投資學Investment

Chapter 1 Investment Environment

Assets

▼ Real Assets

Assets used to produce goods and services

- Contribute directly to the ability of the economy to produce goods and services
- Generate income for the economy
- Examples: land, nature resource, machines

▼ Financial Assets

Claims profit (return) generated by real assets

- Profit and risks are translated to the investors
- Contibute indirectly to the ability of the economy to produce goods and service
- Examples: stocks, bonds(債券), treasuries(基金)

Types of Financial Assets

▼ Fixed Income Securities

Claims fixed dollar: Bonds, Treasuries

If the cash flow is greater than fixed dollars, the bond holders only claim fixed dollars; but when the cash flow is less than fixed dollars, the bond holders only claim the ammount of cash flow

- Equity Securities (股票)

  Residual claims to income (paid off last): Stock

  If the cash flow is greater than fixed dollars, the equity holders get paid by cash flow - fixed dollars, so it can become inf if the cash flow is big; but if the cash flow is less than fixed dollars equity holders don't get anything

- Derivative Securites

  Claims based on the price of other real or financial assets: Options(選擇權), Futures(期貨)

  A **futures contract** is an agreement between two parties to buy or sell an asset at a certain time in the future at a certain price. Here the buyer is **obliged** to buy the asset on the specified future date

  A **options contract** gives the buyer the right to by the asset at a fixed price. However there is **no obligation** on the part of the buyer to go through with the purchase. Nevertheless, when the buyer choose to buy the asset, the seller is **obliged** to sell it.

p.s. On a Balance sheet for cash and cash equlivalents should not be affected by the market

Players in the Financial System

- Households(散戶)

  Typically net savers (Investors). But some households are borrowers (mortgage 抵押)

- Firms

  Net borrowers, raise capital to pay for projects

- Government

  Typically net borrowers, but can become net savers by having tax income greater than government expense

▼ Financial Intermediates

Pools and invest funds: institutions that connect borrowers and lenders

- Investment bankers: Firms that specializes in primary market transactions (IPO)
- Banks
- Insurance companies

Sell Side-Invesment Bankers

- Serve as intermediaries between issuers of securities (證券發行人) and the investing public
- Primary brokerage (主經銷商) service: cash management, securities lending (證券借貸), etc.
- Equity analysts who perform research, set ratings and price targets
- Advice firms on M&A activity (併購)

Buy Side

- Manage large portions of securities for money-managment purposes

▼ Types of Asset Managers Firms

Hedge Funds (對沖基金)

Mutual Funds & ETF Firms (共同基金和 ETF 公司)

Pension Funds (退休基金)

Insurance Companies (保險公司)

Endowments (捐贈基金)

Private Equity (私人產權)

Chapter 2 Asset Classes and Financial Instruments

Stock Indexes

A measure of performance for a specific market

Construction of Indexes

- ▼ Price-weighted average

  Computed by adding prices of stocks and dividing by divisor (Dow Jones Industial Average)

- ▼ Market value-weighted index

  Individual components of the index are included in amounts that correspond to their total market (S&P 500, NASDAQ)

- ▼ Equally weighted index

  Computed from single average of return (Value Line Index)

Chapter 3 Securities Markets

SPAC

SPAC (**特殊目的收購公司)**, SPAC是空殼公司或空白支票公司，它們沒有業務但是上市的目的是與SPAC首次公開募股的收益合併或收購公司。

Markets

- ▼ Direct Search Market

  Buyer and seller must find each other (菜市場)

- ▼ Brokered Market

  A third party assists in locating a buyer or seller (real estate market)

- ▼ Dealer Market

  Dealers purchase these assets for their own accounts, and later sell them for a profit from their inventory (bond, foreign exchange trade market, NASDAQ)

- ▼ Auction Market

A market where traders meet at one place to buy or sell an asset (NYSE, 紐約證交所)

Orders

- ▼ Market order: Execute immediately at best price

  Bid Price, in dealers markets, the bid price is the price at which the dealeris willing to buy

  Ask Price, in dealers markets, the asked price is the price at which the dealer is willing to sell

- ▼ Price-contingent order

  Limit buy/sell order, specifies price at which investor will buy/sell

  Stop Orders, not to be executed until price point hit

Margin Trading (保證金交易)

Definition: Securities purchased with money borrowed in part from broker (uses leverage)

Purpose: Provides investors with easy access to debt financing in purchasing stocks

Mechanics:

- Investor borrows part of the purchase price from a broker ⇒ stocks become the collateral (擔保品) for the loan
- Investor contributes the remaining portion, Margin refers to the percentage or amount contributed by the investor

Requirements:

- Initial Margin Requirement (IMR): Minimum set by Federal Reserve under Regulation T, currently **50%** for stocks ⇒ 1-IMR = The maximum % amount investor can borrow
- Maintenance Margin Requirement (MMR): The minimum amount of equity that must be maintained in a margin account

Margin Call:

1. If Margin ≤ MMR, then the margin call occurs (Margin = Equity in Account/Value of Stock)

2. Notification from broker that investors must put up additional funds or have position liquidated(平倉)
3. If investor doesn't act, the broker may sell securities from the account to payoff enough of the loan to restore the percentage margin to an acceptable level

Pros: Investors can achieve greater upside potential

Cons: Investors are exposed to greater downside risk

Short Sales

Definition: A market transaction in which an investor sells borrowed securities in anticipation of a price decline and is required to return an equal number of shares at some point in the future

Purpose: To profit from a decline in the price of a stock or security

Mechanism:

1. Borrow stock through a broker
   a. A broker lend shares from it's clients account
   b. Naked short selling is illegal
2. Sell it and deposit proceeds in an account with the broker, Margin = (total cash - stock value)/stock value
3. Buy the stock and return to the party from which it was borrowed (covering the short position)

Margin requirements: Under regulation T, it requires all short sales account to have 150% of the value of the short sale at the time the sale is initiated

Payoff

- Long position: Buying stocks

  Stock price

  1. Goes up ⇒ profit can be inf
  2. Stays ⇒ profit = 0
  3. Goes down ⇒ profit = -100% (the worst situation)

Payoff: [-100%, inf]

- Short position: Selling stocks

  Stock price

  1. Goes up ⇒ profit can be -inf
  2. Stays ⇒ profit = -dividends
  3. Goes down ⇒ profit = Sold stock price

  Payoff: [-inf, 100%]

Chapter 4 Mutual Funds, Investment Companies

Net Asset Value (NAV) for investment companies:

NAV = (Market Value of Assets - Liabilities)/Shares Outstanding (流通股，指一間公司在公開市場上所有流通的股數)

Types of Investment Companies

- Unit investment trusts

  The portfolios of unit investment trusts are essentially fixed and thus called “unmanaged”

- Managed Investment Companies

  Managed companies are so named because securities in their investment portfolios continually are bought and sold, “The portfolios are managed”

  - Closed-end funds

    基金的發行期完結、或規模達預期目標後，便不會接受投資者認購或贖回，而基金的發行單位亦是固定的。

    When investors in closed-end funds wish to cash out their shares, they sell them to the market with market price

  - Open-end funds (Mutual Funds)

不設有固定的發行單位，投資者可隨時按照個人的需要，在每一個交易日內根據公開的基金淨值來認購或贖回基金單位。

When investors in open-end funds wish to cash out their shares, they sell them back to the fund at NAV

	# of shares	Redeem (贖回)	Price when redeem	Holding Cash
Closed-end funds	Fixed	Cannot	Market price	No Need
Open-end funds	Changeable	Can	NAV	Need

- Hedge Funds (對沖基金)

  For private investors to pool assets to be invested by a fund manager

  - Lock-up period

    Many hedge fund require investors to initially lock-up , that is, periods as long as several years in which investments can’t be withdrawn

  - Light regulation

    Their managers can persue investment strategies involving heavy use of derivatives (衍伸品), short sales (賣空), leverage (槓桿), which are not open to mutual fund managers

Mutual Funds

- Money Market Fund (MMF)

  Funds invest in money market securities such as commercial paper, repurchase agreements, or certificates of deposit

- Equity Funds
  - Income Funds (high-dividend)
  - Growth Funds (capital gains)
  - Sector Funds (specific industries)
  - Regional Funds (China, BRIC, ...)
- Bond Funds

- Balanced Funds

  Equity (stock) + Fixed Income (bond)

- Index Funds

  Mimic the performance of a broad market

Cost of Investing in Mutual Funds

- Operating expense: Cost occured in operating the portfolio (0.2-2%)
- Types of Loads (sales charge)
  - Front-end load: paid when you purchase the shares (0-6%)
  - Back-end load: exit fee (start from 5-6%, reduce 1% each year)
- 12 b-1 Charges: distribution cost (銷售成本) (limited to 1% of avg. NAV per year)

Exchange Traded Funds (ETFs)

Definition: Financial instruments that allows investors to trade index portfolios like shares of stock

Potential advantages:

1. Trade continuously all day (Mutual funds NAV is quoted only once a day)
2. Can short sell or purchase on margin
3. Lower costs (no 12b1)
4. Lower expense (don’t have to maintain records for share holders)

Chapter 5 Portfolio Theory and Practice

Holding Period Return (HPR)

= [(Ending price - Beginning price) + Dividend during period] / Beginning price

Expected Return (E) = Sumation (possibility*Return)

Risk

The variance of the rate of return is a measure of volatility

Volatility is reflected in deviations of actual returns from the mean return

Var(x) = sigma(x)^2 = E[x-E(x)]^2 = Sumation(possibility*Return)^2

Standard Deviation Estimation

Because wo don't know all the future states of the world and the accompanying returns, we estimate variances and standard deviations using samples we have

- Sample Mean: Sumation(Return)/T
- Sample Variance: (T/(T-1))*(1/T)*Sumation(Return,t - avg Return)^2, T-1 is to make the sample unbiased
- Sample Standard Deviation: sqrt(Sample Variance)

Compared Return

Comparing the return, divide it with a same period of time isn't totally fair, so we compare it with Compounding, (1+EAR)^(1/total years) EAR=Effective Annual Return

Example:

Jake invested in Microsoft over 8 years and earned a 250% return

Jenny invested in Nike over 20 years and earned a 400% return

Jordan invested in Tesla over 6 months and earned a 15% return

If the return is converted to same time frame (Arithmetic Average)

Jake: 250/8=31.25%

Jenny: 400/20=20%

Jordan: 15*2=30%

If compounding is considered (Geometic Average)

Jake: (1+2.5)^(1/8)-1=16.95%

Jenny: (1+4)^(1/20)-1=8.38%

Jordan: (1+0.15)^2-1=32.25%

Distribution

Normal Distribution: Typically portfolio returns follow normal distribution

Binomial Distribution(二項分布)

Lognormal Distribution: Compounded returns converges to a lognormal ditribution

Normality and Risk Measures

What if excess returns aren’t normally distributed?

We use

- Skewness: A measure of asymmetry = Average[(Return-avg Return)^3/STD^3]

  Positive skewed distribution (Right-skewed): Has a long right tail

  Negative skewed distribution (left-skewed): Has a long left tail

- Kurtosis: A measure of the degree of fat tails = Average[(Return-avg Return)^4/STD^4]-3

  Because Kurtosis will have a fat tail, so the Return near mean will be over-estimated, far from mean will be under-estimated

- Sharpe Ratio: A kind of measure of portfolio performance = Risk premium(風險溢價)/SD of excess return

Measures from Down-side Risk

Value of Risk (VaR): quantile of a distribution ⇒ best of worst case

- Loss corresponding to a very low percentile of the entire return distribution, such as the fith or first percentile return

Conditional Tail Expectation (CTE): expectation of the values below VaR ⇒ average of worst cases

Chapter 6 Capital Allocation to Risky Assets

Risk Aversion (風險避免)

- Excess Return (risk premium): return earned in excess of the risk free rate (T-Bill)
  - Excess Return = return - risk free return

- Tells you how much better you are doing than if you had invested in something with a certain return, but the asset with the higher return would always be considered better

- Price of Risk: the ratio of portfolio risk premium to variance
    - Price of Risk = (E[Return] - risk free return)/SD^2

      Tells us how much excess return is required to invest in a security with riskiness SD^2

- Sharpe Ratio: the ratio of the portfolio risk premium to variance
    - Price of Risk = (E[Return] - risk free return)/SD

      Methods of ranking in terms of risk and return

Utility Function (Measurement of Satisfication)

U = E(r) - A*Var^2/2

E(r): Expected Return on the asset or portfolio, A: coefficient of risk aversion, Var: Variance of return

E(Rc) = y*E(Rp) + (1-y)*E(Rf)   SD(C) = y*SD(P)

E(Rc): Expected return of portfolio, y: proportion invested in risky asset, E(Rp): Expected return of risky asset, E(Rf): Expected return of risk free asset

We can find the maximum Utility by differentiate U and set it to zero, then the Y will be the optimal portfolio for us.

Capital Allocation Line (CAL)

Plot of risk-return combinations (E(Rc) = y*E(Rp) + (1-y)*E(Rf)) availible by varying portfolio allocation between a risk-free asset and a risky asset

Let E(Rc) be Y-variable, E(Rf) be Y-intercept, [E(Rp)-E(Rf)]/SD(P) be slope which equals Sharpe Ratio, SD(C) be X-variable ⇒ CAL ⇒ E(Rc) = E(Rf) + [E(Rp)-E(Rf)]/SD(P)*SD(C)

In reality, Borrowing rate tends to be higher than lending rate, so when y>1, the slope becomes [E(Rp)-E(Rb)]/SD(P), which E(Rb)>E(Rf)

Chapter 7 Optimal Risky Portfolio

Diversification

Investment strategy designed to reduce risk by spreading the portfolio across many securities/stock

p.s. always useful unless stocks perfectly move together (corr=1)

Co-Movement (Covariance, Correlation)

Covariance: expected value of the product of the deviations from the mean for two variables

Cov(Ri, Rj) = E[[Ri-E(Ri)]*[Rj-E(Rj)]] = Sumation(P(s)*[Ri-E(Ri)]*[Rj-E(Rj)]) = SDij

Correlation: covariance divided by SD of the two variables [-1,1]

Corr(Ri, Rj) = Cov(Ri, Rj)/sqrt(VaR(Ri)*VaR(Rj))

Chapter 9 Capital Asset Pricing Model (CAPM)

Basic assumption for CAPM

- Markowitz assumptions (Mean-Variance optimization)
- A single period horizon
- Common risk-free rate: All investors may borrow or lend on equal terms
- Homogeneity of investor expectation: All inverstors have same info. about the distribution of returns in terms of mean, variance, covariance (But htey can have diff. risk aversion.
- Demand of assets equals supply in equlibrium
- No market friction (no tax, no transaction cost)

Market Portfolio

Market Portfolio, M: The market portfolio is the portfolio of all risky assets traded in the market.

Supose there are n total assets:

Asset i's market capitalization: MKCAPi = Pricei*Shares outstanding

Total market capitalization: MKCAPm = sum(MKCAPi)

When Market Equilibrium, all investors' optimal risky portfolio will be the same, which is M.

What if the weight for stock i in Portfolio is greater than M, then there is a demand for stock i, hence the price of stock i will increase until the weight is restored.

CAPM

$$\beta = \frac{Cov(r_i, r_m)}{Var(r_m)} = \frac{\sigma_{i,m}}{\sigma_m^2} = \frac{\sigma_i}{\sigma_m} \times \frac{\sigma_{i,m}}{\sigma_i \sigma_m}$$

$$E(r_i) = r_f + \beta_i \left[E(r_m) - r_f \right]$$

- Multiply w_i on both sides, and then sum up across all i's

$$\sum_{i=1}^{n} w_i E(r_i) = \sum_{i=1}^{n} w_i r_f + \sum_{i=1}^{n} w_i \beta_i \left[E(r_m) - r_f \right]$$

$$E(r_m) = r_f + \sum_{i=1}^{n} w_i \beta_i \left[E(r_m) - r_f \right]$$

E(rm) = market return

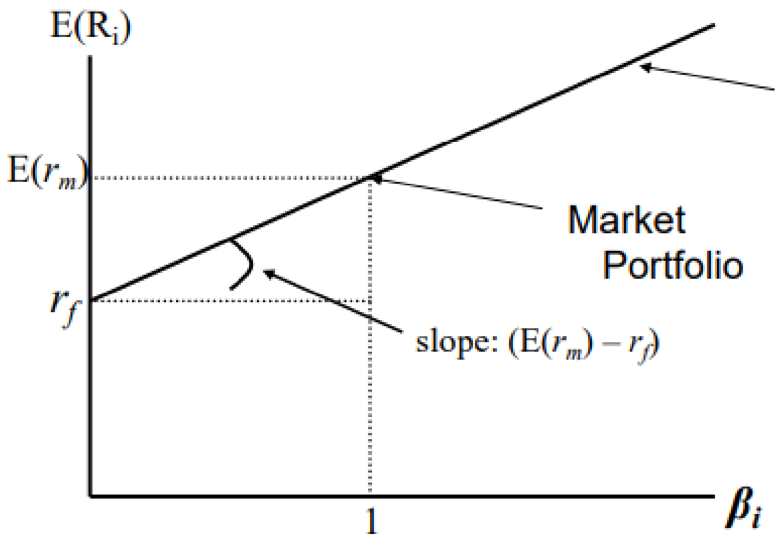
$$\Rightarrow \beta_m = \sum_{i=1}^{n} w_i \beta_i = 1$$ => Weighted average of betas across all stocks

$\beta_i > 1$ => aggressive

$\beta_i < 1$ => defensive

Ex: Beta=2, If the market is up(down), you will expect to be up(down) twice as much

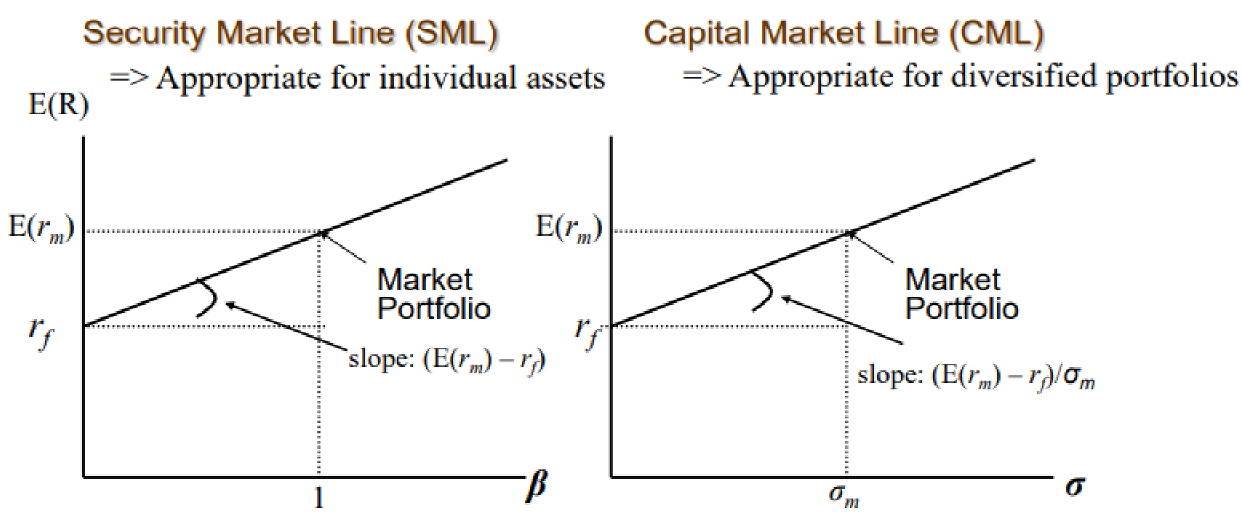
Security Market Line (SML)

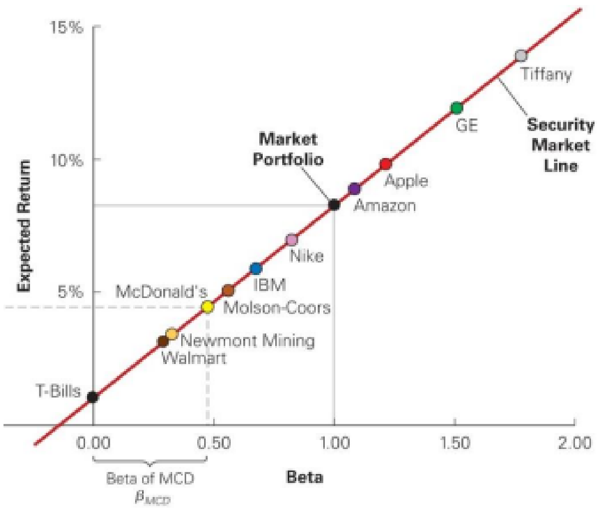


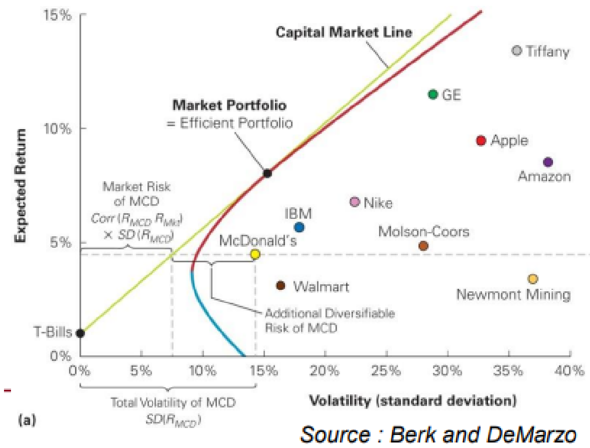
SML shows the expected return-beta relationship.

Compare Security Market Line(SML) with Capital Market Line(CML)

SML	Appropriate for individual assets	slope: E(rm)-rf
CML	Appropriate for diversified portfolios	slope: (E(rm)-rf)/varm







Source : Berk and DeMarzo

Single Index Model

$$r_i = \alpha_i + \beta_i r_M + e_i$$

An index model is a statistical model of security returns. An oppose to equilibrium-based model(Ex:CAPM)

Index model specifies two source of uncertainty for a security's return:

1. Market wide component:

   systematic or macroeconomic uncertainty, such as changes in interest rate, cost of labor, that causes the systematic risk that affects the returns of all stocks,

2. Firm specific component:

   unique microeconomic uncertainty, such as death of certain people or the lowering of firm's credit rating, etc...

$$\begin{aligned} r_i - r_f &= \alpha_i - (1-\beta_i) r_f - \beta_i r_f + \beta_i r_m + \varepsilon_i \\ &= \alpha_i - (1-\beta_i) r_f + \beta_i (r_m - r_f) + \varepsilon_i \end{aligned}$$

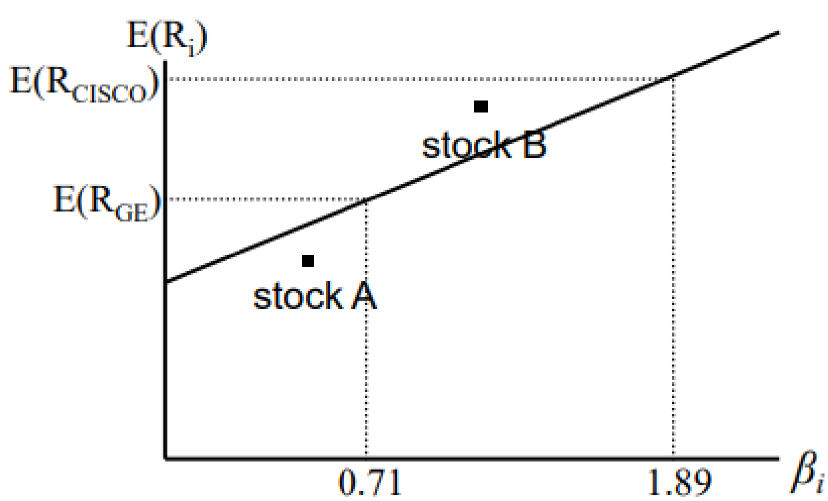
$$E(r_i - r_f) = E[\alpha_i^{Excess} + \beta_i(r_m - r_f) + \varepsilon_i]$$
$$= \alpha_i^{Excess} + \beta_i E(r_m - r_f) + E(\varepsilon_i)$$

CAPM implies that alpha Excess = 0

In the CAPM model there is nothing such as overpricing or underpricing, each asset is correctly priced, and it is positioned on the SML.

Ex: If the market return is expected to be 14%, a stock has a beta of 1.2 and the T-bill rate is 6%, the SML would predict and expected return rate ⇒ (6+1.2*(14-6))% = 15.6% And if one believe the stock would provide an expected return of 17%, this implies that the alpha would be 1.4%

In the graph of SML, if a stock is above SML ,then the price is UNDERPRICED since it has a higher expected return to its price, so the price should be higher to lower the expected return. And if a stock is under SML, then the price is OVERPRICED since it has a lower expected return to its price, so the price should be lower to greater the expected return.



In this graph, stock A is below SML, so stock A is overpriced, and stock B is above SML, so stock B is underpriced.

If beta in CAPM is zero, it is called zero-beta CAPM, and that indicates the asset or portfolio is risk free.

However does CAPM really exist? ⇒ YES!!!

1. Expected return is linear and increases with beta
2. Expected return is not affected by nonsystematic risk
3. But zero alphas does not work for all stocks

Summary of CAPM

- CAPM provides a simple pricing model
- CAPM determines risk-return trade-off
  - Invest only in risk-free asset and the market portfolio
  - Beta measures systematic risk
  - Required rate of return is proportional to beta
- CAPM is controversial
  - It is difficult to test (difficult to identify the market portfolio)
  - Empirical evidence is mixed

Chapter 10 Arbitrage Pricing Theory and Multifactor Models of Risk and Return

Single-factor Models

$$r_i = E(r_i) + \beta_i F + e_i$$

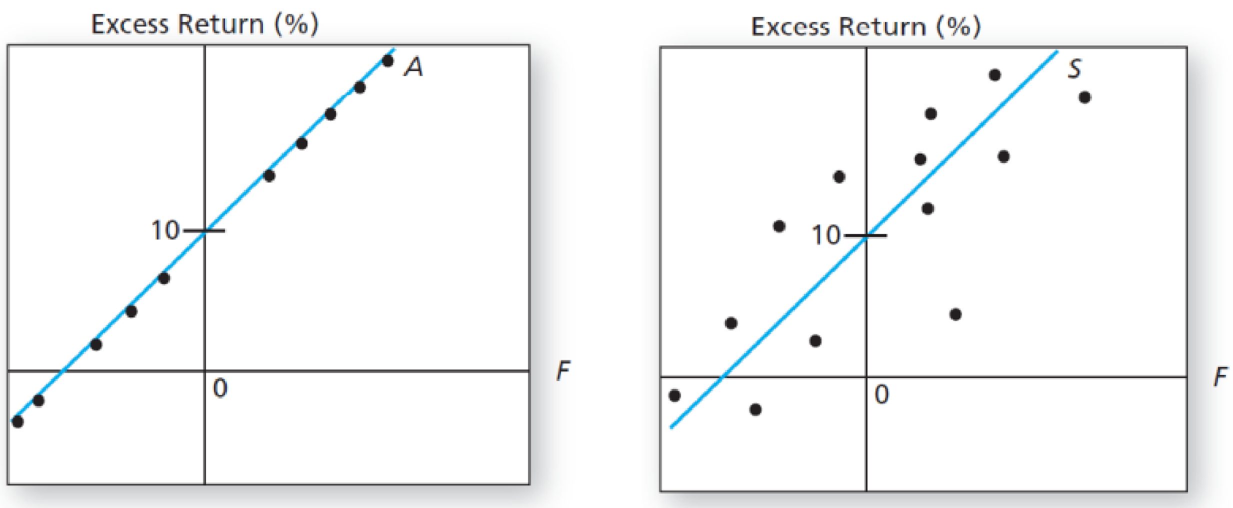
- F is the deviation of the common factor from its expected value

  E(F)=0: The common factor is constructed to have zero expected value
- Beta is the sensitivity of firm i to that factor
- e is the firm-specific disturbance

The actual return of firm i will equal its initially expected return + random amount attributable to unanticipated macroeconomic events + random amount attributable to firm-specific events.

Ex: Suppose the macro factor F is measured by GDP, and the beta is 1.2. If the GDP is assumed to increases by 4%, but it only increased 3%, then the value of F will be -1%, representing the stock would have a 1.2% = -1% * 1.2 lower than previously expected.

For a well-diversified portfolio, it will have multiple stocks, and if all the stocks are equally weighted, then the nonsystematic variance would be zero, which means the return will be ⇒ ri = E(ri)+beta*F



A

B

Well-diversified portfolio, all points hold on the line

Undiversified portfolio, all points scatter around the line, the vertical distance between the line and the points are their individual firm-specific disturbance

Multifactor Models

A two-factor model

$$r_i = E(r_i) + \beta_{iGDP}GDP + \beta_{iIR}IR + e_i$$

- Suppose the two most important macroeconomic sources of risk are uncertainties by unanticipated growth in GDP and changes in interest rates(*IR*).

Advantage of multifactor models:

Since not every stock is sensitive to the same thing, such as an electric-power utility v.s. an airline.

Because the demand of eletricity in residential is not very sensitive to business cycle, the beta will have a low beta on GDP, but the utility's stock price might have a relatively high sensitivity to interest rate, since the cash flow generated by the utility is relatively stable, it present much like a bond, varying with interest rates.

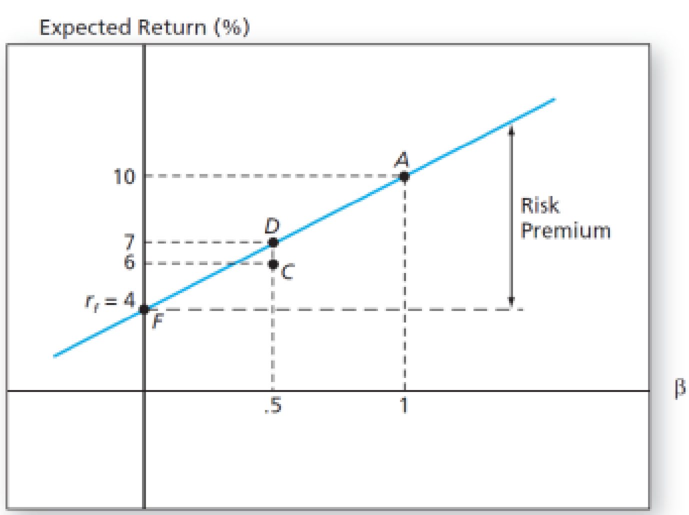
For an airline, the performance is very sensitive to economic activities than to interset rate, so it will have a higher beta on GDP than interest rate.

Arbitrage Pricing Theory (APT)

Three key propositions(主張)

1. Security returns can be described by a factor model
2. There are sufficient securities to diversify away idiosyncratic(特殊的) risk
3. Well-functioning security markets do not allow for the persistance of arbitrage opportunities

If we observe a violation of the law, arbitrage activity will simutaneously buy the assets where it is cheap and sell where it is expensive, during this progress, the price will bid up in where it is low and force it down at where it is high, till the arbitrage opportunity is eliminated.



In this graph, we can make portfolio D by having 0.5*A+0.5*F, then their is an arbitriage opportunity, since portfolio D and portfolio C shares the same beta, their expected return must be the same, but it is not. And we can see from the chart, portfolio C has a lower expected return, that means portfolio C has a higher price, so we can keep selling portfolio C and by portfolio D with no risk, till their expected return goes the same.

11. Suppose that the market can be described by the following three sources of systematic risk with associated risk premiums.

Factor	Risk Premium
Industrial production (*I*)	6%
Interest rates (*R*)	2
Consumer confidence (*C*)	4

The return on a particular stock is generated according to the following equation:

$$r = 15\% + 1.0I + .5R + .75C + e$$

Find the equilibrium rate of return on this stock using the APT. The T-bill rate is 6%. Is the stock over- or underpriced? Explain.

From APT, we can know that the expected rate of return E(r)= 6% + 1*6% + 0.5*2% + 0.75*4%= 16% According to the equation, actual rate of return E(r) = 15%, since the expected return of all factors are zero by definition. Because the expected rate of return (16%) is greater than the actual rate of return (15%) , so we know that the stock is overpriced.

APT v.s. CAPM

Advantages

1. No assumptions about investor preference/belief (CAPM assumes risk aversion)
2. Can be easily extended to multifactor models
3. No assumptions about empirical distribution of security returns
4. No special role of the market portfolio

Disadvantages

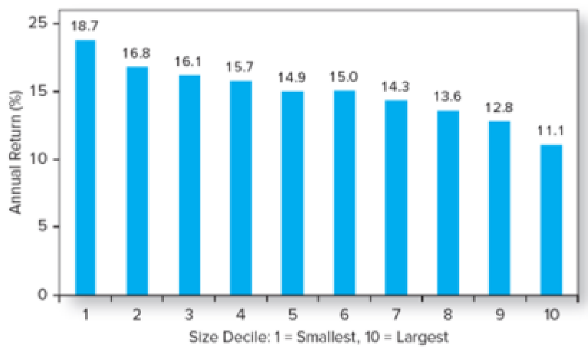
1. Little guidance for the economic content factors (GDP, interest rate, etc...)

2. There is no guidance for appropriate numbers of factor

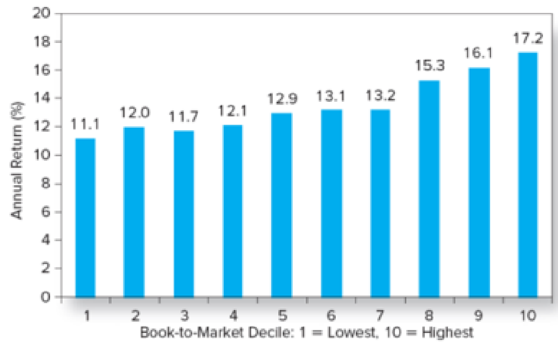
APT is based on the factor model of returns and arbitrage

CAPM is based on the investors' portfolio demand and equilibrium

Fama-French 3 Factor Model



Average annual return for 10 size-based portfolios



Average return as a function of book-to-market ratio

From the graph, we can see that small stocks (low ratio of market-to-book value) have outperformed large stocks (high ratio of market-to-book value) [book value: 帳面價值]

This explains why smaller firms and firms with high book market experience higher returns, and may be more sensitive to financial distress or business cycle.

Chapter 11 Efficient Market Hypothesis (EMH)

Key Idea:

- In well functioning capital markets. it is difficult to detect misvaluation of security
- Once information becomes available. market perticipants analyze it
- Profit opportunities quickly vanish

⇒ Makes active strategy NOT USEFUL

Price changes follows a random walk, so that the price is unpredictable. If prices are determined rationally, then only new information will cause them to change.

Efficient Market Hypothesis

- Weak-form efficiency

  Stock prices reflect all information contained in the history of past trading data

  The weak-form hypothesis holds that if such data ever conveyed reliable signals about future performance, all investors already would have learned to exploit the signal.

  This is the least strict version of market efficiency

- Semistrong-form efficiency

  Stock prices reflects all publicaly available information regarding the prospects of a firm

  The price of the stock can not be predicted based on the public information

  This is a moderate version of market efficiency

- Strong-form efficiency

  Stock price reflect all information. including information available only to company insiders

  Insider trading, investors with private informations could profit at the expense of other investors, so it is regulated by the SEC

  This is the most strict version of market efficiency

Weak-form efficiency < Semistrong-form efficiency < Strong-form efficiency

Ex: The monthly rate of return on T-bill is 1%. The market went up this month by 1.5%, which has a equity beta of 2. In addition, the firm won a lawsuit that awards $1 million. What is the rate of return this month?

Based on broad market trends, the CAPM indicates the stock should have increased by: $1.0\% + 2.0 \times (1.5\% - 1.0\%) = 2.0\%$

Implications

- Technical Analysis: Using prices and volume infornation to predict future prices.

  ⇒ Ineffective under Weak-form EMH

- Fundamental Analysis: Using economic and accounting information to predict stock price.

⇒ Ineffective under Semistrong-form EMH

This indicates that PASSIVE STRATEGY (Buy and Hold, Index Fund) is efficient.

Evidence shows that average mutual funds (actively managed) performance is generally less than broad market performance

Evidence Against Market Efficiency

Over intermediate horizon (3 to 12 months), stock prices exhibits a “momentum”, which good performance keeps outperform bad performance.

Over long horizon (3 to 5 years), stock prices exhibit a “reversal effect” property in which past loser rebound to become winners.

Chapter 12 Behavioral Finance

Investor Irrationality

Inverstors do not always process information correctly and therefore infer incorrect probability distributions about future rates of returns ⇒ Error in Information Processing

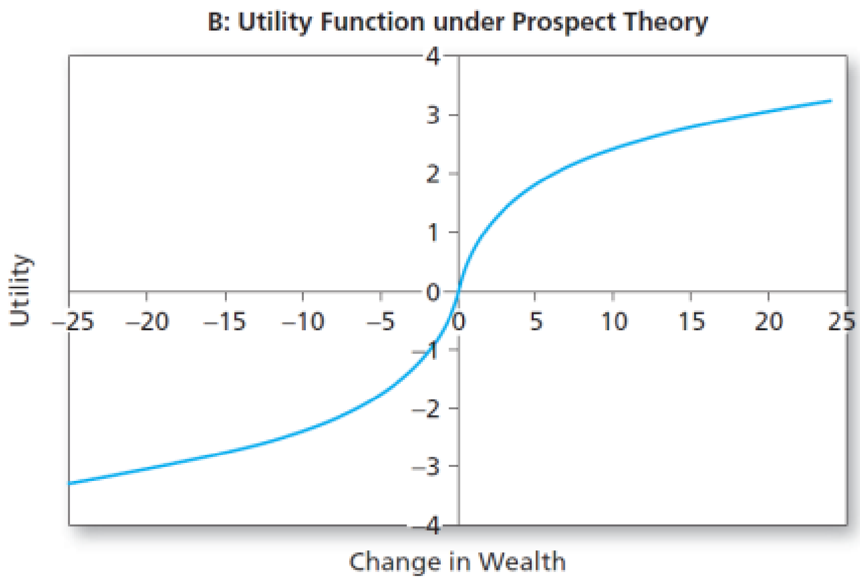
- Forcasting Errors: Too much weight to recent experience.
- Overconfidence: People tend to overestimate the prediction or belief, and tend to overestimate their abilities.
- Conservatism: Investors are too slow (too conservative) in updating their beliefs in response to new evidence.
- Representativeness: Infer information from small samples as if from a population.

Given a probability distribution of returns, they often make inconsistent or systematically suboptimal decisions ⇒ Behavior Bias

- Mental accounting: Investors keep different accounts for each asset in their minds.
- Regret Avoidance: Have more regret when decision was more unconventional
- Disposition Effect: The tendancy of investors to sell assets that have increased in value, while keeping assets that have dropped in value. (Reluctant to realize losses)

Prospect Theory

Higher wealth provides higher satisfaction, but at a dimishing rate (A gain of $1000 increases utlity by less than a loss of $1000)



Limits to Arbitrage

Several factors limit the ability to profit from the mispricing

1. Fundamental Risk: Investment opportunities (undervalue stocks) are hardly risk-free
2. Implementation Cost: Restrictions on short sales
3. Model Risk: The valuation model could be wrong

Chapter 14 Bond Prices & Yields

Bond Basics

A debt security

- A claim on a specific periodic stream of income
- Often called fixed-income securities because they promise either a fixed stream of income or one that is determined according to a specified formula

Bond indenture (契約): The contract between the issuer and the bondholder

- Coupon rate: Determines the interest payment

- Par value (equivalently, face value): When the bond matures, the issuer repays the debt by paying the bond's par value
- Maturity date

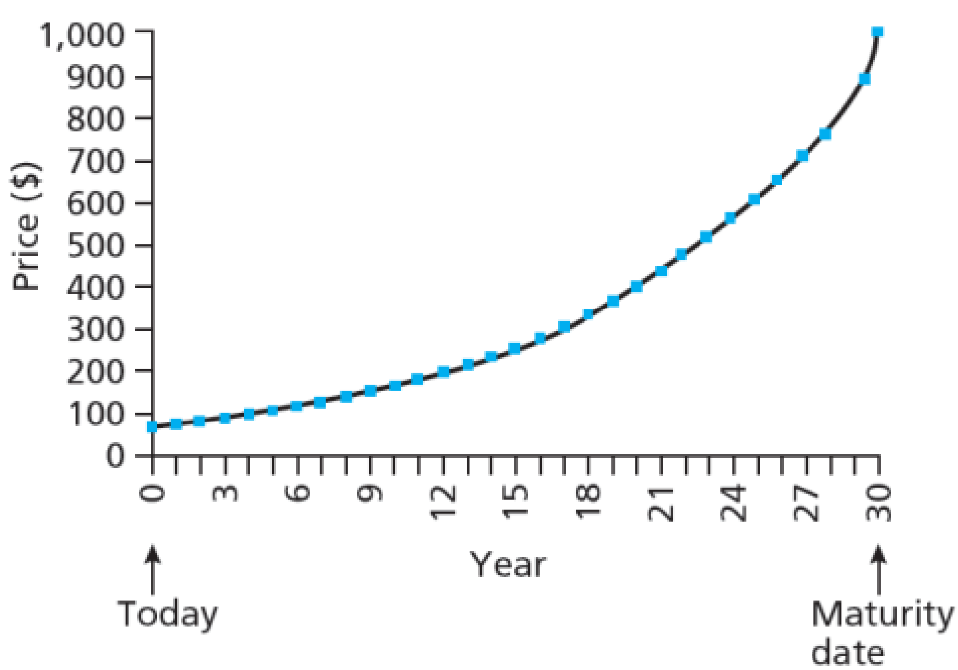
Payment

- Interest payments are made each period
- No principle (Face value) is paid until the maturity date

The interest payment is known as the coupon

- Expressed as a percentage of the face value
- 8% coupon bond with a $1000 face value would pay $80/year
- Coupon payments typically paid annually or semi-annually
- Zero-coupon bond only pays face value at maturity

  To illustrate, consider a zero coupon with 30 years intil maturity, and suppose the market interest rate is 10% per year, when n=0, the price of the bond is $1000/(1.1)^30 = $57.31, the next year n=1, the price of the bond is $1000/(1.1)^29 = $63.04



Main Features of Bonds

1. Issuer:

   US Treasury/Goverment, States, Agencies, Corporations

2. Term:

   Short (less than 1 yr): T-bills, Commercial papers

   Long (more than 1 yr): T-bonds, Corporate bonds, Consols

3. Price v.s. Par value:

   Par bond: Face value ($1000)

   Discount bond: Bonds selling below par value

   When a coupon is paid, the price drop will be larger than the price increases between coupons, the bond premium will tend to decline as time pass.

   Premium bond: Bonds selling above par value

   When a coupon is paid, the price increase between coupons will exceed the drop, so the bond price will rise and its discount will decline as time pass.

   Ultimately the price of all bonds approach the face value when the bonds mature and their last coupon is paid.

4. Credit risk: Risk free or Defaultable

   Measured by Moody's, Standard & Poor's Corporation, and Fitch Invertors Service

   Providing financial information on firms as well as quality ratings of large corporate and municipal bond issue

   Lower-rated bonds are classified as junk bonds or high-yield bonds

5. Coupon:

   Coupon rate: Total annual interest payment per dollar face value

   Fixed or variable

6. Currency

7. Seniority and security:

8. Covenants

Bond Value

Bond Value = Present Value of Coupons + Present Value of Par Value

$$P_B = \sum_{t=1}^{T} \frac{C}{(1+r)^t} + \frac{\text{Par Value}}{(1+r)^T}$$

PB = Price of Bond

Ct = Interest or coupon payments

T = Number of periods to maturity

r = Market rate of interest, Semi-annual discount rate or the semi-annual yield to maturity

We can calculate this by excel: pv(I, N, PMT, FV)

I = Market rate of interest

N = Numbers of periods to maturity

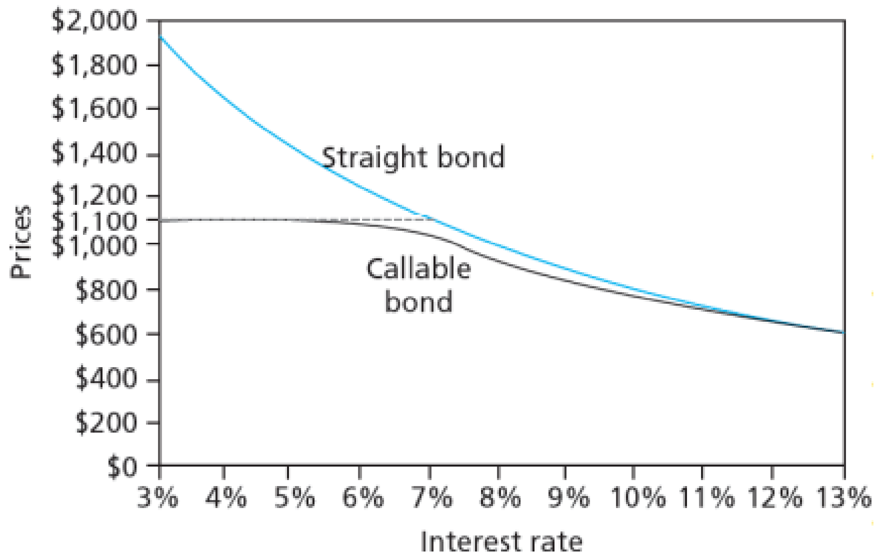
PMT = Coupon payment

FV = Face value

Price and interest rates have an inverse relationship.

Callable Bond

A callable bond is a type of bond that allows the issuer of the bond to retain the privilege of redeeminf the bond at some point before the bond reaches its date of maturity.



Bond Yield

Yeild to maturity: The interest rate that makes the PV of a bond's payments equal to its price

We can calculate this by excel, rate(N, PMT, PV, FV)

N = Numbers of period to maturity

PMT = Coupon payment

PV = Par value = the money you paid for the bond, so it must be below 0

FV = Face value

$$Bond\ Price = \frac{Coupon1}{(1+YTM)} + \frac{Coupon2}{(1+YTM)^2} + \ldots + \frac{CouponN}{(1+YTM)^N} + \frac{Fave\ Value}{(1+YTM)^N}$$

Current Yield: Annual coupon divided by bond price.

Ex: For a 8%, 30-year bond, selling at $1276.76 ⇒ current yield = $80/1276.76 = 0.0627 per year

Summary

Prices fall as market interest rate (yield) rises

Interest rate fluctuations are primary source of bonds market risk

Bonds with longer maturities are more sensitive to fluctuations in market interest rate

Yield to Maturity

- It is the average return if the bond is held to maturity
- Depends on coupon rate, maturity and par value
- All of these are readily observable

Holding Period Return

- It is the rate of return over a particular investment period
- Depends on the bond's price at the end of the holding period, an unknown future value
- Can only be forecasted

Ex: Consider a 30-year bond paying an annual coupon of $80 and selling at par value of $1000. The bond's initial yield to maturity is 8%, if the yield remains over the year, so during the holding period return will also be 8%. Suppose the yield falls, the bond price increases to $1050. Then the holding period return is greater than 8%: Holding period return = ($80 + $1050-$1000)/$1000 = 0.13

Bond Indentures

A bond is issued with an indenture, which is the contract between the issuer and the bondholders. Part of the indenture is a set of restrictions that protect the rights of the bondholders.

- Sinking Funds
    - Bonds call for payment of par value at the end of the bond's life
    - This payment constitutes a large cash commitment for the issuer
    - To ensure the commitment does not create a cash flow crisis, the firm agrees to establish a sinking fund to spread the payment burden over several years
- Subordination clauses
    - Restrict the ammount of additional borrowing

- Additional debt might be subordinated in priority to existing debt, that is in the event of bankruptcy, subordinated or junior debtholders will not be paid unless and until the prior senior debt is fully paid off

- Dividend Restrictions

  Covenants also limit the dividends firm may pay. These limitations protect the bondholders because they force the firm to retain assets rather than paying them out to stockholders

- Collateral (擔保品)

  Some bonds are issued with specific collateral behind them. Collateral is a particular asset that the bondholders receive if the firm defaults on the bond.

Credit Default Swaps (CDS)

CDS is an insurance policy on the default risk of a bond or loan. CDS sellers collects annual payments for the term of the contract, but compensates the buyer for loss of bond value in the event of default.

Chapter 16 Managing Bond Portfolios

Duration

A measure of the interest rate sensitivity of a bond/portfolio, Measures how long it takes, for an investor to be repaid the bond's price by the bond's total cash flow.

We know that long-term bonds are more sensitive than short term bonds ⇒ higher duration of a bond is more price sensitive than bonds with lower duration.

We can then use duration to estimate the price change of a bond when yields change

Macaulay Duration

Simplest form of duration, also called “effective maturity”.

The weighted average of the time until each payment is received, with the weights proportional to the present value of the payment

$$w_t = \frac{CF_t / (1+y)^t}{\text{Price}} \qquad D = \sum_{t=1}^{T} t \times w_t$$

Ex: A bond has a coupon rate of 8%, the yield to maturity is 10%, it is a 3-year bond

Year	Payment	PV	Weight	Year*Weight
1	80	72.727	0.0765	0.0765
2	80	66.116	0.0696	0.1392
3	1080	811.42	0.8539	2.5617
SUM		950.263	1.0000	2.7774

PV = Coupon / (1+YTM)^n, weight = PVi / Price

The duration of this bond is 2.7774 Years.

Ex: A bond is a zero-coupon bond, YTM=10%, 3-year bond

Year	Payment	PV	Weight	Year*Weight
1	0	0.000	0.0000	0.000
2	0	0.000	0.0000	0.000
3	1000	751.315	1.0000	3.000
SUM		751.315	1.0000	3.000

The duration of this bond equals its time to maturity.

When interest rate changes, the proportional change in a bond''s price can be related to the change in its YTM, according to the rule:

$$\frac{\Delta P}{P} = -D \times \left[\frac{\Delta(1+y)}{1+y} \right]$$

Modified Duration

Macaulay's duration can be used to calculated Modified Duration, however modified duration is a flawed measure of price sensitivity for bonds with embedded options

$$Modified\ Duration(D^*) = \frac{Macaulay\ Duration}{1+y}$$

$$\frac{\Delta P}{P} = -D^* \ \Delta y$$

There will be an error if the YTM changes a lot.

Ex: Using the example above, the duration is 2.7774 years, so the Modified Duration of the bond is 2.7774/1.1 = 2.5249. If the YTM on the 3-year 8% bond went from 10% to 11%, we would estimate the percentage price change as (2.5249-2.7774) * (0.11-0.10) = -0.02525, price change = (1-0.2525)*950.263 = $926.269, if we recompute the actual price ⇒ $926.688 (really close)

What Determines Duration?

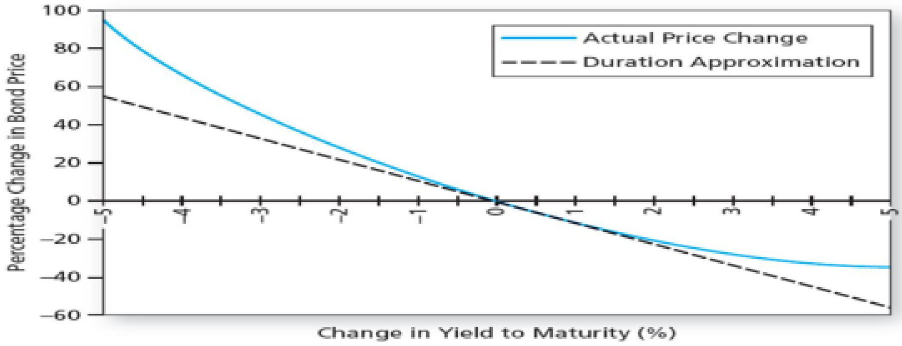
1. The duration of a zero-coupon bond equals its time to maturity.
2. Holding maturity constant, a bond's duration is lower when the coupon rate is higher

   If the coupon rate is higher, the ratio of the PV gets larger and makes the last one lower, that makes the duration lower.
3. Holding the coupon rate constant, a bond's duration generally increases with its time to maturity

   If a bond's YTM increases, its PV decreases, since each PV decreases, the ratio of the last PV gets greater, which makes the duration longer.
4. Holding other factors constant, the duration of a coupon bond is higher when the bond's YTM is lower

Convexity

Duration is a linear approximation for a small change in yields. The duration approximation always understates the value of the bond, it underestimates the increase in bond price when the yield falls, and it overestimates the decline in price when the yield rises.



$$\frac{\Delta P}{P} = -D^{*}\Delta y$$

The approximation can be improved by taking into account the convex nature of the price / yield relationship

$$\frac{\Delta P}{P} = -D * \Delta y + \frac{1}{2}[\text{Convexity} \times (\Delta y)^2]$$

Ex: 30-year maturity, 8% coupon, sells at an initial YTM of 8%. Because the coupon rate = YTM ⇒ the bond sells at par value $1000. The modified duration of the bond at its intitial yield is 11.26 years, and its convexity is 212.4. If the bond's yield increase from 8% to 10%, the bond price will fall to $811.46, a decline of 18.85%

Interest Rate Risk

We want to measure the sensitivity of bond price to interest rate.

Taylor Series Expansion

$$dP = \frac{dP}{dy}dy + \frac{1}{2}\frac{d^2P}{dy^2}(dy)^2 + \text{error}$$

→ Duration + Convexity +error

Duration: The first derivate of the price-yield function

Convexity: The second derivative measures the change in slope

Derive Duration($\frac{dP}{dy}$)

- Approximate dollar price change of the bond for a small change in yield.

$$P = \frac{C_1}{(1+y)} + \frac{C_2}{(1+y)^2} + \ldots + \frac{C_N}{(1+y)^N} + \frac{Fave\ Value}{(1+y)^N}$$

$$\frac{dP}{dy} = -\frac{1}{(1+y)}\left[\frac{1*C_1}{(1+y)} + \frac{2*C_2}{(1+y)^2} + \ldots + \frac{N*C_N}{(1+y)^N} + \frac{N*Fave\ Value}{(1+y)^N}\right]$$

- Percentage price change in a bond for a given change in yield (Dividing by 1/p)

$$\frac{dP}{dy}\frac{1}{P} = -\frac{1}{(1+y)}\left[\frac{1}{P}\left(\frac{1*C_1}{(1+y)} + \frac{2*C_2}{(1+y)^2} + \ldots + \frac{N*C_N}{(1+y)^N} + \frac{N*Fave\ Value}{(1+y)^N}\right)\right]$$

$$\frac{dP}{dy}\frac{1}{P} = -\frac{1}{(1+y)}\left[\frac{1}{P}\frac{C_1}{(1+y)}*1 + \frac{1}{P}\frac{C_2}{(1+y)^2}*2 + \ldots + \frac{1}{P}\frac{C_N}{(1+y)^N}*N + \frac{1}{P}\frac{Fave\ Value}{(1+y)^N}*N\right]$$

$$\rightarrow \frac{dP}{P} = -\frac{dy}{(1+y)} \times Macaulay\ Duration = -\boldsymbol{Macaulay\ Duration(D)} \times \frac{d(1+y)}{(1+y)}$$

$$\rightarrow \frac{dP}{P} = -\boldsymbol{Modified\ Duration(D^*)} \times dy$$

Note) $\boldsymbol{Modified\ Duration(D^*)} = \frac{Macaulay\ Duration}{(1+y)}$

Derive Convexity ($\frac{d^2P}{dy^2}$)

- Duration (The first derivative of the price-yield function)

$$\frac{dP}{dy} = -\frac{1}{(1+y)}\left[\frac{1*C_1}{(1+y)} + \frac{2*C_2}{(1+y)^2} + \ldots + \frac{N*C_N}{(1+y)^N} + \frac{N*Fave\ Value}{(1+y)^N}\right]$$

$$\frac{dP}{dy} = -\left[\frac{1*C_1}{(1+y)^2} + \frac{2*C_2}{(1+y)^3} + \ldots + \frac{N*C_N}{(1+y)^{N+1}} + \frac{N*Fave\ Value}{(1+y)^{N+1}}\right]$$

- The dollar convexity measure of bond (The second derivate of the price-yield function)

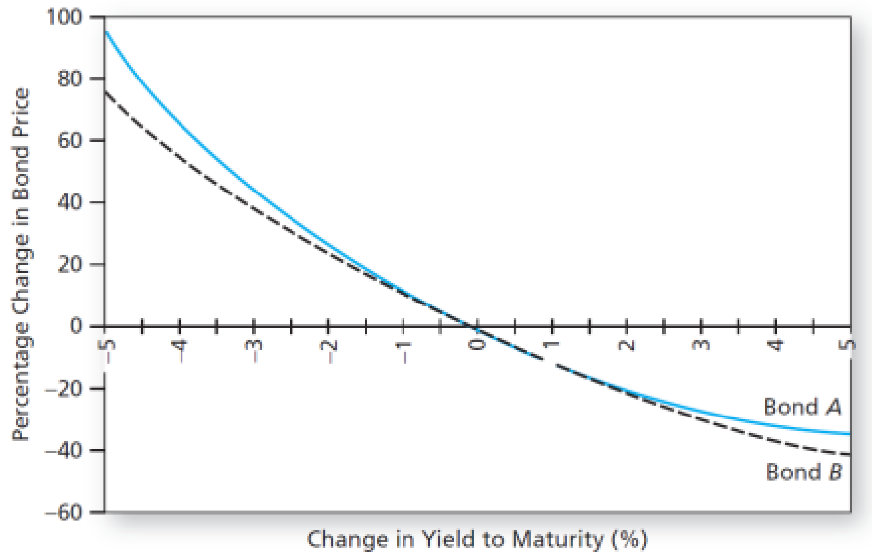
$$\frac{d}{dy}\left(\frac{dP}{dy}\right) = \frac{d}{dy}\left[-\left(\frac{1*C_1}{(1+y)^2} + \frac{2*C_2}{(1+y)^3} + \ldots + \frac{N*C_N}{(1+y)^{N+1}} + \frac{N*Fave\ Value}{(1+y)^{N+1}}\right)\right]$$

$$\frac{d^2P}{dy^2} = \frac{1*2*C_1}{(1+y)^3} + \frac{2*3*C_2}{(1+y)^4} + \ldots + \frac{N*(N+1)*C_N}{(1+y)^{N+2}} + \frac{N*(N+1)*Fave\ Value}{(1+y)^{N+2}})$$

- The percentage convexity measure of a bond

$$\frac{d^2P}{dy^2}\frac{1}{P} = \frac{1}{P}\left[\frac{1*2*C_1}{(1+y)^3} + \frac{2*3*C_2}{(1+y)^4} + \ldots + \frac{N*(N+1)*C_N}{(1+y)^{N+2}} + \frac{N*(N+1)*Fave\ Value}{(1+y)^{N+2}}\right] = \frac{1}{P(1+y)^2}\sum_{t=1}^{N}\frac{C_t}{(1+y)^t}(t^2+t)$$

Bonds with positive convexity means that the price increase for a specific decline in yields exceeds the price decrease for the same rise in yields



From the graph above, we can see that the convexity of bond A is greater than bond B, that makes bond A enjoys greater price increase and smaller price decrease when interest rate fluctuate by larger amounts.

Chapter 18 Equity Valuation

Valuation: If there are mispriced securities, valuation can help identify mispriced securities. And we can access whether a stock is undervalue is to look at its intrinsic (固有的) value (P*) compared to its market price (P). We can measure a securities intrinsic value by examining related economic and financial factors.

Models of Equity Valuation

- Absolute Valuation Model
    - Dividend Discount Model (DDM)
        - No Growth Model:

          Assumption: No growth rate in perpetuity (永久的)

          Appropriate for: Very stable and mature, non-cyclical, dividend-paying firms
        - Gordon Growth Model:

          Assumption: Single growth rate in perpetuity

          Appropriate for: Stable and mature, non-cyclical, dividend-paying firms

        - 2-Stage Growth Model:

          Assumption: Initial high growth rate, constant sustainable long-term growth rate

          Appropriate for: Firms with high current growth rate that will drop to a stable rate in the future

    - Free Cash Flow Model (Discounted Cash Flow Model, FCFE)

      Assumption: Firm's earning growth rates can be estimated

      Appropriate for: Non-dividend paying firms. Firms with uncertain future dividends.

- Relative Valuation Model

Dividend Discount Models (DDM)

Consider simple definition of a return

$$ret = \frac{(price_{t+1} - price_t + div_{t+1})}{price_t}$$

Seperate the top into two pieces

$$ret = \frac{(price_{t+1} + div_{t+1})}{price_t} - \frac{price_t}{price_t} = \frac{(price_{t+1} + div_{t+1})}{price_t} - 1$$

Move 1 to the other side and switch sides for ret+1 and price

$$price_t = \frac{(price_{t+1} + div_{t+1})}{ret + 1}$$

So, tommorow's price should be

$$price_{t+1} = \frac{(price_{t+2} + div_{t+2})}{ret + 1}$$

Put that back into the equation and rearrange

$$price_t = \frac{(div_{t+1})}{ret + 1} + \frac{(price_{t+2} + div_{t+2})}{(ret + 1)^2}$$

If we do this over and over, we will find out the stock's current price is the discounted value of all its future dividends

$$price_t = \frac{(div_{t+1})}{ret + 1} + \frac{(price_{t+2} + div_{t+2})}{(ret + 1)^2}$$

$$price_t = \frac{(div_{t+1})}{ret + 1} + \frac{(div_{t+2})}{(ret + 1)^2} + \frac{(div_{t+3})}{(ret + 1)^3} + \cdots$$

$$= \sum_{t=1}^{\infty} \frac{Div_t}{(1+r)^t}$$

If there is no growth, the dividend

$$= Div_0$$

$$P_0 = \frac{Div}{k}$$

"k" is the discount rate of the stock, typically from CAPM (return).

If there is a constant growth, the dividend

$$= Div_0(1+g)^t$$

$$P_0 = \frac{Div_1}{k-g} = \frac{Div_0(1+g)}{k-g}$$

"k" is the discount rate of the stock, typically from CAPM.

"g" is the constant growth rate.

There are two ways of estimating g (growth rate):

1. Analyst's long-term forcast

   Resort to security analysts who study the prospects for each company

2. ROE * plowback ration

   ROE (Return on Equity) = EPS / Book Equity

   plowback ratio = 1 - payout ratio = 1 - (Div / EPS) (proportion of earnings retained by the firm) ⇒ retention rate = growth rates of Book Equity (BE), earnings, and dividends

If if has non-constant growth, the dividend

$$= Div_0(1+g_1)\,(1+g_2)\,(1+g_3)\ldots$$

Young companies often reinvest money that could be paid to equity holders, because they have many investment opportunities. If a company can persue positive NPV projects that exceed the required rate of return, then it is beneficial for shareholders to have the company retain the earnings to reinvest in the company. In this case, we may see a stock's price rise even if a company does not pay dividends. The reinvestment will make future expected dividends even higher for this company.

Ex: A firm's total asset is 365725000, and its total liabilities are 25857800, the retained earnings are 70400000, ROE is 46.05%, then the growth rate g = ROE * Fraction of Retained earnings, Fraction of Retained earnings = retained earnings / (total asset - total liabilities) = 65.70% ⇒ growth rate g = 0.46 * 0.6570 = 30.22%