bond are used to meet claims

Example of Ratios for Property-Casualty Insurance (Table 3.2)

Loss Ratio	75%
Expense ratio	30%
Combined ratio	105%
Dividends	1%
Combined ratio after dividends	106%
Investment income	(9%)
Operating ratio	97%

When Do Premiums Change?

- In life insurance premiums typically stay the same throughout the life of the contract
- In property-casualty insurance premiums are changed from year to year as risks are reassessed
- In heath insurance premiums can rise because of the overall cost of health care but not because the health risks of the policyholder increase

Moral Hazard and Adverse Selection (pages 58-59)

- Moral hazard is the risk that the existence of the insurance policy causes the policyholder to take more risks
- Adverse selection is the tendency for an insurance company to attract bad risks when it cannot perfectly distinguish between good and bad risks

Typical Summary Balance Sheet: Life Insurance (Investments are mostly long-term corporate bonds)

Assets		Liabs and Net worth	
Investments	90	Policy Reserves	80
Other assets	10	Sub Long Term Debt	10
		Equity Capital	10
Total	100		100

Typical Summary Balance Sheet: Property-Casualty Insurance

(Investments are mostly liquid shorter maturity bonds)

Assets		Liabs and Net worth	
Investments	90	Policy Reserves	45
Other assets	10	Unearned premiums	15
		Sub Long Term Debt	10
		Equity Capital	30
Total	100		100

Regulation of Insurance Companies

- US: Mostly at the state level
- Europe: Mostly at the EU level

Pension Plans

- Defined benefit plan
  - Contributions are pooled
  - Benefits are determined by a formula dependent on the final salary of the employee and the number of years of service
- Defined contribution plan
  - Contributions for each employee are kept separate and invested on behalf of the employee
  - When the employee retires the accumulated value of the contributions is usually converted to an annuity

Defined Benefit Plans

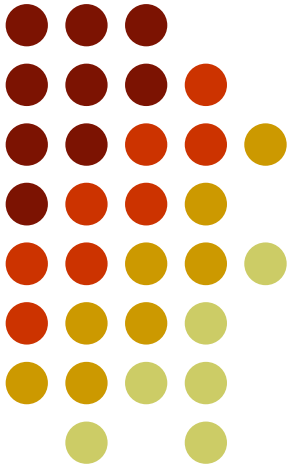
- Actuaries estimate liabilities and calculate a surplus or deficit for the plan.
- The discount rate used for private plans is the AA borrowing rate
- Deficits must be funded by the company within a prescribed period
- A perfect storm: Declining equity prices coupled with declining interest rates

Are Defined Benefit Plans Viable?

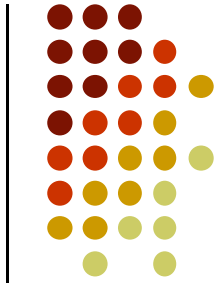
- Employer plus employee contributions are typically 15% of salary or less
- Actuarial estimates show that about 25% of salary is necessary to fund most plans
- Funds typically invest 60% in equities and are relying on good investment returns from equity investments to meet obligations
- Should members of DB plans bear some of the risk associated with equity returns?

Mutual Funds and Hedge Funds

Chapter 4



Open-End Mutual Funds



- Investments in mutual funds in the U.S. have grown from $0.5 billion in 1940 to over $15 trillion in 2014
- Most common type of fund is an open-end fund
- This means that the number of shares in the fund goes up as investors buy more shares and down as they redeem shares
- Net asset value (NAV) of fund is the value of its investments divided by number of shares
- All purchases and sales of shares are at the 4pm NAV

Tax

- Tax is paid as though the investor owned the mutual fund investments
- If the mutual fund realizes capital gains or dividends during a year, the investor has to pay taxes on the amount realized
- The investor's basis (i.e., the amount the investor is assumed to have paid for the mutual fund shares) is adjusted to avoid double taxation when the shares are sold

Types of Fund

- Equity
- Bond
- Hybrid
- Money Market
- Index

Costs (Table 4.2)

- Annual fee
- Front-end load
- Back-end load
- Relatively low in US
- Relatively high in Canada, Denmark, Finland, Italy, Norway, and Spain

Closed-End Fund

- Consists of a fixed number of shares that are traded in the same way as the shares of any other company
- The share price tends to be less than the NAV calculated from the market value of the investments

Exchange-Traded Funds (ETFs, page 75-76)

- Often designed to track an index
- Started by an institutional investor that deposits a block of securities and obtains shares in the fund
- Shares are traded on an exchange
- Large institutional investors can exchange shares in the fund for the underlying assets, and vice versa
- This keeps the share price close to the NAV of the fund's investments

Advantages of ETFs over Open- and Closed-End Mutual Funds

- Can be bought or sold (or shorted) at any time of the day
- Holdings are disclosed twice a day
- Investments do not have to be sold to cover redemptions
- Share price close to NAV of underlying investments

Performance of Mutual Funds

- The classic study is by Jensen in 1969. His results have been confirmed in later studies
- The average alpha of all funds is slightly negative.
- Good performance by a mutual fund manager in the past is not a good guide to future performance

Jensen's Results on the Persistence of Good Performance (Table 4.3)

Number of Consecutive Years of Positive Alpha	Number of Observations	Observations for which the Next Alpha is Positive (%)
1	574	50.4
2	312	52.0
3	161	53.4
4	79	55.8
5	41	46.4
6	17	35.3

Mutual Fund Scandals (pages 77-79)

- Late trading
- Market timing
- Front running
- Directed brokerage

Hedge Funds

- Mutual Funds are restricted because
  - Shares must be redeemable at any time
  - NAV must be calculated daily
  - Investment policies must be disclosed
  - Use of leverage is limited
- Hedge funds (also called alternative investments) are not subject to these restrictions

Hedge Fund Fees

- A typical fee structure is 2 plus 20%
- This means that the fund charges a 2% management fee per year plus an incentive fee equal to 20% of any net (after management fees) profits
- There may be lock up periods during which funds cannot be withdrawn
- Other features: hurdle rates, high-water marks, and clawbacks

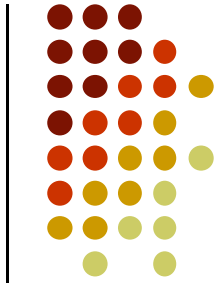
Funds of Funds

- Funds of funds invest in the portfolios of hedge funds
- A typical fee used to be 1 plus 10%
- It is now much lower

Incentives of Hedge Fund Managers (pages 81-83)

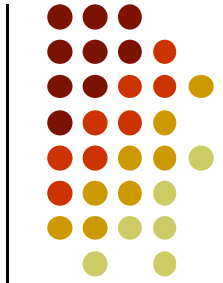
- The incentive component of the hedge fund manager's fee gives the hedge fund manager a call option on the performance of the fund in each year
- The hedge fund manager has an incentive to take high risks
- Should a hedge fund manager choose an investment with a 0.4 probability of a 60% profit and a 0.6 probability of a 60% loss?

Prime Brokers (page 83)



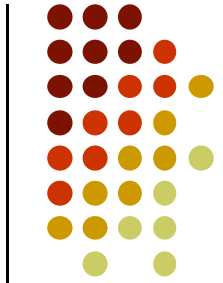
- Prime brokers
  - handle hedge fund trades
  - determine the maximum leverage and collateral requirements
  - borrow securities when the hedge fund is shorting,
  - etc
- Large hedge funds typically use more than one prime broker
- The risks that hedge funds can take are to some extent controlled by their prime brokers

Hedge Fund Strategies



- Long/short equity
- Dedicated short
- Distressed securities
- Merger arbitrage
- Convertible arbitrage
- Fixed income arbitrage
- Emerging markets
- Global macro
- Managed futures

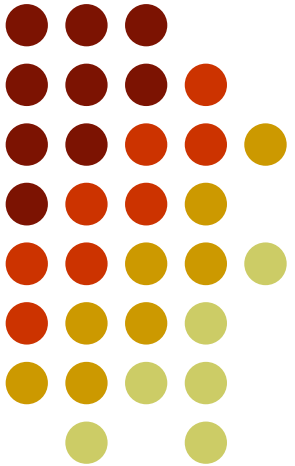
Hedge Fund Returns



- Statistics produced by Dow Jones Credit Suisse indicate that hedge funds outperformed the market between 2004 and 2009, but not between 2009 and 2013 (See Table 4.5)
- Many hedge fund strategies have low betas and therefore cannot be expected to outperform the market when it is doing well.
- However, the statistics may bias average hedge fund performance upward because only hedge funds that choose to report their returns are included in the statistics and these tend to be the hedge funds that are doing well.

Trading in Financial Markets

Chapter 5



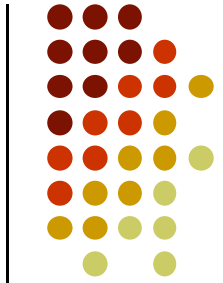
Financial Markets (pages 93-94)

- Exchange traded
  - Traditionally exchanges have used the open-outcry system, but electronic trading has now become the norm
  - Contracts are standard; there is virtually no credit risk
- Over-the-counter (OTC)
  - A network of dealers at financial institutions, corporations, and fund managers who trade directly with each other
  - Contracts can be non-standard; there is some credit risk

Clearing Houses

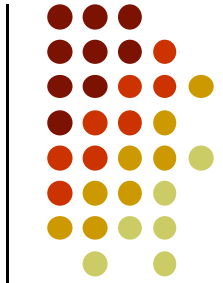
- Clearing houses stand between traders in the exchange-traded market.
- Clearing houses require traders to post cash or marketable securities as collateral (referred to as margin) and clearing house members contribute to a guarantee fund
- The margin is set to be sufficiently high that exchange is unlikely to lose money if it has to close out a trader
- This combined with the guaranty fund means that traders are subject to virtually no credit risk

Alternatives for Clearing OTC Trades



- Bilaterally
  - Usually Involves an ISDA Master Agreement
  - Transactions between two participants netted
  - May require collateral to be posted
- Through CCPs
  - CCP behaves like an exchange clearinghouse and stands between two sides
  - It required initial and variation margin
  - All transactions with CCP netted

Regulatory Changes for OTC Derivatives (page 95)



- Standard OTC derivatives in the U.S. must be traded on electronic platforms known as SEFs. (In Europe the electronic platforms are referred to as organized trading facilities, OTFs)
- Standard derivatives traded between financial institutions must be cleared through CCPs
- Non-standard derivatives traded between financial institutions can be cleared bilaterally but more collateral than before has to be posted
- Trades have to be reported to a central trade repository

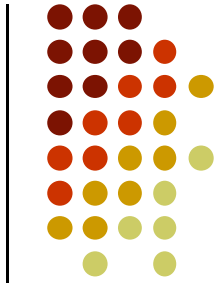
Short Selling (Pages 96-97)

- Short selling involves selling securities you do not own
- Your broker borrows the securities from another client and sells them in the market in the usual way
- At some stage you must buy the securities back so they can be replaced in the account of the client

Short Selling (continued)

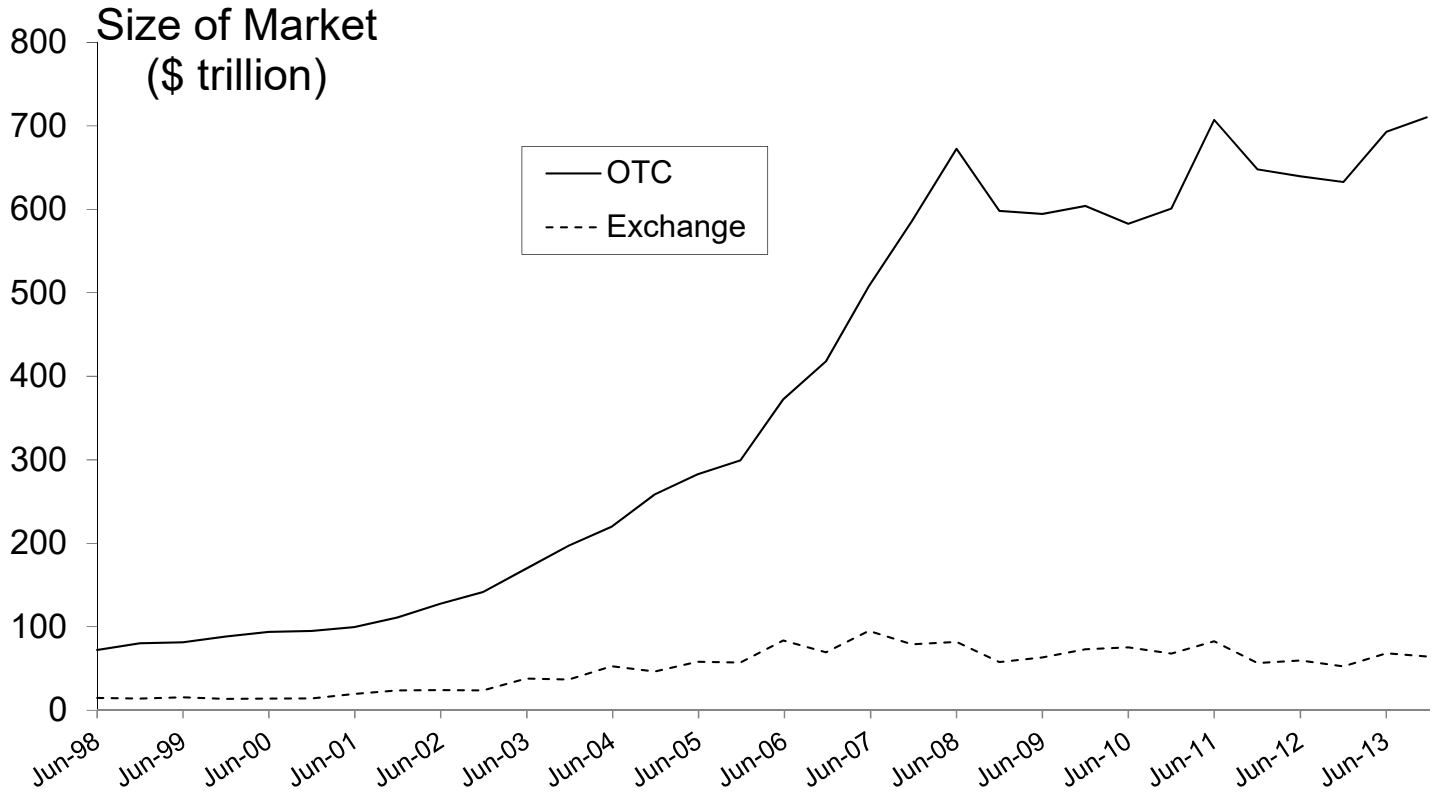
- You must pay dividends and other benefits the owner of the securities receives
- The cash flows from a short position that is entered into at time T_1 and closed out at time T_2 are the opposite of those from a long position where asset is bought at time T_1 and sold at time T_2, except that there may be a small fee for borrowing the asset

Derivatives



- Forwards
- Futures
- Swaps
- Options
- Exotics

Growth of Derivatives Markets
(Figure 5.1)



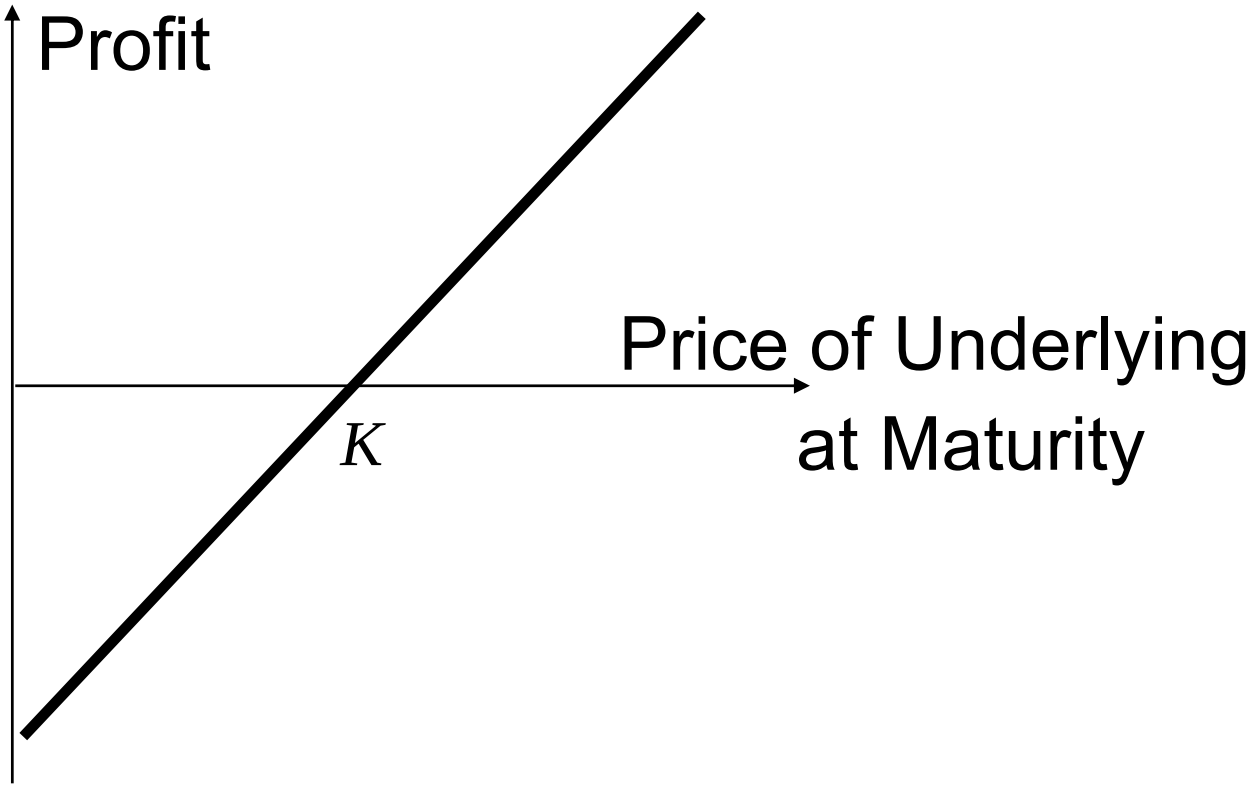
Forward Contracts

- A forward contract is an agreement to buy or sell an asset at a certain price at a certain future time
- Forward contracts trade in the over-the-counter market
- They are particularly popular on currencies and interest rates

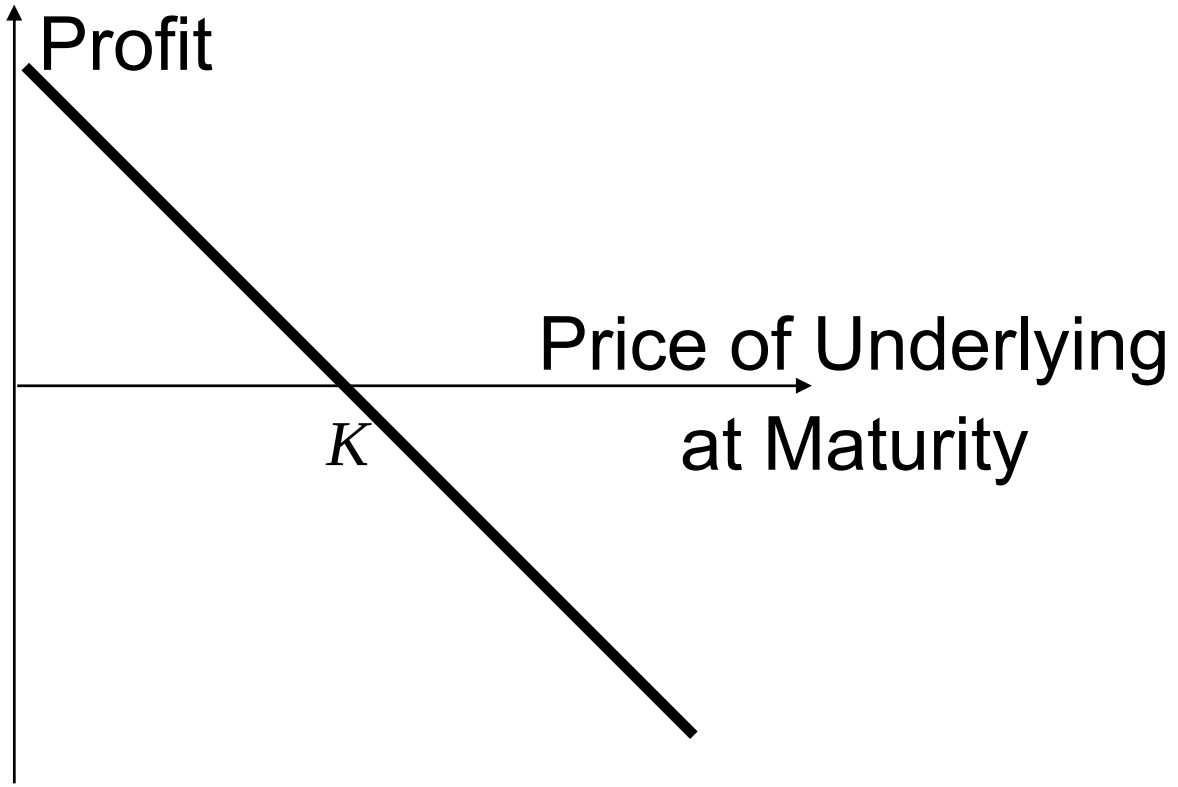
Foreign Exchange Quotes for GBP June 17, 2014 (See page 99)

	Bid	Offer
Spot	1.6961	1.6965
1-month forward	1.6957	1.6962
3-month forward	1.6950	1.6955
1-year forward	1.6919	1.6925

Profit from a Long Forward Position



Profit from a Short Forward Position



Futures Contracts (page 100-101)

- Agreement to buy or sell an asset for a certain price at a certain time
- Similar to forward contract
- Whereas a forward contract is traded OTC, a futures contract is traded on an exchange

Futures Contract continued

- Contracts are settled daily (e.g., if a contract is on 200 ounces of December gold and the December futures moves $2 in my favor, I receive $400; if it moves $2 against me I pay $400)
- Both sides to a futures contract are required to post margin (cash or marketable securities) with the exchange clearinghouse. This ensures that they will honor their commitments under the contract.

Swaps

A swap is an agreement to exchange cash flows at specified future times according to certain specified rules

An Example of a "Plain Vanilla" Interest Rate Swap

- An agreement to receive 6-month LIBOR & pay a fixed rate of 5% per annum every 6 months for 3 years on a notional principal of $100 million
- Next slide illustrates cash flows

Cash Flows for one set of LIBOR rates

(See Table 5.4, page 104)

		---------Millions of Dollars---------		
Date	LIBOR Rate	*FLOATING* Cash Flow	*FIXED* Cash Flow	Net Cash Flow
Mar.5, 2010	4.2%			
Sept. 5, 2010	4.8%	+2.10	–2.50	–0.40
Mar.5, 2011	5.3%	+2.40	–2.50	–0.10
Sept. 5, 2011	5.5%	+2.65	–2.50	+0.15
Mar.5, 2012	5.6%	+2.75	–2.50	+0.25
Sept. 5, 2012	5.9%	+2.80	–2.50	+0.30
Mar.5, 2013	6.4%	+2.95	–2.50	+0.45

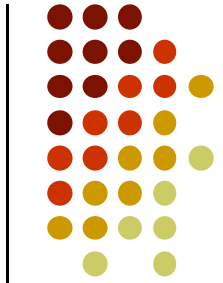
Typical Uses of an Interest Rate Swap

- Converting a liability from
  - fixed rate to floating rate
  - floating rate to fixed rate

- Converting an investment from
  - fixed rate to floating rate
  - floating rate to fixed rate

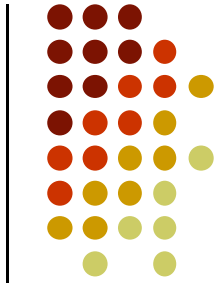
Quotes By a Swap Market Maker

(Table 5.5, page 105)

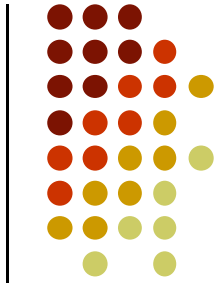


Maturity	Bid (%)	Offer (%)	Swap Rate (%)
2 years	6.03	6.06	6.045
3 years	6.21	6.24	6.225
4 years	6.35	6.39	6.370
5 years	6.47	6.51	6.490
7 years	6.65	6.68	6.665
10 years	6.83	6.87	6.850

Other Types of Swaps sand Related Instruments



Floating-for-floating interest rate swaps, amortizing swaps, step up swaps, forward swaps, constant maturity swaps, compounding swaps, LIBOR-in-arrears swaps, accrual swaps, diff swaps, cross currency interest rate swaps, equity swaps, extendable swaps, puttable swaps, swaptions, commodity swaps, volatility swaps…….



Options

- A call option is an option to buy a certain asset by a certain date for a certain price (the strike price)
- A put option is an option to sell a certain asset by a certain date for a certain price (the strike price)
- Options trade on both exchanges and in the OTC market

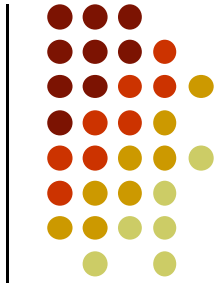
American vs European Options

- An American option can be exercised at any time during its life
- A European option can be exercised only at maturity

Intel Option Prices: June 17, 2014; Stock Price=29.97 (See Table 5.6; page 106)

Strike Price	Aug14 Call	Oct14 Call	Jan15 Call	Aug14 Put	Oct14 Put	Jan15 Put
18	2.30	2.45	2.80	0.30	0.66	1.13
19	1.45	1.76	2.17	0.60	0.99	1.53
20	0.84	1.20	1.62	1.04	1.43	2.04
21	0.41	0.82	1.22	1.60	2.02	2.64

Options vs Futures/Forwards



- A futures/forward contract gives the holder the obligation to buy or sell at a certain price
- An option gives the holder the right to buy or sell at a certain price

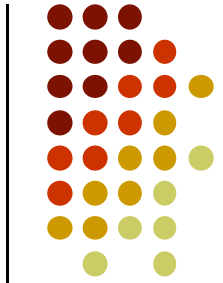
Hedging Examples

- A US company will pay £10 million for imports from Britain in 3 months and decides to hedge using a long position in a forward contract
- An investor owns 1,000 shares currently worth $28 per share. A two-month put with a strike price of $27.50 costs $1. The investor decides to hedge by buying 10 contracts

Options vs Forwards

- Forward contracts lock in a price for a future transaction
- Options provide insurance. They limit the downside risk while not giving up the upside potential
- For this reason options are more attractive to many corporate treasurers than forward contracts

Interest Rate Options

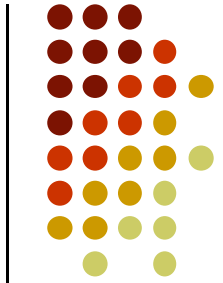


- Caps and floors
- Swap options
- Bond options

Nontraditional Derivatives (pages 108-112)

- Weather derivatives
- Energy derivatives
  - Oil
  - Natural gas
  - Electricity

Exotic Options (pages 112-114)

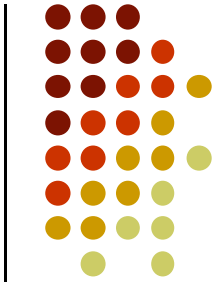


- Asian options
- Barrier option
- Basket options
- Binary options
- Compound options
- Lookback options

Example of the Use of Exotic Options (Business Snapshot 5.3, page 113)

- If a company earns revenue month by month in many different currencies, Asian basket put options can provide an appropriate hedge

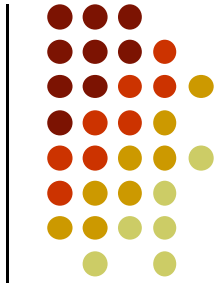
Structured Products



- Products created to meet the needs of clients
- A bizarre structures product is the “10/30” deal between Bankers Trust and Procter and Gamble (See Business Snapshot 5.4)
- The payments by P&G were

$$\max\left[0, \frac{98.5\left(\frac{\text{5 yr CMT \%}}{5.78\%}\right) - \text{30 yr TSY price}}{100}\right]$$

Types of Traders

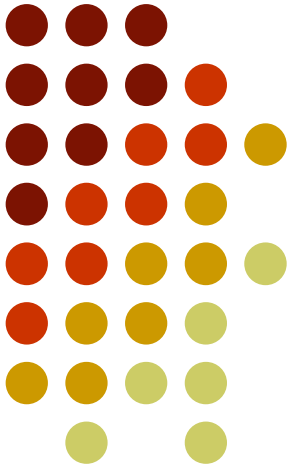


- Hedgers
- Speculators
- Arbitrageurs

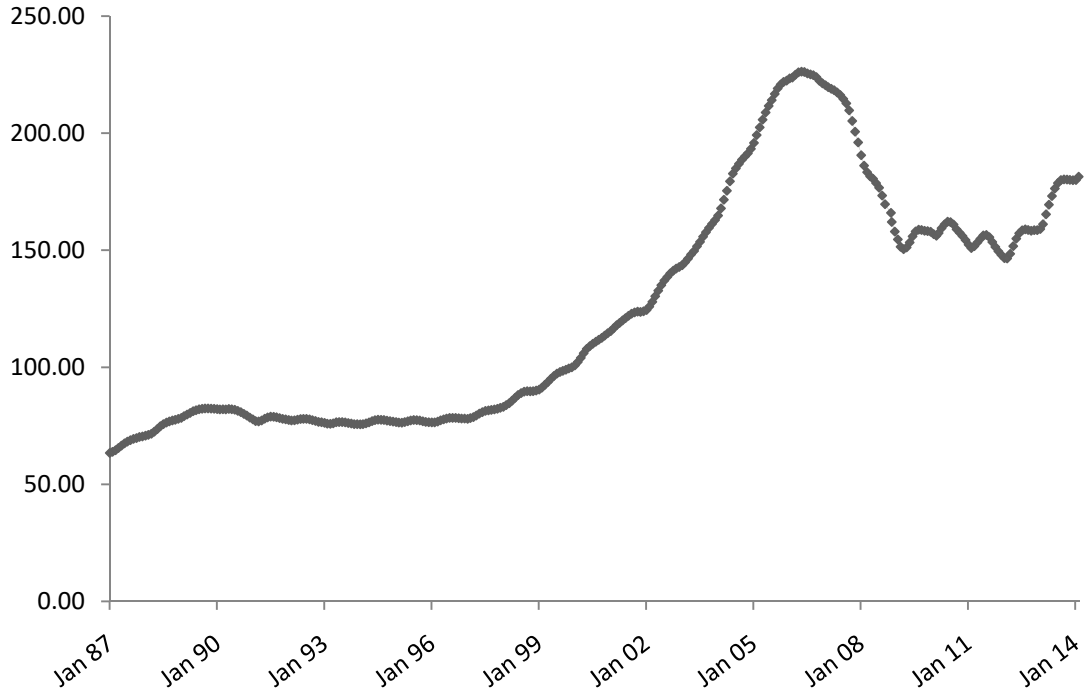
Some of the largest trading losses in derivatives have occurred because individuals who had a mandate to be hedgers or arbitrageurs switched to being speculators (See for example SocGen, Business Snapshot 5.5, page 115)

The Credit Crisis of 2007

Chapter 6



U.S. Real Estate Prices, 1987 to 2014:
S&P/Case-Shiller Composite-10 Index



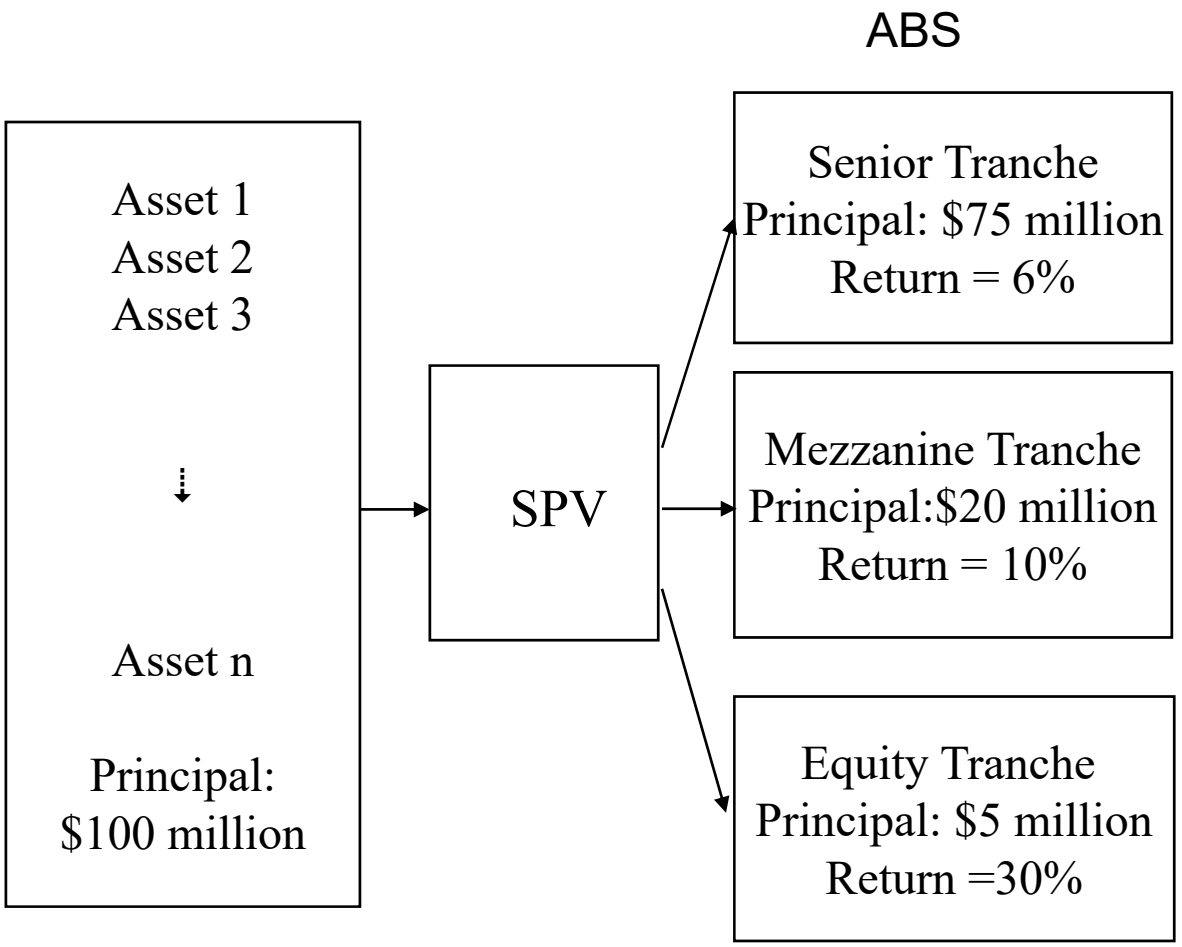
What happened…

- Starting in 2000, mortgage originators in the US relaxed their lending standards and created large numbers of subprime first mortgages.
- This, combined with very low interest rates, increased the demand for real estate and prices rose.
- To continue to attract first time buyers and keep prices increasing they relaxed lending standards further
- Features of the market: 100% mortgages, ARMs, teaser rates, NINJAs, liar loans, non-recourse borrowing

What happened...

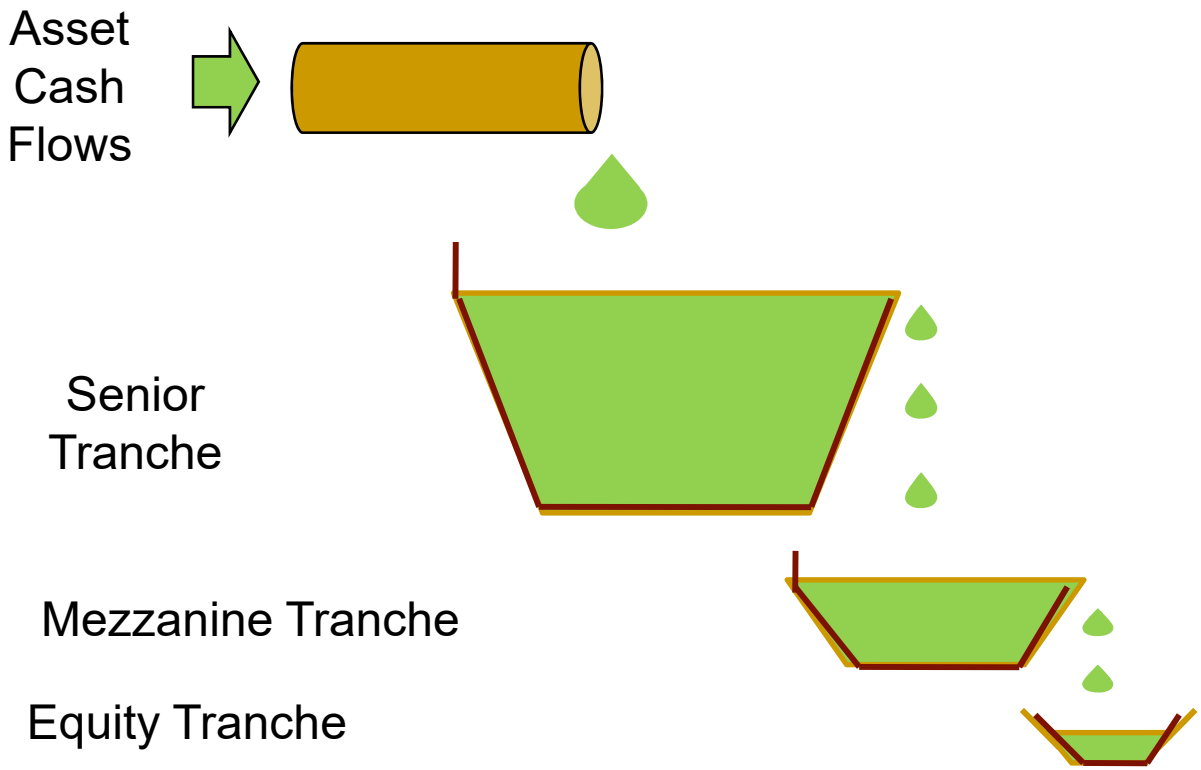
- Mortgages were packaged in financial products and sold to investors
- Banks found it profitable to invest in the AAA rated tranches because the promised return was significantly higher than the cost of funds and capital requirements were low
- In 2007 the bubble burst. Some borrowers could not afford their payments when the teaser rates ended. Others had negative equity and recognized that it was optimal for them to exercise their put options.
- U.S. real estate prices fell and products, created from the mortgages, that were previously thought to be safe began to be viewed as risky
- There was a "flight to quality" and credit spreads increased to very high levels

Asset Backed Security (Simplified)

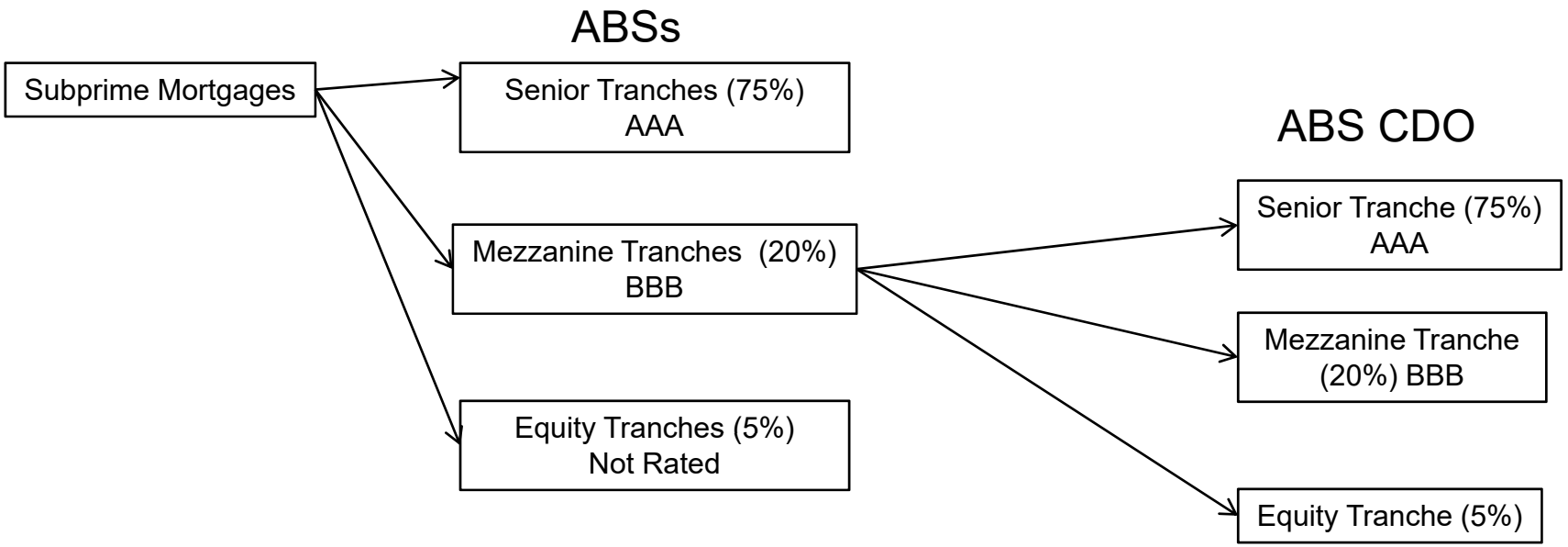


A "waterfall" defines the precise rules for allocating cash flows to tranches

The Waterfall



ABS CDOs or Mezz CDOs (Simplified)

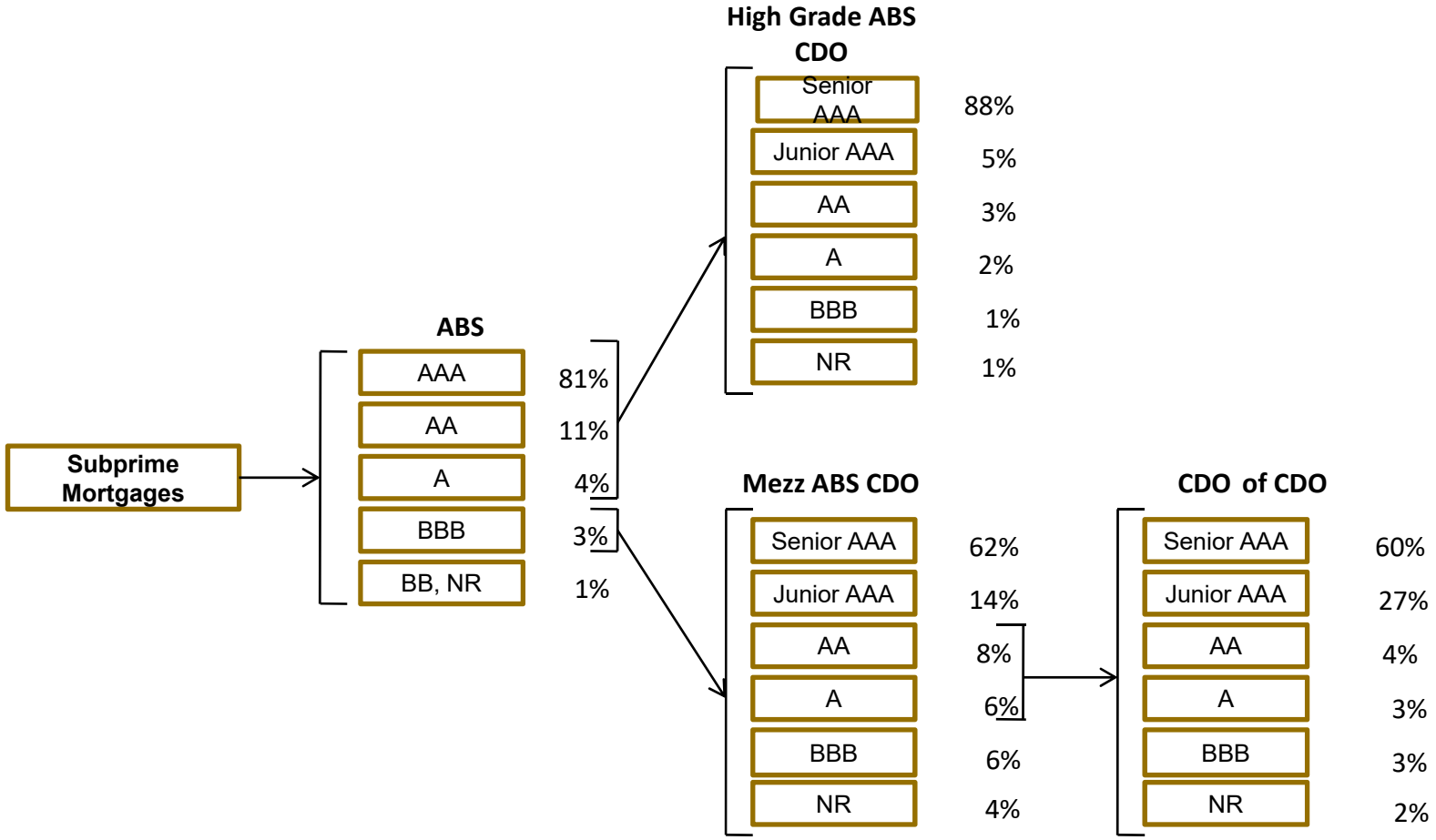


How much of the original portfolio of subprime mortgages is AAA?

Losses to AAA Tranche of ABS CDO (Table 6.1)

Losses on Subprime portfolios	Losses on Mezzanine Tranche of ABS	Losses on Equity Tranche of ABS CDO	Losses on Mezzanine Tranche of ABS CDO	Losses on Senior Tranche of ABS CDO
10%	25%	100%	100%	0%
15%	50%	100%	100%	33.3%
20%	75%	100%	100%	66.7%
25%	100%	100%	100%	100%

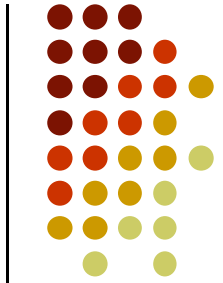
A More Realistic Structure
(Figure 6.5)



BBB Tranches

- BBB tranches of ABSs were often quite thin (1% wide)
- This means that they have a quite different loss distribution from BBB bonds and should not be treated as equivalent to BBB bonds
- They tend to be either safe or completely wiped out (cliff risk)
- What does this mean for the tranches of the Mezz ABS CDO?

Regulatory Arbitrage



- Capital required for securities created from a portfolio of mortgages was considerably less than capital that would be required if mortgages had been kept on the balance sheet

Role of Incentives

- Arguably the incentives of valuers, the creators of ABSs and ABS CDOs, and rating agencies helped to create the crisis
- Compensation plans of traders created short-term horizons for decision making

Importance of Transparency

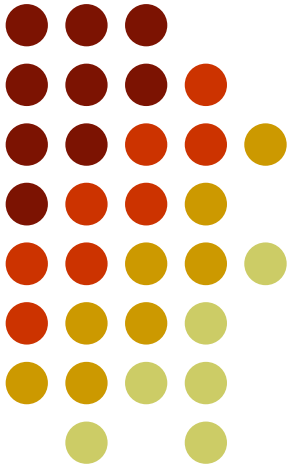
- ABSs and ABS CDOs were complex inter-related products
- Once the AAA rated tranches were perceived as risky they became very difficult to trade because investors realized they did not understand the risks
- Other credit related products with simpler structures (eg, credit default swaps) continued to trade during the crisis.

Lessons from the Crisis (page 133-134)

- Beware irrational exuberance
- Do not underestimate default correlations in stressed markets
- Recovery rate depends on default rate
- Compensation structures did not create the right incentives
- If a deal seems too good to be true (eg, a AAA earning LIBOR plus 100 bp) it probably is
- Do not rely on ratings
- Transparency is important in financial markets
- Resecuritization was a badly flawed idea

Valuation and Scenario Analysis: The Risk-Neutral and Real Worlds

Chapter 7



Valuation vs. Scenario Analysis

- In valuation, we are interested in the present value of future cash flows
- In scenario analysis, we are interested in the range of situations that might exist at a future time

Example (page 137)

- One-year European call option on a stock worthy $50 with a strike price of $55
- The value might be calculated as $4.5 and it might be sold for $5
- But a scenario analysis might show there is a 5% chance of the stock price rising above $80
- This would cost the seller about $20

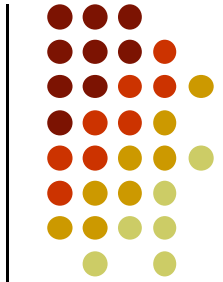
Volatility and Asset Prices

- If the average return from an asset is μ and its volatility is σ then the most popular model (known as geometric Brownian) motion gives

$$\ln S_T \approx \phi\left[\ln S_0 + (\mu - \sigma^2/2)T,\ \sigma^2 T\right]$$

where S_T is the stock price at time T and $\phi(m,v)$ is a normal distribution with mean m and variance v.

Probability of Extreme Values



$$\text{Prob}(S_T > V) = N(d_2)$$
$$\text{Prob}(S_T < V) = N(-d_2)$$

where

$$d_2 = \frac{\ln(S_0/V) + (\mu - \sigma^2/2)T}{\sigma\sqrt{T}}$$

and $N(x)$ is the probability that a variable with a standard normal distribution will be less than x

$$\text{Prob}(S_T > V) = q \text{ when } V = S_0 \exp\left[(\mu - \sigma^2/2)T - N^{-1}(q)\sigma\sqrt{T}\right]$$
$$\text{Prob}(S_T < V) = q \text{ when } V = S_0 \exp\left[(\mu - \sigma^2/2)T + N^{-1}(q)\sigma\sqrt{T}\right]$$

Risk-Neutral Valuation (pages 139-143)

- In a risk-neutral world investors do not require an extra expected return for bearing risks
- If when valuing derivatives we assume that the world is risk-neutral, we get the right valuation for the real world (where investors do require an extra return for bearing risks) as well as for the risk-neutral world

Applying Risk-Neutral Valuation to Value a European Stock Option

1. Assume that the expected return from the stock is the risk-free rate
2. Calculate the expected payoff from the option
3. Discount at the risk-free rate

Valuing a Forward Contract with Risk-Neutral Valuation

- Payoff is $S_T - K$
- Expected payoff in a risk-neutral world is $S_0 e^{rT} - K$
- Present value of expected payoff is

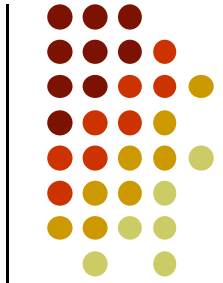
$$e^{-rT}[S_0 e^{rT} - K] = S_0 - Ke^{-rT}$$

Valuing a Binary Option with Risk-Neutral Valuation

- Consider a binary option that pays off \$100 if the stock price at time T is greater than V
- The value of the binary option is $100e^{-rT}N(d_2)$ where r is the risk-free rate (assumed constant) and $N(d_2)$ is the probability that the stock price is greater than V in a risk-neutral world

$$d_2 = \frac{\ln(S_0/V) + (r - \sigma^2/2)T}{\sigma\sqrt{T}}$$

Black-Scholes-Merton



$$c = e^{-rT}\hat{E}\left[\max\left(S_T - K, 0\right)\right]$$

$$p = e^{-rT}\hat{E}\left[\max\left(K - S_T, 0\right)\right]$$

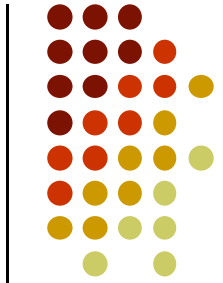
where c is the value of a European call option, p is the value of a European put option, K is the strike price and $\hat{E}$ denotes expected value in a risk-neutral world

Discrete Future Outcomes (pages 142-143)

- Suppose that a variable can take n different values
- Define π_i as the value of a derivative that pays off \$1 if the ith outcome occurs
- When applying risk-neutral valuation we set the risk-neutral probability of the ith outcome equal to

$$\frac{\pi_i}{\sum_{j=1}^{n} \pi_j}$$

Default Probabilities



- Risk-neutral default probabilities can be implied from bond prices or credit spreads.
- They are greater than real-world default probabilities

Girsanov's Theorem (page 144)

- For valuation we work in the risk-neutral world
- For scenario analysis we work in the real world
- Girsanov's theorem shows that when we move from one world to the other expected returns change but volatilities stay the same

Why Both the Real and Risk-Neutral Worlds Can Be Relevant for Scenario Analysis

- In a scenario analysis we should
  - Randomly sample paths followed by market variables out to the time horizon
  - Value the portfolio using risk-neutral valuation at the time horizon for each sample

Monte Carlo Simulation (page 145)

- For a variable with a constant expected return, μ, and a constant volatility, σ

$$\ln S_{t+\Delta t} = \ln S_t + \left(\mu - \sigma^2/2\right)\Delta t + \varepsilon\sigma\sqrt{\Delta t}$$

  where ε is a random sample from a standard normal distribution

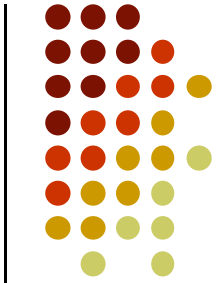
- This means

$$S_{t+\Delta t} = S_t \exp\left[\left(\mu - \sigma^2/2\right)\Delta t + \varepsilon\sigma\sqrt{\Delta t}\right]$$

Mean Reversion

- Interest rate, volatilities, and some commodity prices follow mean reverting processes where they are pulled back to a long run average value
- Superimposed on the pull is a random change

Determining Real World Processes



- To determine real world processes from risk-neutral processes for a variable we can use CAPM to adjust the expected return
- If σ is the volatility of the variable, σ_M is the volatility of an index of market returns market, ρ is the correlation between percentage changes in the variable and percentage changes in the market index, then we should increase the expected return by $\lambda\sigma$ where

$$\lambda = \frac{\rho}{\sigma_M} \times \text{Excess of market return over risk - free rate}$$

Example

- If a commodity is uncorrelated with the return on a market index its expected return should be the same in both worlds
- But if $\rho = 0.3$, $\sigma = 40\%$, $\sigma_M = 20\%$, and the excess return of the market over the risk-free rate is 6%, then $\lambda = 0.09$ and the expected return should be 3.6% higher in the real world than the risk-neutral world