Investment Analysis

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Lecture 1 [BMK04, chapters 1-3]

Taxonomy

fixed income:		formula for a stream of income
	money market	short term instruments, low risk T-bill, CD, commercial papers, federal funds
	bond market	long term instruments, default risk is an issue bonds, mortgage-backed securities
equity:		ownership share in the corporation common and preferred stocks
derivatives:		payoff depends on the values of other assets futures, forwards, options, swaps

Links to the real economy

consumption smoothing

allocation of risk

separation of ownership and management

size and capital requirements $\times$ agency problems
stock options as incentives, though...
creative accounting
takeover threat: proxy contest $\times$ competition

Financial markets

competitiveness:	near efficient, hence. . . very few, if any, free lunches
portfolio management:	passive $\times$ active
risk-return tradeoff:	modern portfolio theory risk management diversification
absolute efficiency:	no trade equilibrium

Portfolio management

selection *among* and *within* asset classes

top-down strategy	first, asset allocation
	then, security analysis
bottom-up strategy	first, security analysis
	then, asset allocation

Players

firms:	net borrowers
households:	net savers
government:	borrowers (issuer of bills, notes, and bonds) or lenders depending on tax revenue and government expenditures
financial institutions:	intermediaries investment banks

Market structures

direct search: sporadic trading, low-priced and nonstandard goods

brokered: active trading, economies of scale in search, specialized knowledge
examples: primary market, block trades

dealer: active trading, highly specialized
market making: bid-ask spread
example: secondary OTC market (NASD)

auction: heavy trading (especially if continuous), no search for the best price across dealers, highly integrated
example: secondary exchange market (NYSE)

Recent trends

globalization: efficient communication technology enhances foreign investment opportunities
examples: ADRs, Eurobonds

securitization: *mortgage pass-through securities* aggregate the individual home mortgages into relatively homogeneous pools, and hence funds availability to homebuyers no longer depends on local credit conditions and monopoly powers

Brady bonds securitize bank loans to countries with shaky fiscal condition

Money market instruments

(1) treasury bills

$\longrightarrow$ government issues the bill and, at the maturity, the holder receives a payment equal to its face value

$\longrightarrow$ sales by auction: competitive $\times$ noncompetitive bids

$\longrightarrow$ strong secondary market ensures that the T-bills are highly liquid and that the transaction costs are low

(2) certificates of deposit

$\longrightarrow$ time deposit with a bank that pays interest and principal to the depositor only at the end of the fixed term of the CD

Money market instruments

(3) commercial papers

$\longrightarrow$ large, well-known companies issue their own short-term unsecured debt notes directly to the public rather than borrowing from banks

$\longrightarrow$ sometimes are backed by a bank line of credit so as to provide the firm access to cash if needed to pay off the paper at the maturity

$\longrightarrow$ trades in secondary market, hence high liquidity

$\longrightarrow$ yield depends on the credit ranking and maturity

(4) Eurodollars

$\longrightarrow$ dollar-denominated deposits in banks outside US (not necessarily European)

$\longrightarrow$ most are time deposits with maturity below 6 months

$\longrightarrow$ Eurodollar CD has the advantage (over Eurodollar time deposit) of allowing the holder to sell it before maturity so as to realize its cash value

Money market instruments

(5) repurchase agreements, repos

$\longrightarrow$ short-term borrowing, usually overnight

$\longrightarrow$ government securities serve as collateral

(6) federal funds

$\longrightarrow$ banks with excess Fed funds lend to banks with a shortage at the FF (overnight) rate

$\longrightarrow$ barometer of the US money market

Money market instruments

(7) LIBOR

⟶ overnight rate at which large banks in London are willing to lend money among themselves

⟶ barometer of the European money market

(8) yields on money market instruments

⟶ spread between any money market instrument and the T-bill of the same maturity

Bond market instruments

(1) treasury notes and bonds

$\longrightarrow$ T-notes maturity ranges up to 10 years, whereas T-bonds' are from 10 to 30 years

$\longrightarrow$ even though T-bonds are no longer issued with maturity beyond 10 years, there are still some outstanding

$\longrightarrow$ semiannual interest (coupon) payments

$\longrightarrow$ <u>major difference</u>: T-bonds are callable during a certain period (usually the last 5 years) giving the right to the Treasury to repurchase the bond at par value

Bond market instruments

(2) international bonds

⟶ Eurobonds: bond denominated in a currency other than that of the country of the issuer

⟶ Samurai/Yankee bond: dollar/yen-denominated bond sold in the US/Japan by a non-US/Japanese issuer

(3) corporate bonds

⟶ semiannual coupons, returning the face value at the maturity

⟶ default risk: secured bonds $\times$ debentures

⟶ sometimes with a option (callable or convertible)

(4) mortgage and mortgage-backed securities

$\longrightarrow$ major component of the fixed-income market

$\longrightarrow$ fixed-rate $\times$ adjustable-rate mortgage: interest rate may vary with some measure of the current market interest rate
(e.g., 2% above the one-year T-bill rate)

$\longrightarrow$ mortgage-backed security: ownership claim in a pool of mortgage loans that are traded in the secondary market
(also known as pass-throughs)

Equity securities

(1) common stocks

$\longrightarrow$ represent ownership shares in a corporation that entitle the stockholder to vote on any matter of corporate governance in the annual meeting, hence nonvoting stocks sell for a lower price

$\longrightarrow$ residual claim: last in the line if firm goes chapter 11

$\longrightarrow$ limited liability

$\longrightarrow$ low dividend-yield stocks presumably offer greater prospects of capital gains, otherwise. . .

$\longrightarrow$ P/E ratio: how much stock purchases must pay per dollar of earnings the firm generates for each share

Equity securities

(2) preferred stocks

- ⟶ like bonds, it promises to pay a fixed stream of income each year (perpetuity: infinite maturity)
- ⟶ contractual obligation to pay interest rate on the debt, though...
- ⟶ the firm retains discretion to make the dividend payments to the preferred stockholders (no contractual obligation to pay those dividends)
- ⟶ unpaid dividends cumulate and must be paid on full before any dividend payment to common stockholders
- ⟶ sometimes with a option (redeemable or convertible)

Derivative markets

contingent claims: payoffs depend on the values of other assets, such as commodity prices, bond and stock prices, or market index values

examples : futures
forwards
options: call and put
swaps

major distinction: obligation × right

main purposes: hedging × leverage

Buying on margin

purchasing stocks on margin means that the broker partially finances the investor $\longrightarrow$ *leverage*

the *percentage margin* is the ratio of equity value of the account to the market value of the securities

$$\text{margin} = \frac{\text{equity in account}}{\text{stock value}} = 1 - \frac{\text{broker's loan}}{\text{stock value}}$$

if the stock value falls below the brokers loan, then owners equity becomes negative $\longrightarrow$ *not enough collateral*

solution: if the % margin falls below the *maintenance margin*, then *margin call*

Short Sales

- ⟶ borrowing stocks to sell from the broker in order to profit from a decline in the security's price
- ⟶ the short seller must then purchase the corresponding amount of shares of that same stock so as to cover the short position (and also pay for the dividends, if any)
- ⟶ exchange rules usually permit short sales only when the last recorded stock return is positive in order to prevent waves of speculation against the stock
- ⟶ shares loaned out for the short sale are typically provided by the broker, who holds other investors' portfolio

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Lecture 2 [BMK04, chapter 5]

Rates of return

holding-period return

$$\text{HPR} = \frac{\text{ending price} - \text{beginning price} + \text{cash dividend}}{\text{beginning price}}$$

assumption: dividend payment at the end of the holding period

alternative: if dividends are received earlier, the definition of HPR ignores reinvestment income between the receipt of the dividend and the end of the holding period

multi-period return: geometric average $\times$ arithmetic average

regular cash flows: annual percentage rates $\times$ effective annual rate

Risk and uncertainty

any investment involves some degree of risk (or uncertainty) about future holding-period returns

sources: macroeconomic fluctuations
changing fortunes of various industries
asset-specific unexpected developments

scenario analysis: list of possible outcomes and their likelihood

reward: expected return $\mathbb{E}(r) = \sum_{s=1}^{S} p(s)\, r(s)$

risk: variance? $\sigma^2 = \sum_{s=1}^{S} p(s)\, [r(s) - \mathbb{E}(r)]^2$

Risk aversion

how much of an expected reward one must offer to compensate for the risk involved in investing money in risky assets instead of investing in a risk-free asset

empirical evidence: otherwise no investor would hold stocks!

reward: difference between the expected HPR on the risky asset and the risk-free rate $\longrightarrow$ **risk premium**

risk-free rate: any money market instrument, usually the T-bill
but. . . the T-bill also varies over time

Gamblers and speculators

there is a widespread view that speculators act as gamblers in financial markets, **but. . .** speculation and gambling are quite different!

gambling taking risk for no purpose beyond enjoyment of the risk itself, hence it does not call for a risk premium
$\longrightarrow$ usefulness is at most arguable

speculation activity undertaken despite the risk because there is a favorable risk-return tradeoff
$\longrightarrow$ extremely useful to the economy

<u>behavioral finance</u> $\longrightarrow$ advocates that gamblers and speculators may momentarily suffer from the same sort of fever

Quantifying the degree of risk aversion

suppose that investors choose their portfolio according to both expected return and variance

if we quantify the degree of risk aversion with a parameter A, then it is pretty intuitive that the risk premium an investor demands of a risky asset must depend on both the risk aversion coefficient and the risk of the portfolio: e.g.,

$$A = \frac{\text{risk premium relative to the risk-free rate}}{\text{risk as measured by the variance}} = \frac{\mathbb{E}(r_P) - r_f}{\frac{1}{2}\sigma_P^2}$$

in practice, the risk premium that the investors expect to earn is unobservable as it depends on the expectation about the risk and return of various assets

Historical data

sample statistics treat each past outcome as one possible scenario and each historical outcome as equally likely

mean return $\bar{r}_A = \frac{1}{T}\sum_{t=1}^{T} r_t \quad \times \quad \bar{r}_G = \prod_{t=1}^{T}(1 + r_t)^{\frac{1}{T}} - 1$

sample variance $\hat{\sigma}^2 = \frac{1}{T-1}\sum_{t=1}^{T}(r_t - \bar{r})^2$

empirical results strong evidence of risk-return trade-off
small stocks, large stocks, T-bonds, T-bill

problem variability of the past HPR is an unreliable guide to risk in the case of the risk-free asset

T-bill as the risk-free rate

measurability the rate of return one earns on any money market instrument is known at the <u>beginning</u> of the period

default risk the power to tax and to control the money supply lets the government, and only the government, issue default-free bonds

problems inflation affects the purchasing power and maturity may differ from the desired holding period

in practice all money market instruments may proxy the risk-free rate for they are virtually immune to interest rate risk due to their short maturities and for they are fairly safe in terms of default or credit risk

Inflation

if prices change, then the increase in the purchasing power will not equal the increase in the dollar wealth due to investments for part of the investment earnings are offset by the reduction in the purchasing power of the dollars received at the end of the holding period

interest rate: nominal $\times$ real

$$1 + r = \frac{1 + R}{1 + \pi} \qquad \longrightarrow \qquad r = \frac{R - \pi}{1 + \pi}$$

approximation: $r \sim R - \pi$, works pretty well for small inflation rates and is exact only for continuously compounded rates

Equilibrium nominal rate of interest

Fisher argues that as investors are concerned with their purchasing power, they will demand higher nominal rates of return on their investments if expected inflation rises $\longrightarrow$ **Fisher equation**: $R = r + \mathbb{E}(\pi)$

remark: the measurability property of the money market instruments does not hold in real terms, because one has to rely on inflation expectations $\longrightarrow$ price-indexed government bonds

in practice: any inflation uncertainty over the course of a few weeks (or even months) is negligible as compared to the uncertainty of stock market returns.

Asset allocation

riskier investments presumably offer higher returns, hence it is not surprising that stock investments usually entail average returns that exceed the returns on T-bills and even long-term bonds.

but... investors must not make all-or-nothing choices from these investment classes $\longrightarrow$ build portfolios

the most straightforward way to control for the risk of a portfolio is through the fraction of the portfolio invested in the risk-free rate versus risky assets $\longrightarrow$ **asset allocation**

<u>caveat</u>: take for now the composition of the risky portfolio as given

Example

portfolio (\$300) = 30% on risk-free asset (\$90)
+ 70% on risky portfolio (\$210)

risky portfolio (\$210) = 54% on stocks (\$113.4)
+ 46% on bonds (\$96.6)

the investor may reduce the risk of the portfolio by changing the fraction invested in the risk-free asset, e.g.,

portfolio (\$300) = 44% on risk-free asset (\$132)
+ 56% on risky portfolio (\$168)

risky portfolio (\$168) = 54% on stocks (\$90)
+ 46% on bonds (\$42)

Portfolio expected return and risk

consider a **portfolio** with a proportion y of the investment in the risky portfolio and $1 - y$ in the risk-free asset, hence

$$r_P = y\,r + (1-y)\,r_f \qquad \longrightarrow \qquad \begin{cases} \mathbb{E}(r_P) = y\,\mathbb{E}(r) + (1-y)\,r_f \\ \\ \sigma_P = y\,\sigma \end{cases}$$

$\Rightarrow$ the expected value and the standard deviation are linear operators!

risk premium: $\mathbb{E}(r_P) - r_f = y\,\left[\mathbb{E}(r) - r_f\right]$

polar cases: invest all in the risky asset ($y = 1$)
invest all in the risk-free asset ($y = 0$)

Capital allocation line

the points that describe the risk and return of the portfolio for various asset allocations form a straight line with intercept r_f and slope of $\frac{1}{\sigma}\left[\mathbb{E}(r) - r_f\right]$, which is also known as the **reward-to-variability ratio**

nongovernment investors cannot borrow at the risk-free rate, hence leverage ($y > 1$) implies a different slope that depends on the borrowing rate $r_B > r_f \longrightarrow$ kink at $y = 1$

slopes of the CAL:

	$y < 1$	$\longrightarrow$	$\frac{1}{\sigma}\left[\mathbb{E}(r) - r_f\right]$
	$y > 1$	$\longrightarrow$	$\frac{1}{\sigma}\left[\mathbb{E}(r) - r_B\right]$

Risk tolerance and asset allocation

the **capital allocation line** plots all feasible risk-return combinations available from allocating the complete portfolio between the risky portfolio and the risk-free asset

investors must now choose one **optimal** combination according to their levels of **risk aversion**

the investor's asset allocation problem also depends on the tradeoff between risk and return. . . **if** the reward-to-variability ratio increases, **then** the investor might well decide to take a riskier position

one of the main **roles of the financial adviser** is to assess the clients' attitude toward risk so as to determine the appropriate portfolio

Passive strategy

premise: securities are fairly priced, hence there is no reason to undertake security analysis $\longrightarrow$ *low cost* + *free-riding*

bottom line: neutral diversification approach by investing in a diversified value-weighted portfolio of common stocks that mirrors the corporate sector of the broad economy $\longrightarrow$ *indexing*

capital market line: the capital allocation line provided by one-month T-bills and a broad index of common stocks

historical evidence: the average rates of return and the standard deviation of the risk premium of large common stock over one-month T-bills are quite volatile $\longrightarrow$ noise impedes reliable inference

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Lecture 3 [BMK04, chapter 6]

Sources of risk

macroeconomic factors: the general economic conditions affect the performance of every firm, and hence have an impact in the rate of return that each stock will eventually provide
examples: business cycle, inflation rate, interest and exchange rates

firm-specific factors: affect only the stock of that firm without noticeably influencing other firms
examples: R&D success, management style and philosophy

empirical literature: common factors $\times$ idiosyncratic factors

Diversification

motivation: adding another security to the portfolio may actually reduce the risk because the firm-specific influences on the securities that compose the portfolio differ

limit: ultimately, however, even with a large number of risky assets in a portfolio, there is no way to avoid all risk given that virtually all securities are influenced by the general economic conditions

insurance principle: the reduction of risk to very low levels by spreading the investment across securities with independent risk sources

typology: market/systematic/nondiversifiable risk
unique/firm-specific/nonsystematic/diversifiable risk

Road map

1. capital allocation between risky and risk-free assets ✓
   (stock and bond fund $\times$ risk-free asset)

2. asset allocation between two risky assets
   (stock fund $\times$ bond fund)

3. allocation between the risk-free asset and the two risky assets
   (stock fund $\times$ bond fund $\times$ risk-free rate)

4. portfolio allocation with many securities
   (stocks $\times$ bonds $\times$ risk-free rate)

Asset allocation between two risky assets

question: how the uncertainties of asset returns interact?

answer: the key determinant of portfolio risk is the extent to which the returns of the assets co-move, that is to say, tend to vary in tandem or in opposition $\longrightarrow$ in a linear world,... **correlation matrix**

risk-return tradeoff: $r_P = w\, r_B + (1-w)\, r_S$

$$\sigma_P^2 = w^2\, \sigma_B^2 + (1-w)^2\, \sigma_S^2 + 2\, w(1-w)\, \rho_{BS}\, \sigma_B\, \sigma_S$$

the formula describing the variance of the portfolio implies that there is a tremendous potential for gains from **diversification**

Example

input data: $\mathbb{E}(r_B) = 6\%$, $\mathbb{E}(r_S) = 10\%$
$\sigma_B = 12\%$, $\sigma_S = 25\%$
$w = 1/2$, $\rho_{BS} = 0$

expected return:
$$\mathbb{E}(r_P) = w\,\mathbb{E}(r_B) + (1-w)\,\mathbb{E}(r_S) = \tfrac{1}{2}\,(6+10) = 8\%$$

variance:
$$\sigma_P^2 = w^2\,\sigma_B^2 + (1-w)^2\,\sigma_S^2 = \tfrac{1}{4}\,(0.12^2 + 0.25^2) = \tfrac{0.0769}{4} = 0.019225$$

standard deviation: $\sigma_P = 13.87\% < 18.5\% = w\,\sigma_B + (1-w)\sigma_S$

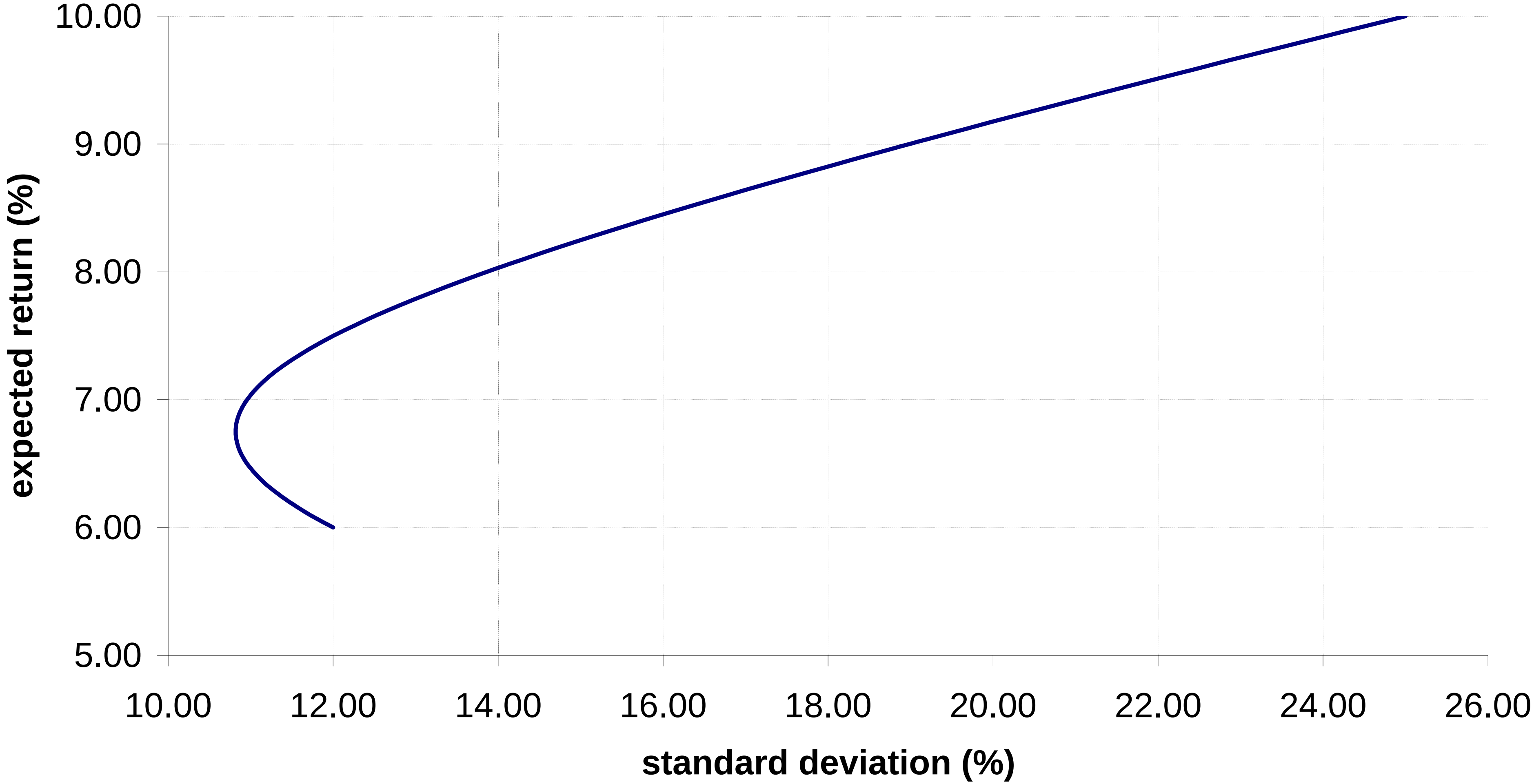
Benefits from diversification

diversification gains are almost **cost–free** in the sense that it allows the portfolio to experience the full contribution of the stock's higher expected return, while keeping the portfolio standard deviation below the average of the component standard deviations

main point: diversification does not require adding a security that has negative correlation with the portfolio

one could think of doing even better by choosing the weight so as to minimize risk, **but. . .** expected return will also change

Investment opportunity set for bonds and stocks



Mean-variance criterion

investors desire portfolio that lie to the northwest in the investment opportunity set $\longrightarrow$ *high expected return with low volatility*

preferences: risk-return tradeoff $\longrightarrow$ mean-variance criterion

dominance: portfolio A $\succeq$ portfolio B

if and only if

$$\mathbb{E}(r_A) \geq \mathbb{E}(r_B) \text{ and } \sigma_A \leq \sigma_B$$

$\Rightarrow$ any portfolio on the downward sloping portion of the investment opportunity set is dominated by the minimum variance portfolio

otherwise. . . it may depend on the investor's attitude toward risk

The effects of correlation

perfect positive correlation: the portfolio standard deviation is a weighted average of the component security standard deviations, and hence diversification entails no benefit

perfect negative correlation: it is possible to weigh the portfolio so as to reduce its variance all the way to zero $\longrightarrow$ *hedging*

in general, there are benefits to diversification whenever asset returns are less than perfectly correlated

Road map

1. capital allocation between risky and risk-free assets ✓
   (stock and bond fund $\times$ risk-free asset)

2. asset allocation between two risky assets ✓
   (stock fund $\times$ bond fund)

3. allocation between the risk-free asset and the two risky assets
   (stock fund $\times$ bond fund $\times$ risk-free rate)

4. portfolio allocation with many securities
   (stocks $\times$ bonds $\times$ risk-free rate)

Optimal risky portfolio with a risk-free asset

example: consider the same figures as before, but now assume a more realistic correlation of 0.20 and the existence of a risk-free asset yielding 5%

portfolio A: the capital allocation line using the minimum variance portfolio, which invests 87.06% in bonds and 12.94% in stocks
$\longrightarrow$ reward-to-variability ratio = 0.13

portfolio B: the capital allocation line using the portfolio that invests 80% in bonds and 20% in stocks
$\longrightarrow$ reward-to-variability ratio = 0.15

$\Rightarrow$ portfolio B **dominates** portfolio A

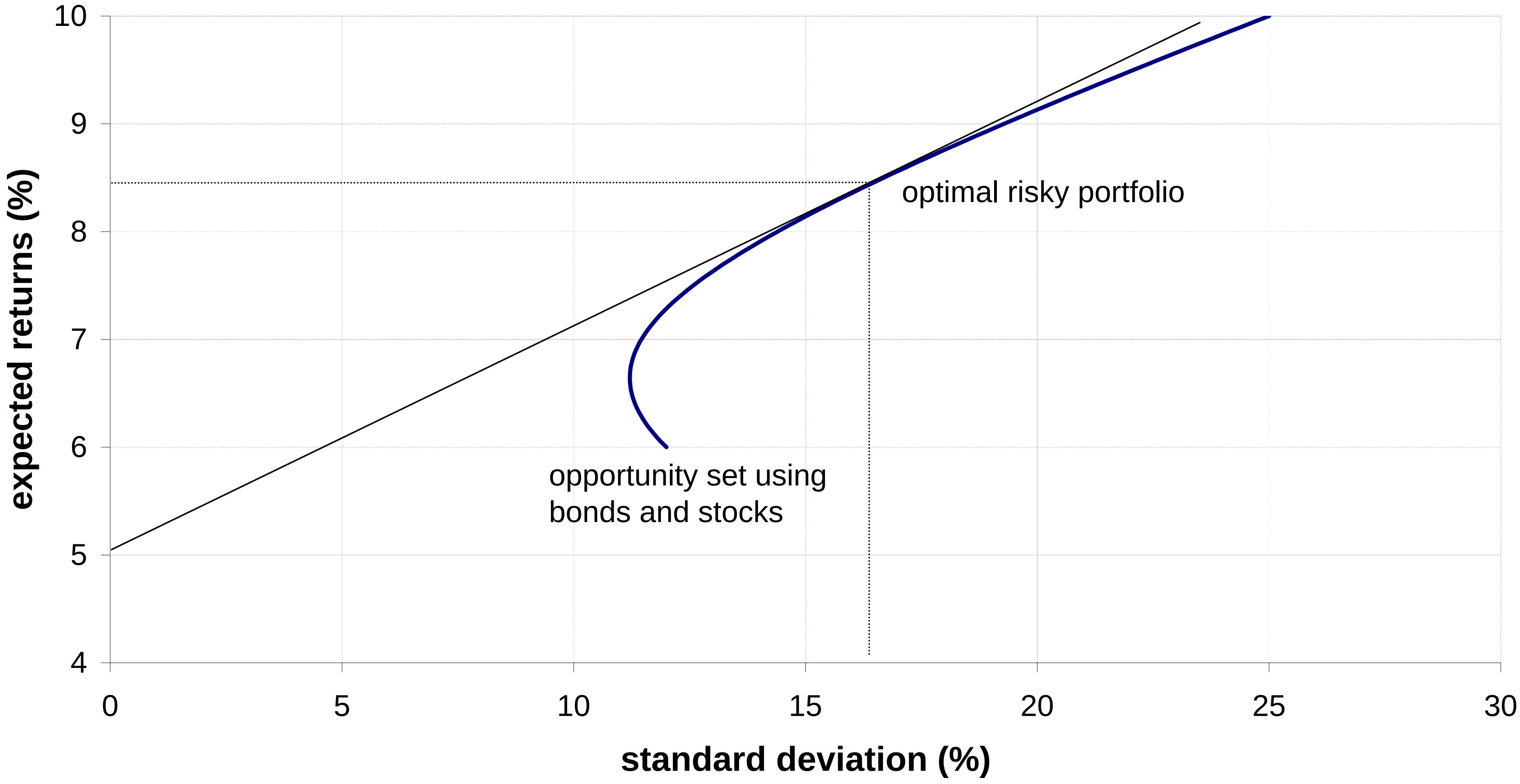
Reward-to-variability ratio dominance

combinations of the risk-free asset and portfolio B provide a higher expected return for **any level of risk** (as measured by the standard deviation) than combinations of the risk-free asset and portfolio A, hence **all risk-averse investors** would prefer to form their portfolio using the risk-free asset with portfolio B rather than with portfolio A

but. . . why stop at portfolio B?

optimal risky portfolio: tangency portfolio, which invests 32.99% in bonds and 67.01% in stocks, yielding $\mathbb{E}(r_*) = 8.68\%$ and $\sigma_* = 17.97\%$

Optimal capital allocation line



Optimal portfolio

the optimal portfolio formed from the optimal risky portfolio and the risk-free asset depends on the investor's risk aversion, **though all** risk-averse investors will choose the tangency portfolio as their risky portfolio given that it results in the highest return per unit of risk

$\Rightarrow$ back to the problem of allocating the investment funds between the risky portfolio and the risk-free asset

summing up: the optimal portfolio reflects considerations of both efficient diversification (i.e., finding the optimal risky portfolio) and risk aversion $\longrightarrow$ separation property

Road map

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   (stock fund $\times$ bond fund $\times$ risk-free rate)

4. portfolio allocation with many securities
   (stocks $\times$ bonds $\times$ risk-free rate)

Efficient frontier of risky assets

consider three risky assets A, B and C

1. draw the curves that depict all risk-return combinations of all the portfolios formed from (A, B) and (B, C)

2. draw the curves that depict all risk-return combinations of all the portfolios formed from (E, F), where E and F denote portfolio on the opportunity sets AB and BC, respectively

3. the curve EF extends the opportunity set to the northwest

4. continue to take points (each representing a portfolio) from these **three** curves and keep combining them into new portfolios, thus shifting the opportunity set farther to northwest

efficient frontier: envelope of all curves (Markowitz, 1951)

Remarks

1. individual assets end up inside the efficient frontier, otherwise. . .
2. one may discard portfolios below the minimum variance portfolio
3. short sale restrictions $\longrightarrow$ maximization under positivity constraints
4. assure a minimum level of expected dividend yield
5. eliminate firms that engage in undesirable social activity

conclusion: in principle, the portfolio manager tailor the efficient frontier to meet any particular objective

price: lower reward-to-variability ratio

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Lecture 4

[BMK04, chapter 7]

Equilibrium prices

question: how are expected returns determined in a competitive securities market?

partial answer: to understand market equilibrium, one must first connect the determination of optimal portfolios with security analysis and actual buy/sell transactions of investors affect only the stock of that firm without noticeably influencing other firms

$\longrightarrow$ efficient diversification leads to a demand schedule for shares, which in turn determines joint with the supply forces the equilibrium prices and expected rates of return

Example with only two stocks

		stock A		stock B
price ($/share)		39		39
shares outstanding (millions)		5		4
market value ($ millions)		195		156
expected annual dividend ($/share)		6.40		3.80
discount rate (%)		16		10
expected end-of-year price ($/share)		40		38
expected return (%):	dividend yield	16.41		9.74
	capital gain	2.56		-2.56
	total	18.97		7.18
standard deviation of the rate of return		40		20
correlation coefficient			0.20	
risk-free rate (%)			5	
optimal risky portfolio (%)		0.8070		0.1930

Assumptions of the security analysis

$\longrightarrow$ neither firm A or firm B will grow in the future

$$\text{expected share price} = \frac{\text{dividend perpetuity}}{\text{discount rate}}$$

$\longrightarrow$ expected returns are based on the assumption that the next year's dividends will conform to their forecasts and that share prices will converge to their fundamental values

$\longrightarrow$ the correlation coefficient and standard deviations are constant over time and hence the figures stem from sample estimates

Demand for shares

how does the demand for shares of stock A vary with its expected end-of-year price?

current price ($)	45.0	42.5	40.0	37.5	35.0
capital gain (%)	-11.11	-5.88	0.00	6.67	14.29
dividend yield (%)	14.22	15.06	16.00	17.07	18.29
expected return (%)	3.11	9.18	16.00	23.73	32.57
optimal weight (%)	-0.41	0.32	0.70	0.94	1.09
optimal number of shares ($220M budget)	-2.01M	1.65M	3.86M	5.49M	6.88M

Demand schedule

main assumption: we are taking the price of stock B as given

downward sloping: *income effect* $\longrightarrow$ at a lower price, one can purchase more shares with the same budget

substitution effect $\longrightarrow$ at a lower price, the expected return is higher and hence stock A becomes more attractive relative to stock B

short selling: the negative number of shares in the demand schedule indicate that we are assuming no restrictions

Index funds' demand for stocks

goal: mimic the market return

$$\text{optimal weight for stock A} = \frac{\text{market capitalization of stock A}}{\text{total market capitalization}}$$
$$= \frac{195}{195+156} = 0.5556$$

once more, market capitalization depends on the prices of stocks A and B, hence one may derive the **conditional demand schedule** by varying the price of stock A given a constant price of stock B

Conditional demand schedule for stock A

investment budget: \$130M

current price	market share	dollar investment	number of shares
45.00	0.5906	76.772M	1.706M
42.50	0.5767	74.996M	1.763M
40.00	0.5618	73.034M	1.826M
39.00	0.5556	72.222M	1.852M
37.50	0.5459	70.961M	1.892M
35.00	0.5287	68.731M	1.964M

Supply versus demand

index funds' demand line: very steep and inelastic as it does not depend on the expected return

market demand: for each price, add up the quantity demanded by all investors $\longrightarrow$ *horizontal aggregation*

supply curve: vertical at the number of outstanding shares

capital asset pricing model: derives a set of mutually consistent equilibrium prices and expected rates of returns across all stocks in contrast to our partial equilibrium analysis that take the price of stock B as given

Capital asset pricing model: Assumptions

1. investors are price takers
2. investors plan for one identical holding period
3. unlimited access to risk-free borrowing or lending opportunities
4. there are no transaction costs (e.g., taxes and commissions)
5. investors are rational mean-variance optimizers
6. homogeneous expectations

Capital asset pricing model: Results

1. every investor holds the market portfolio, which includes all assets in the economy with market-capitalization weights

2. the market portfolio not only lies on the efficient frontier, but also coincides with the optimal risky portfolio $\longrightarrow$ CML = best CAL

3. the risk premium on the market portfolio is proportional to the variance of the market portfolio and to the degree of risk aversion of the average investor $\longrightarrow \mathbb{E}(r_M) - r_f = A\,\sigma_M^2$

4. the risk premium on individual assets is proportional to the risk premium on the market portfolio $\longrightarrow$ *single factor structure*

Why all investors hold the market portfolio?

all investors apply the same mean-variance analysis (assumption 5) to the same universe of securities, with the same investment horizon (assumption 2), identical tax consequences (assumption 4) and same security analysis inputs (assumption 6) $\longrightarrow$ *identical efficient frontiers*

as the investors face the same risk-free borrowing and lending rates (assumption 3), they will draw the same capital allocation line and find the same tangency portfolio $\longrightarrow$ *identical optimal risky portfolio*

with everyone holding the same risky portfolio, the share of each stock in the aggregate risky portfolio will equal its share in the individual (common portfolio) $\longrightarrow$ *market portfolio*, by definition

Is the passive strategy efficient? 4.12

mutual fund theorem: a passive strategy using the capital market line as the capital allocation line suffices to satisfy the investment demands of all investors $\longrightarrow$ *incarnation of the separation property*

why are there different risky portfolios? different security analysis inputs $\longrightarrow$ *heterogeneous expectations about the risk-return tradeoffs*

logical inconsistency: the CAPM predicts that the passive strategy is efficient and costless, why does anyone engage into active portfolio management? if no one follows a active strategy, then who will perform security analysis so as to bring about the efficiency of the market portfolio?

Risk premium of the market portfolio

$\longrightarrow$ when investors purchase stocks, their demand drives prices up, thereby lowering the expected rates of returns and the risk premia

$\longrightarrow$ if the risk premia decrease, then investors will move their funds out of the risky market portfolio to the risk-free asset

$\longrightarrow$ **in equilibrium,** the risk premium on the market portfolio must be just high enough to induce investors to hold the available supply of stocks

$\longrightarrow$ if the risk premium is too high/low relative to the average degree of risk aversion, then the demand will increase/decrease and prices will rise/decline

Expected return on individual securities

one may reduce the nonsystematic risk to an arbitrary low level through diversification, therefore investors do not require a risk premium as compensation for bearing nonsystematic risk

systematic risk measure: $$\beta_i = \frac{\text{Cov}(r_i - r_f, r_M - r_f)}{\text{Var}(r_M - r_f)}$$

gauges how the excess return on the individual asset reacts to changes in the excess return on the market portfolio

$\longrightarrow$ identical ratio of risk-premium to beta: $\mathbb{E}(r_M - r_f) = \frac{1}{\beta_i}\,\mathbb{E}(r_i - r_f)$

Security market line

CAPM's expected return-beta relationship $\mathbb{E}(r_i - r_f) = \beta_i \, \mathbb{E}(r_M - r_f)$ quantifies the conclusion that **only systematic risk, as measured by the beta of the security, matters** to investors who can diversify away the nonsystematic risks

robustness: if there are differences in the investors' personal tax rates and human capital, then the market portfolio is no longer the optimal risky portfolio for every investor, though a modified version of the expected return-beta relationship still holds

if the expected return-beta relationship holds for every individual security, then it also holds for any combination of assets
$\longrightarrow$ portfolio beta = weighted average of the individual betas

Remarks

CML $\times$ SML: the former plots graphs the risk premia of *efficient portfolios* (risky market portfolio + risk-free asset) as a function of the portfolio standard deviation, whereas the latter the risk premia of *individual assets* as a function of their systematic risk (the beta gauges the asset's contribution to the standard deviation of the portfolio)

alpha: difference between the fair and actual expected return on a security for, if the asset were fairly priced, it would lie on the SML

applications: event study analysis
investment management industry $\longrightarrow$ mispricing
regulation $\longrightarrow$ utility rate-making cases
capital budgeting $\longrightarrow$ internal rate of return cutoff

Investment Analysis

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Lecture 5 [BMK04, chapter 7]

Limitations of the CAPM

1. *market portfolio* includes **all** assets in the economy

$\longrightarrow$ because many assets are not traded, investors would not have access to the market portfolio even if they could identify it

$\longrightarrow$ shaky real-world foundations, **though** the theory is legitimate if the predictions approximate well the real-world outcomes

2. it is about *expected* rather than actual returns

$\longrightarrow$ realized returns for a particular holding period seldom, if ever, coincide with the initial expectations

Index model

idea: verify whether the predictions of the CAPM are sufficiently accurate for the actual returns of an **index portfolio**, such as the S&P500

advantage: the composition and rate of return of the index is easily measured and unambiguous

application: test whether the index portfolio is the mean-variance efficient portfolio

expectations $\longrightarrow$ **historical data:** $r_i - r_f = \alpha_i + \beta_i \left(r_M - r_f \right) + e_i$

Expectations in the index model

assumption: the firm-specific random effect e_i during the holding period gauges the deviation of the realized return of the ith security from the forecast that accounts for the index's holding period return (i.e., the regression line) $\longrightarrow$ *mean zero*

$$\mathbb{E}\left(r_i - r_f\right) = \alpha_i + \beta_i \, \mathbb{E}\left(r_M - r_f\right)$$

CAPM's expected return-beta relationship: $\alpha_i = 0$

magic of the index model: converts the CAPM prediction about the unobserved expected excess return of a security relative to the unobserved market portfolio into a prediction about the intercept in a regression of observed variables!!!

Empirical evidence

caveat: there is a joint-hypothesis problem given that rejecting the null hypothesis that $\alpha_i = 0$ for every security in the economy may reflect a deficiency either of the CAPM framework or of the index model that serves as proxy for the market portfolio

$\longrightarrow$ few instances of persistent, positive significant alpha values

<u>examples</u>: small versus large stocks
after recent sharp declines
if ratio of book value to market value is high
after announcements of unexpected good earnings

Estimating the index model

it suffices to observe the excess return on the market index and on the individual asset over a number of holding periods, say T, and then run the following linear regression

$$r_{it} = \alpha_i + \beta_i r_{Mt} + e_{it} \qquad t = 1, \ldots, T$$

context: time series if only one asset
simultaneous equations if a small number of assets
panel data if a large number of assets

single asset context: there is only one explanatory variable apart the intercept, hence the dependent variable plots around a straight line with intercept alpha and slope beta in a scatter diagram
$\longrightarrow$ *security characteristic line*

Estimates of the index model

if we estimate the statistical quantities that characterize the returns on a security (i.e., the beta and the variance) using historical data, then we must control for the sampling error $\longrightarrow$ *statistical inference*

key quantity: residual variance $\longrightarrow \hat{\sigma}_e^2 = \frac{1}{T-2} \sum_{t=1}^{T} \hat{e}_i^2$

testable implication: $\alpha = 0$ for all assets in the economy so as to equate their expected returns to that attainable with the market (efficient) portfolio and the risk-free asset

otherwise: $\alpha < 0 \longrightarrow$ plots below the SML (i.e., overpricing)
$\alpha > 0 \longrightarrow$ plots above the SML (i.e., underpricing)

Predicting betas

even if the single-index model representation is not fully consistent with the CAPM, the dichotomy between the systematic risk as measured by the beta and the diversifiable risk represented by the residual variance is still very useful

beta estimate: constant value based on historical data, hence it does not reveal possible changes in the future beta, **but**... it turns out that securities with high beta today (i.e., $\beta > 1$) tend to exhibit a lower beta in the future and vice versa $\longrightarrow$ **mean reversion**

dirty adjustment: weighted average of the sample estimate of the beta with the value one, where the weight assigned to the sample estimate depends on its statistical reliability

CAPM under attack

Roll's critique: as we do not observe the true market portfolio, the CAPM is not falsifiable

$\longrightarrow$ it turns out however that the error stemming from the use of the market index as a proxy for the true market portfolio is perhaps the lesser of the problems involved in testing the CAPM

Fama-French portfolios: the beta has no prediction power once one controls for the firm characteristics, such as the ratio of book value to market value and size

market microstructure: it is paramount to account for liquidity risk and adverse selection costs

Multiple risk factors

while the CAPM assumes there is only one source of systematic risk, which relates to the market portfolio, the **arbitrage pricing theory** (APT) considers multiple sources of risk

price to pay: forget the simple and intuitive world of the mean-variance efficient portfolio

first-principle derivation: establishes relations among expected rates of return that rule out riskless profits by any investor in well-functioning capital markets $\longrightarrow$ *no-arbitrage considerations*

good news: the APT derives a risk-return tradeoff
very similar to the CAPM

Arbitrage opportunities

arbitrage: exploitation of relative mispricing among two or more securities to earn risk-free economic profits with a zero-investment portfolio

law of one price: it is a *necessary* condition for the absence of arbitrage opportunity because if an asset is trading at different prices in two markets, a simultaneous trade will ental a sure profit provided that the price differential exceeds the transaction costs

technology: even though the electronic communication and trade execution in modern markets restrict such opportunities, they enable fast operators to make large profits by trading huge volumes at the instant that an arbitrage opportunity opens

Example

	high real interest rate		low real interest rate	
	high inflation	low inflation	high inflation	low inflation
probability	0.25	0.25	0.25	0.25
stock A	-20.00	20.00	40.00	60.00
stock B	0.00	70.00	30.00	-20.00
stock C	90.00	-20.00	-10.00	70.00
stock D	15.00	23.00	15.00	36.00
portfolio $\frac{1}{3}(A, B, C)$	23.33	23.33	20.00	36.67

$\longrightarrow$ arbitrageur will short sell (as much as possible) the stock D and use the proceeds to purchase the equally weighted portfolio

No-arbitrage × risk-return dominance

CAPM: when the equilibrium price risk-return relationship does not hold, *many* investors will change their portfolios according to their endowment and degree of risk aversion

⟶ aggregation of these limited portfolio changes over many investors ensures enough volume to restore the equilibrium prices

APT: even few investors are able to mobilize enough volume to take advantage of the arbitrage opportunities, restoring equilibrium

⟶ implications derived from no-arbitrage conditions are stronger than those stemming from risk-versus-return dominance arguments

Well-diversified portfolio

starting point: a well-diversified portfolio has zero nonsystematic risk, and hence it follows that

$$r_P - r_f = \alpha_P + \beta_P \left(r_M - r_f\right)$$

preliminary result: $\alpha_P = 0$ for any well-diversified portfolio with zero beta (i.e., completely riskless), otherwise... nonzero excess return

final result: $\alpha_P = 0$ for any well-diversified portfolio, otherwise... the arbitrageur could combine two of these portfolios into a zero-beta riskless portfolio

$\longrightarrow$ expected return-beta relationship identical to that of the CAPM without any assumption about the investor preferences!!!

Multifactor version of the APT

it is easy to think of several factors that might affect stock returns: business cycles, interest rate fluctuations, inflation, oil prices,... one must therefore consider the exposure of the stocks to unanticipated changes in those factors

$$r_i - r_f = \alpha_i + \beta_i^{(1)} \left(f_1 - r_f\right) + \ldots + \beta_i^{(k)} \left(f_k - r_f\right) + e_i,$$

where the f_j's denote the excess returns on the portfolios that represent the systematic factors

one may form benchmarks portfolios for a multifactor generalization of the SML relationship by building **well-diversified factor portfolios** with a beta of one on one factor and a zero beta on all others

Investment Analysis

Marcelo Fernandes
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Lecture 6

[BMK04, chapter 8]

Kendall's time-series results

business cycle economists use to believe in the 1950s that tracing the evolution of several economic variables over time would clarify and help predicting the progress of the economy through boom and bust periods

natural candidate: stock market prices for they reflect the prospects of the firms and hence peaks and troughs in economic performance ought to show up

Kendall (JRSS 1953): no predictive patterns in stock prices

$\longrightarrow$ animal spirits dominate the stock market
(erratic market psychology)

Does such an interpretation hold water?

if stock prices are predictable, then investors would reap **unending profits** simply by purchasing the stocks with positive forecasts and selling those stocks about to fall in price $\longrightarrow$ not really!!!

example: if the stock price is about to increase by $\Delta\%$, all investors would like buy the stock, but no one would like to sell **supply** $\times$ **demand** $\longrightarrow$ price would increase by exactly $\Delta\%$

$\longrightarrow$ stock prices will **immediately reflect** the forecast news!!!

intuition: forecasts about the *future* performance determines instead *current* performance, as markets participants will attempt to get in on action before the price jump $\longrightarrow$ **anticipation argument**

A random walk down Wall Street

stock prices must reflect any **public information** that relates to stock performance (e.g., information on the macroeconomy or on the firm's industry and management) $\longrightarrow$ **information flow** $\times$ **trading activity**

$\longrightarrow$ stock prices then respond only to new information, which is by definition **unpredictable**, otherwise it would have been part of today's information set

if stock prices react only to unpredictable news, they must also move in a random and unpredictable manner $\longrightarrow$ **random walk**

Results' interpretation

far from supporting market irrationality, randomly evolving prices are the necessary consequence of rational investors competing to discover relevant new information before the rest of the market

please do not confuse randomness in price changes with irrationality in price levels

$\longrightarrow$ predictability in stock prices implies market inefficiency because it indicates that investors are not using all available information

efficient market hypothesis: security prices fully (and correctly) reflect all available information, and hence it is impossible to earn economic profits by trading on that information

Competition as a source of efficiency

incentive constraint: investors will spend time and resources to gather and process new information only if such activity is likely to generate higher investment returns

Grossman & Stiglitz, American Economic Review 70, 1980, On the impossibility of informationally efficient markets

$\longrightarrow$ pricing efficiency may differ across markets and securities
example: emerging markets, small versus large stocks

competition among the many well-backed, highly paid, aggressive security analysts ensures that, as a general rule, stock prices ought to reflect available information regarding their proper levels

Versions of the efficient market hypothesis

the modern definition of market efficiency is relative to the available information set

weak: market trading historical data
example: past prices, trading volume, short interest

semi-strong: market trading historical data + prospects of the firm
example: balance sheet composition, earning forecasts

strong: all relevant information, including insider information
example: SEC restrictions on trading by corporate officers

Technical analysis

if stock prices respond sluggishly to fundamental supply and demand factors, it makes sense to search for and exploit predictable patterns in stock prices $\longrightarrow$ **chartist** $\times$ **econometrician**

Lo, Mamaysky & Wang, Journal of Finance 55, 2000, Foundations of technical analysis: Computational algorithms, statistical inference, and empirical implementation

EMH implication: technical analysis is completely useless!!!

empirical evidence: earlier results show that some technically oriented trading strategies would have generated abnormal profits in the past, **though. . . reality check** says luck $\longrightarrow$ *nonrecurrent gains*

Fundamental analysis

research on the determinants of the **present discounted value** of all the payments a stockholder will receive from each share of stock

<u>example</u>: earnings and dividends prospects
risk profile of the firm
expectations for future interest rates

EMH implication: it will add value only if better than the others'

<u>tools</u>:	macroeconomic and industry analysis	[BMK04, chapter 11]
	equity valuation	[BMK04, chapter 12]
	financial statement analysis	[BMK04, chapter 13]

Active versus passive portfolio management

competition among investors ensures that only <u>serious</u> analyses and <u>uncommon</u> techniques are likely to entail the **differential insight** that may generate trading profits

<u>example</u>: serious $\longrightarrow$ financial economics, econometrics
uncommon $\longrightarrow$ behavioral finance $\times$ chartism, econophysics

security analysis is *economically feasible* only for managers of large portfolios, hence the **small investor** is better off pooling resources in a **mutual fund** so as to obtain the advantages of large size

portfolio: index or not to index?

Role for rational portfolio management

$\longrightarrow$ efficient diversification requires competent security analysis

$\longrightarrow$ rather than beating the market, portfolios must match investors' profiles, such as, for example, age, tax bracket, risk aversion, and employment

examples: (1) investors holding executive stock options

(2) older investors who are essentially living off savings must avoid long-term bonds, whose market values fluctuate dramatically with interest rates changes

Resource allocation

main investment implication of the efficient market hypothesis is that profit opportunities to better-informed traders are at the expense of less-informed traders, **but**. . . there are other implications as well!!!

deviations from informational efficiency would also result in a large cost to the overall economy $\longrightarrow$ **inefficient resource allocation**

example: if the value of biotech assets as reflected in the stock prices of biotech firms exceed the cost of acquiring those assets, the managers of such firms will have a strong signal that the market will regard further investments in the firm as a venture with positive net present value

Efficient market hypothesis under scrutiny

professional portfolio managers are among the first to cast a stone for obvious reasons, **but**... the debate will probably never end for three empirical issues

1. magnitude of their contribution relative to market volatility
   $\longrightarrow$ **personal view:** wrong question

2. selection bias: winning investors have no incentives to reveal their successful investment strategies
   $\longrightarrow$ **personal view:** performances are observable

3. lucky event: for any fixed period of time, there exists at least one winning investment scheme
   $\longrightarrow$ **personal view:** reality check

Testing weak efficiency

statistical tools: serial correlation $\times$ serial dependence
filter rules $\times$ reality check

empirical results: short $\times$ long horizons $\longrightarrow$ dividends-price ratio
momentum $\times$ contrarian strategy

issues: market microstructure effects

some funds seem to persistently outperform simple indices, even after controlling for risk through market betas $\longrightarrow$ **skill?** not really, multi-factor performance attribution models show that funds earn persistent returns by following fairly mechanical styles rather than persistent skill at stock selection

Fad hypothesis

if stock prices overreact to relevant news, they exhibit positive serial correlation (i.e., momentum) over short time horizons, but negative serial correlation over longer horizons due to subsequent correction $\longrightarrow$ **excess volatility** due to the overshooting

spurious evidence?

(1) instead of the stock market fad interpretation, one could think of mean reversion in stock prices as a rational response of market prices to **time-varying market risk premia** (i.e., discount rate)

(2) building a long series of returns over a long horizon requires time span $\longrightarrow$ **structural breaks** $\times$ **small sample**

Predictors of broad market movements

there are several papers that aim at identifying observed variables that are able to predict market returns

example: return on the aggregate stock market tends to be higher when the dividend yield (i.e., D/P ratio) is high

spurious evidence? these variables are probably proxying for the variation in the market risk premium

example: given a dividend level, the stock price will be lower and the dividend yields will be higher when the risk premium (and hence the expected market return) is larger

Testing semi-strong efficiency

relevance: fundamental analysis uses a much richer information set to create portfolios than technical analysis

evidence: surprisingly, several easily accessible statistics seem to predict abnormal risk-adjusted returns $\longrightarrow$ **market anomalies**

<u>example</u>: price-earning ratio and dividend yield
sluggish response to firms' earning announcements
market capitalization $\longrightarrow$ small-firm(in-January) effect
book-to-market ratio $\longrightarrow$ positive effect due to optimism?

joint-hypothesis issue: how to adjust for risk?
CAPM $\times$ multifactor interpretation

Behavioral interpretation

forecasting errors: excessive weight to recent experience relative to prior beliefs typically entail P/E and book-to-market effects due to optimism

overconfidence: (1) dominance of active portfolio management in the face of the typical underperformance of such strategies, (2) men trade far more actively than women, though high trading activity is highly predictive of poor investment performance

regret avoidance: preference for conventional decisions accords with size and book-to-value effects

So, are markets efficient?

there are enough anomalies in the empirical evidence to justify the search for mispriced securities, **though**... one must look with many grains of salt at supposedly superior trading strategies

financial markets are **near efficient** and competitive enough to ensure that there is no free lunch (or easy picking)

Scheinkman & Xiong, 2005
Heterogeneous beliefs, speculation and trading in financial markets
(`http://www.princeton.edu/~joses/wp/survey.pdf`)

Investment Analysis

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Lecture 7 [BMK04, chapter 9]

Terminology

bond: security that relates to a borrowing agreement in which the issuer must make specified payments to the bondholder over a certain period of time

bond indenture: contract between the issuer and the bondholder that establishes the coupon rate, the maturity, and the par value of the bond

coupon rate: determines the annual interest payment, which typically comes in two semiannual installments
$\longrightarrow$ induce investors to pay par value to buy the bond

par value: face value of the bond, which acts as the principal

Treasury bonds and notes

maturity: notes up to 10 years, bonds from 10 to 30 years

par value: denominations of $1,000 or more

call provision: Treasury could repurchase callable T-bonds at par value during the call period (usually the last 5 years of the bond's life)

dealer: quote bid and ask prices as a percentage of par value (points plus fractions of 1/32 points)

yield to maturity: measure of the average rate of return to an investor who purchases the bond for the ask price

Accrued interest

quoted price: does not include the interest that accrues between coupon payment dates, hence it differs from what investors pay for the bond

$$\text{accrued interest} = \frac{\text{annual coupon payment}}{2} \times \text{pro-rata}$$

pro-rata: actual/actual

example: you will probably pay (a value very close to) \$1,040 to buy an 8% coupon bond with face value of \$1,000 one day before its maturity, even though the quoted bond price is (very close to) \$1,000

Corporate bonds

maturity: in theory, sky is the limit, **though**...
in practice, it depends on the credit rating of the firm

dealers: only OTC trading, hence quite thin market
quote as a percentage of par value
(points plus fractions of 1/32 points)

current yield: annual interest income the bondholder receives as a percentage of the price paid for the bond, thus it does not account for prospective price movements

Call provisions on corporate bonds

while the Treasury no longer issues callable T-bonds, some corporate bonds are issued with call provisions, allowing the issuer to repurchase the bond at a specified **call price** before the maturity date

example: a firm issues a callable bond if a high coupon rate when market interest rates are high and then, when interest rates fall, it prefers to retire the high-coupon debt and issue new bonds at a lower coupon rates $\longrightarrow$ **refunding**

deferred callable bonds: initial period of call protection

provision risk: to compensate the bondholder for forfeiting their bonds for the call price, callable bonds entail higher coupon and yield

Convertible bonds

holders of bonds with **conversion ratio** of $(m : n)$ have the right to exchange m bonds for n shares of common stocks of the firm

market conversion value: the current value of the shares for which the bond may be exchanged

conversion premium: excess of the bond value over the market conversion value

price to pay: lower coupon rates and yield to maturity

Extendable and floating-rate bonds

extendable/put bonds: similar to the callable bonds, but it is the bondholder who has the right to extend or retire the bond

floating-rate bonds: tie the interest payments to some measure of current market rates, such as the 6-month LIBOR zero rate

although **the coupon rate of floaters** adjust to changes in the general level of market interest rates, it does not adjust to firm-specific changes and hence the **chief source of risk** involved in floaters relate to changing credit conditions

Preferred stock

strictly speaking, preferred stocks are **equity, though**. . . they promise to pay a specified stream of dividends

unlike corporate bonds, failure to pay the promised dividend does not result in corporate bankruptcy $\longrightarrow$ dividends cumulate

dividends: typically fixed yielding a perpetuity, **though**. . . floaters are recently becoming popular

voting power: none, unless the firm skips the dividend payment

Other examples

Eurobonds: Eurodollar, Euroyen, Eurosterling

foreign bonds: Yankee bonds, samurai bonds, bulldog bonds

asset-backed bonds: mortgage-backed, David Bowie, Walt Disney

indexed bonds: tied to a general price index or commodity price

pay-in-kind bonds: issuers choose to pay either in cash or in bonds

catastrophe bonds: transfer risk from the firm to the capital markets

reverse floaters: coupon rate falls if the market interest rate rises

Bond pricing

the price an investor is willing to pay for a claim to the future coupon and principal repayments depends on **present value calculations**, which in turn depend on market interest rates

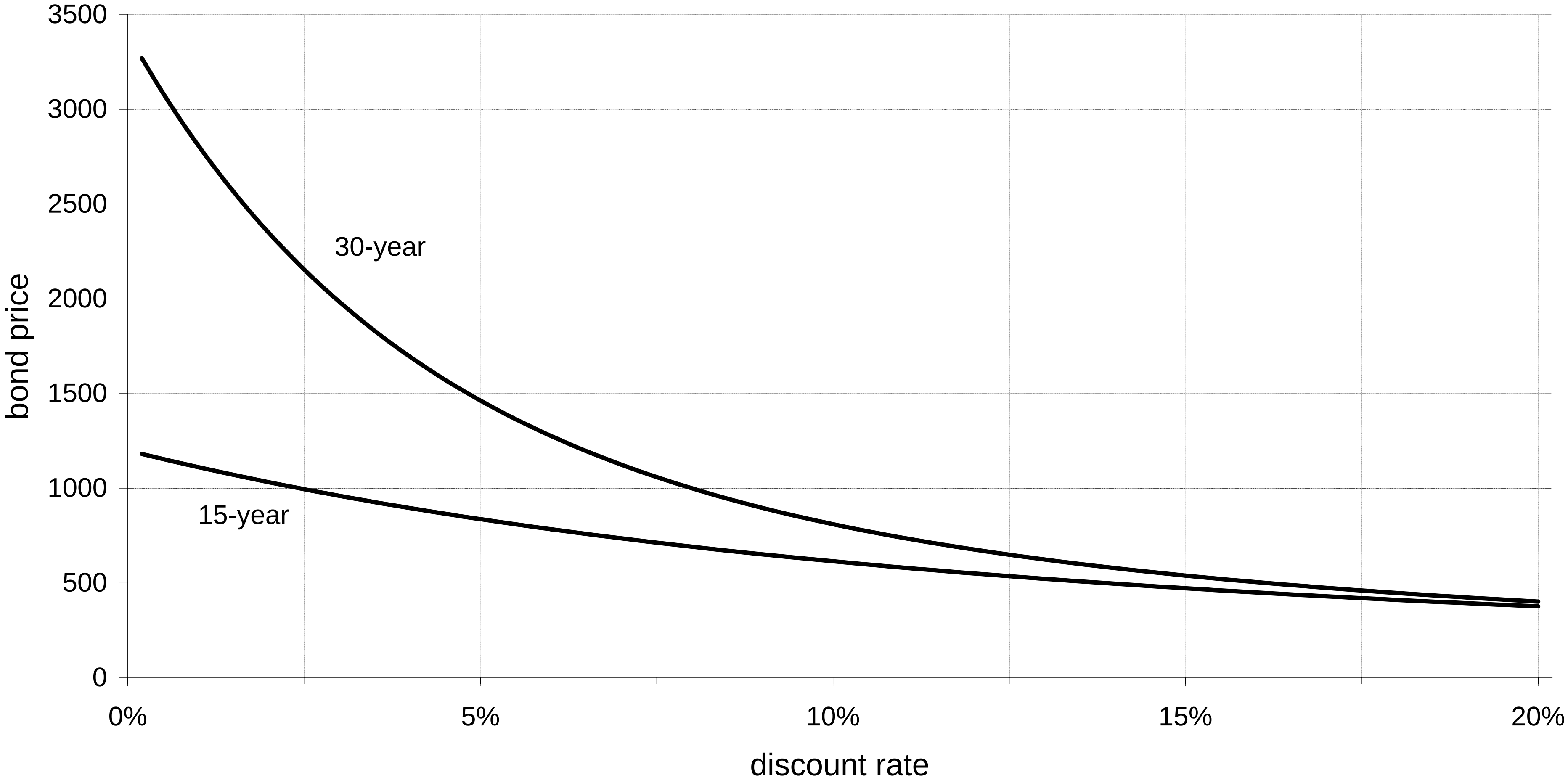
discount rate: real risk-free rate of return plus premium on the expected inflation, default risk, liquidity, call risk,...

simplifying assumption: single interest rate r that is appropriate for discounting cash flows of any maturity

$$\text{bond value} = \frac{\text{par value}}{(1+r)^T} + \sum_{t=1}^{T} \frac{\text{coupon}}{(1+r)^t}$$

The inverse relationship between bond prices and yields

(8% coupon bonds with 15- and 30-year maturities)



Bond prices and yields

the inverse relationship between bond prices and yields is a key feature is fixed-income securities

convexity: if the interest rate increases by Δ_r, bond prices only fall by $\Delta_B < \Delta_r$ because the present value of the bond's payments involves a stronger discounting, but the initial base is smaller

$$\text{convexity} = \frac{\text{rate of change of the slope of the price-yield curve}}{\text{bond price}} = \frac{1}{B}\frac{\partial^2 B}{\partial y^2}$$

Practice

$\longrightarrow$ corporate bonds are typically issued at par value, hence the underwriters of the bond issue must choose a coupon rate that very closely approximates market yields

$\longrightarrow$ investors may after buy or sell bonds in the secondary OTC market at prices that move in accordance with market forces

$\longrightarrow$ the sensitivity to fluctuations in the interest rate also depend on the time to maturity, e.g., short-term bonds are less prone to interest rate risk

proxy for the risk-free asset: T-bills rather than T-bonds

Bond yields

the current yield of a bond measures only the cash income provided by the bond as a percentage of the bond price, ignoring any prospective capital gains or losses

yield to maturity: measures the overall rate of return of the bond over its life by computing the discount rate that makes the present value of a bond's payments equal to its price $\longrightarrow$ *internal rate of return*

How to annualize semiannual yields?
equivalent yields use simple interest $(1+r)$
effective yields use compound interest $(1+r)^2$

Premium versus discount bonds

premium bonds: selling above par value, hence eventual capital loss

$$\text{effective yield} \;<\; \underset{\text{(current yield)}}{\frac{\text{coupon}}{\text{bond price}}} \;<\; \underset{\text{(coupon rate)}}{\frac{\text{coupon}}{\text{par value}}}$$

discount bonds: selling below par value, hence eventual capital gain

$$\text{effective yield} \;>\; \text{current yield} \;>\; \text{coupon rate}$$

Yield to call

the yield to maturity assumes that the bondholder will keep the bond until maturity $\longrightarrow$ **what if the bond is callable?**

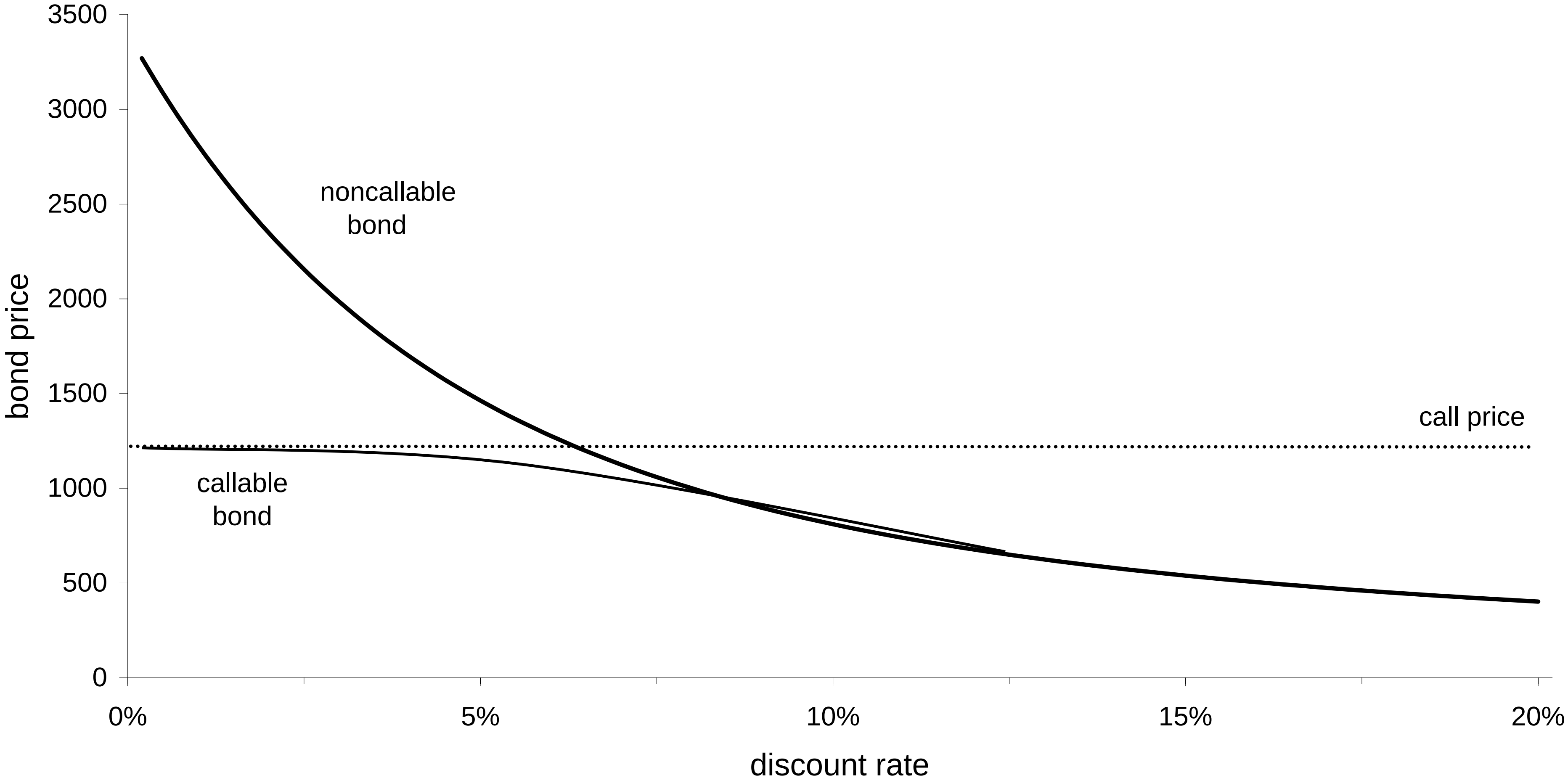
$\longrightarrow$ the present value of the bond's **scheduled** payments rises if the interest rate falls, **though**... the issuer call the bond as soon as it exceeds the call price

yield to call: similar to the yield to maturity, except that the *call price* and *time until call* replace the par value and time until maturity, respectively

example: calls are more likely for premium bonds, hence investors are usually more interested in the callable premium bond's yield to call rather than the yield to maturity

The inverse relationship between bond prices and yields

(8% coupon non- and callable bonds with 30-year maturity)



Yield to maturity versus holding period return

$\longrightarrow$ if the yield to maturity does not vary during the life of the bond, then it coincides with the holding period return

$\longrightarrow$ if the yield to maturity increases/decreases during the life of the bond, then the bond price will go down/up and the holding period return will be low/high relative to the initial yield

intuition: the yield to maturity is measurable for it depends only on quantities that are observable today (i.e., coupon rate, par value, maturity, current price), whereas the holding period return depends on the market price of the bond at the end of that holding period

Zero-coupon bonds

bonds that are intentionally issued with low coupon rates that cause the bond to sell at a discount from par value, namely, **original issue discount bonds**, are less common than coupon bonds issued at par

extreme case: zero-coupon bonds

$\longrightarrow$ they carry no coupon, and so they must offer return in the form of price appreciation

Treasury strips: long-term zero-coupon bonds are usually created by breaking down the cash flows of coupon-bearing notes and bonds into a series of independent securities with the help of the STRIPS program of the US Treasury

Default risk

as any **promise**, bonds are prone to the risk that the issuer defaults on the obligation $\longrightarrow$ there are several agencies that provide financial information on firms as well as quality ratings of large corporation and sovereign bonds

grades: investment $\longrightarrow$ low default risk
speculative $\longrightarrow$ junk and high-yield bonds

agency	investment grade	junk
Moody's Investor Services	Baa and above	Ba and lower
Duff and Phelps, Fitch, S&P	BBB and above	BB and lower

Determinants of bond safety

coverage ratios: ratio of earnings to some fixed costs as a proxy of cash flow difficulties

leverage ratio: debt-to-equity ratio signals whether the firm is able to earn enough to satisfy the bond obligations

liquidity ratio: ratio of current assets (with or without inventories) to liabilities

return on assets: ratio of earnings before interest and taxes to overall assets as a proxy of financial health

Yield curve

expectations hypothesis: the slope of the yield curve is attributable to expectations of changes in the short-term rates, hence long-term bonds entail relatively high yields only if the market expects interest rates to rise

$\longrightarrow$ expected HPR on a bond does not depend on the maturity!!!

liquidity preference: long-term bonds are more risky than short-term bonds, hence forward rates must pay a liquidity (or term) premium over the expectation of the future short rate

$\longrightarrow$ yield curve is upward sloping even if there is no expectation of future increases in the interest rates

Investment Analysis

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Lecture 8 [BMK04, chapter 10]

Managing bond portfolios

active investment strategy: aims at achieving returns that are more than commensurate with the risk borne

tools: interest rate forecasts to predict the entire bond market
intramarket analysis to identify any sort of security mispricing

passive investment strategy: aims to maintain a proper balance between risk and return

tools: immunization strategy so as to insulate the portfolio from interest-rate risk

$\longrightarrow$ sensitivity of bond prices to interest rate fluctuations

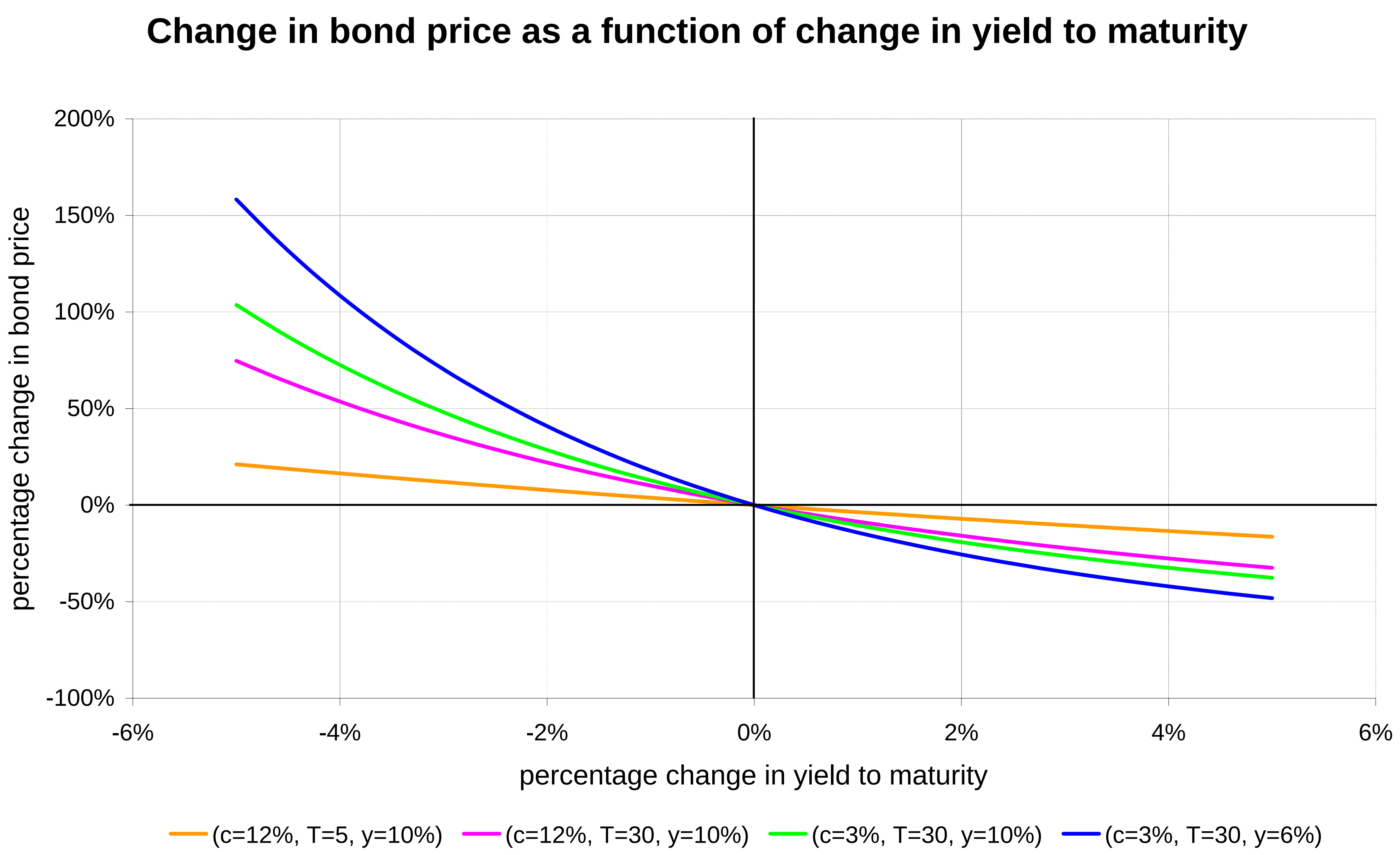
Interest rate risk

as interest rates rise and fall, bondholders respectively experience losses and gains $\longrightarrow$ **source of risk** for fixed-income investments

in a competitive market, all securities must offer investors a fair expected rate of return

example: if the competitive yield is 8%, bonds with an 8% coupon will sell at par value, **though**... if the market rate rises to 9%, then the price of the 8% bond must decrease so that the eventual price appreciation compensates for the lower coupon payments

key relationship: sensitivity as a function of maturity


Change in bond price as a function of change in yield to maturity
200%
150%
100%
50%
0%
-50%
-100%
percentage change in bond price
-6%
-4%
-2%
0%
2%
4%
6%
percentage change in yield to maturity
(c=12%, T=5, y=10%)
(c=12%, T=30, y=10%)
(c=3%, T=30, y=10%)
(c=3%, T=30, y=6%)

Interest rate sensitivity

all	inverse relationship between bond prices and yields the price curve is convex with respect to the yield
A$\times$**B**	long-term bonds are more sensitive to yield changes interest rate risk is less than proportional to maturity
B$\times$**C**	inverse relationship between interest rate risk and coupon
C$\times$**D**	inverse relationship between interest rate risk and yield

$\longrightarrow$ **maturity** is the major determinant of interest rate risk, given that the **coupon** payments matter only because it effectively reduces the maturity of the bond (as discounted by the **yield to maturity**)

Effective maturity

it is not fair to compare the maturities of zero-coupon bonds and coupon bonds given that the latter pays coupons in a regular basis (e.g., semiannually)

duration: weighted average of the times to each cash flow paid out by the bond, with weights proportional to the present value of the payment

$$\text{weight at time } t = \frac{\text{present value of the cash flow at time } t}{\text{bond price}}$$

motivation: convey information on the sensitivity of the bond to interest rate changes

Duration

if the yield is **continuously compounded**, then

$$\frac{\Delta B}{B} = -D\,\Delta y \quad \Rightarrow \quad D = -\frac{1}{B}\frac{\partial B}{\partial y}$$

otherwise

$$\frac{\Delta B}{B} = -D\,\frac{\Delta y}{1 + y/m} \quad \Rightarrow \quad D^* = \frac{D}{1 + y/m} = -\frac{1}{B}\frac{\partial B}{\partial y}$$

$\longrightarrow$ bond price volatility is proportional to the bond's duration, so that the later becomes a natural measure of exposure to interest rate volatility

Duration rules

1. the duration of a zero-coupon bond equals its time to maturity

2. holding time and yield to maturity constant, there is an inverse relationship between duration and coupon rate

3. holding the coupon rate constant, duration increases with the time to maturity for all but very deep discount bonds

4. holding other factors constant, the duration of a coupon bond decreases with the yield to maturity

5. the duration of a perpetuity is $(1+y)/y$ with discrete compounding

Passive bond management

passive managers take bond prices as fairly set and seek to control only the risk of their fixed-income portfolios

interest rate risk: impact in the current net market value $\longrightarrow$ banks
future values of the portfolio $\longrightarrow$ pension funds

main tool: adjust the maturity structure of the fixed-income portfolio so as to shield the net worth from exposure to interest rate movements

$\longrightarrow$ immunization and dedication techniques

Immunization

idea: duration-matched assets and liabilities let the asset portfolio meet the investor's obligations despite interest rate movements

example: banks assets largely comprise commercial and consumer loans or mortgage and hence they have a higher duration than the primary bank liabilities, i.e., customers' deposits

interest rate risk: price risk $\times$ reinvestment rate risk

if interest rate increases, reinvested coupons will grow at a faster rate, offsetting the capital loss due to the bond price depreciation

Matching durations

$\longrightarrow$ passive managers choose the portfolio duration such that the price effect and the reinvestment rate effect cancel out exactly

$\longrightarrow$ if the portfolio duration equals the investor's horizon date, then **small parallel shifts** in the interest rates will not affect the accumulated value of the investment fund at the horizon date

summary: duration matching thus balances the difference between the accumulated value of the coupon payments, which determines the reinvestment rate risk, and the sale value of the bond

Rebalancing

as interest rates and asset durations continually change, portfolio managers must rebalance their fixed-income portfolio to realign its duration with the duration of the obligation

duration generally decreases less rapidly than maturity as time passes by, so even if the portfolio manager immunizes the obligation at the outset, the asset and liability durations will fall at different rates

$\longrightarrow$ **continuous rebalancing:** it is a very active passive strategy!!!

in practice, that is not feasible and hence the portfolio manager must find a compromise between the transaction costs and the desire for perfect immunization

Cash flow matching

simple alternative to immunization: why not buy a zero-coupon bond that provides a payment in an amount exactly sufficient to cover the expected cash flow outlay? ⟶ **dedication strategy**

it automatically immunizes a portfolio from interest rate movements because the cash flow from the bond portfolio and the obligation exactly offsets each other ⟶ **no rebalancing!!!**

drawbacks: sometimes unfeasible, e.g., perpetuity and pension funds impose severe constraints on bond selection

⟶ active managers prefer to exchange dedication for the possibility of achieving superior returns by identifying mispriced bonds

Convexity

duration relates to a first-order Taylor approximation to the impact of interest rates on bond prices $\longrightarrow$ **underestimation due to convexity**

correction: second-order term of the Taylor approximation becomes more relevant as the yield change increases

$$\frac{\Delta B}{B} = -D\,\Delta y + \frac{1}{2}\frac{1}{B}\frac{\partial^2 B}{\partial y^2}(\Delta y)^2 \quad \Rightarrow \quad C = \frac{1}{B}\frac{\partial^2 B}{\partial y^2}$$

convexity: curvature of the bond price-yield relationship as measured by the rate of change of the slope of the price-yield curve as a fraction of the bond price $\longrightarrow$ **very desirable trait,** hence it is not for free

Potential value in active bond management

1. interest rate forecasting so as to anticipate movements across the entire spectrum of the fixed-income market

$\longrightarrow$ if the interest rates are likely to decline, managers will increase portfolio duration

2. relative mispricing within the fixed-income market

$\longrightarrow$ the analyst may think that the default premium of a bond is unnecessarily large

caveat: it does not suffice to get it right, the analyst must get it first given that markets are near efficient

Taxonomy of active bond strategies

substitution swap: exchange of a bond for another nearly identical in terms of coupon, maturity, default risk, call provisions, etc

intermarket spread swap: yield spread between two sectors of the bond market is temporarily out of line

rate anticipation swap: exchange of bonds with different maturities in accordance to the analyst's interest rate forecast

pure yield pickup swap: exchange of a shorter duration bond for a longer duration bond as a means of increasing return (and risk) by holding higher yielding, longer maturity bonds example: pure yield pickup swap

October 2006 T-note: 4.35%
February 2031 T-note: 5.36%

the investor who swaps the shorter-term bond for the longer-term bond will earn a higher rate of return as long as the yield curve does not shift upward during the holding period

example: intermarket spread swap

10-year T-bond
10-year Baa bond

if the spread is currently above its historical average, the investor may think of replacing holdings of T-bonds with corporate bonds

Horizon analysis

forecast of bond returns based largely on a prediction of the yield curve at the end of the investment horizon

example: the portfolio manager with a two-year horizon wishes to forecast the total return on a 20-year 10% coupon bond with a yield to maturity of 9%

the analyst forecasts that two-years from now, 18-year bonds will sell at yields to maturity of 8% and that coupon payments are reinvested in short-term securities at a rate of 7%

$$\text{return} = \left(\frac{\text{forecast bond price} + \text{future value of the reinvested coupons}}{\text{current bond price}} \right)^{1/2} - 1$$

Contingent immunization

idea: allow the fixed-income manager to actively trade provided that poor performance does not endanger the prospect of achieving the minimum acceptable portfolio return

at that point, the manager must then **immunize** the portfolio so as to ensure a guaranteed rate of return over the remaining portion of the investment period

example: \$10M portfolio with a minimum two-year cumulative return of 10%, hence the final value of the portfolio must at least amount to \$11M $\longrightarrow$ if the interest rate is 10% per annum, for instance, the manager may lose up to \$0.91M given that $\$9.09\text{M} \times (1.10)^2 = \$11\text{M}$

Interest rate swaps

contract between two parties to trade the cash flows corresponding to different securities without actually exchanging the securities directly

notional principal: floater $\times$ fixed-rate bond

pricing swaps: difference between the value of the bonds

swap dealer: receives a compensation via bid-ask spread for bearing the credit risk and providing financial intermediation services, e.g., funneling the net payments from one party to the other

Investment Analysis

Marcelo Fernandes
Queen Mary, University of London

Lecture 9 [Easley & O'Hara, Journal of Finance, 1992]

Adverse selection costs

bid-ask spread: execution and order processing costs $\longrightarrow$ constant?
monopoly power $\longrightarrow$ competition?
inventory costs $\longrightarrow$ risk aversion
adverse selection costs $\longrightarrow$ endogenous!!!

Easley & O'Hara: sequential trading model that individuates the effects of asymmetric information

insider $\times$ **uninformed**
market maker is unable to identify who is who, hence...
bid-ask spread $\longrightarrow$ reward to provide liquidity under asymmetric information

Assumptions

single market maker: risk neutral, competitive, updates by Bayes

asset value V with signal $\psi \in \{L, 0, H\}$

$$\mathbb{E}(V \mid \psi = L) = V_L$$
$$\mathbb{E}(V \mid \psi = H) = V_H$$
$$\mathbb{E}(V \mid \psi = 0) = \delta V_L + (1 - \delta) V_H = V_*$$

informed traders: risk neutral, always trade

uninformed traders: liquidity and portfolio reasons

Informational structure

information event with probability $\alpha \longrightarrow$ Dow-Jones rumor wire

if there are news, then bad ($\psi = L$) with probability δ
good ($\psi = H$) with probability $1 - \delta$

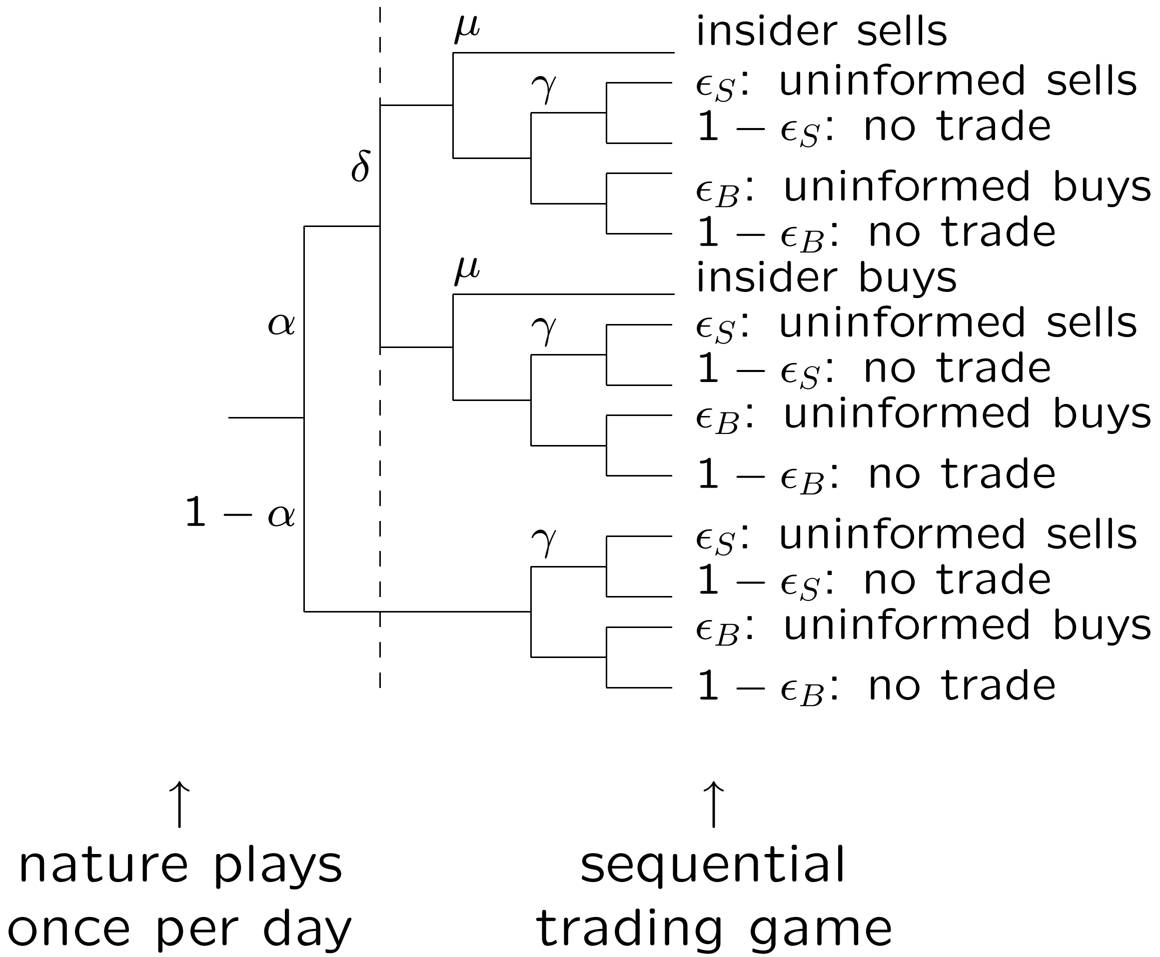
trader population: insider with probability μ
uninformed with probability $1 - \mu$

uninformed trader

potential seller with probability $\gamma \longrightarrow$ trades with probability ϵ_S

potential buyer with probability $1 - \gamma \longrightarrow$ trades with probability ϵ_B

Tree diagram of the trading process



Informational content

market maker always assign a nonzero probability for the good and bad states of the nature, hence the bid and ask prices will always lie between V_L and V_H $\longrightarrow$ **insider always trade**

no-trade event carries as much information as buys and sells, because it is more likely to occur when there are no news

volume signals whether there is new information
inventory position (or signed volume) signals its direction

preliminary conclusions
$\longrightarrow$ it takes volume to move prices
$\longrightarrow$ quote revision depends on the number of buys, sells and no-trades

Evolution of beliefs

(n_t, β_t, s_t) is a sufficient statistic for trade history Q^t

n_t number of no-trade outcomes
β_t number of buys
s_t number of sells

<u>example</u>: probability MM assigns to the absence of new information

$$\begin{aligned} p_{0t} &= \Pr(\psi = 0 \,|\, Q^t) \\ &= (1-\alpha)(\gamma\epsilon_S)^{s_t}[(1-\gamma)\epsilon_B]^{\beta_t} \Big\{ (1-\alpha)(\gamma\epsilon_S)^{s_t}[(1-\gamma)\epsilon_B]^{\beta_t} \\ &\quad + (1-\mu)^{n_t} \Big[\alpha\delta(\mu + (1-\mu)\gamma\epsilon_S)^{s_t}((1-\mu)(1-\gamma)\epsilon_B)^{\beta_t} \\ &\quad + \alpha(1-\delta)((1-\mu)\gamma\epsilon_S)^{s_t}(\mu + (1-\mu)(1-\gamma)\epsilon_B)^{\beta_t} \Big] \Big\}^{-1}. \end{aligned}$$

Quote revision

the evolution of beliefs will completely determine the evolution of quotes and, as the market maker is competitive, the bid/ask quotes will coincide with the expected value of the stock given that the next trade outcome is a sell/buy, respectively

$$
\begin{aligned}
b_{t+1} &= \mathbb{E}(V \,|\, Q^t, Q_{t+1} = S) \\
&= V_L \, \mathsf{Pr}(\psi = L \,|\, Q^t, S) + V_* \, \mathsf{Pr}(\psi = 0 \,|\, Q^t, S) + V_H \, \mathsf{Pr}(\psi = H \,|\, Q^t, S)
\end{aligned}
$$

$$
\begin{aligned}
a_{t+1} &= \mathbb{E}(V \,|\, Q^t, Q_{t+1} = B) \\
&= V_L \, \mathsf{Pr}(\psi = L \,|\, Q^t, B) + V_* \, \mathsf{Pr}(\psi = 0 \,|\, Q^t, B) + V_H \, \mathsf{Pr}(\psi = H \,|\, Q^t, B)
\end{aligned}
$$

transaction price: optional sampling yields a subordinated process

Implications

1. quotes change even in the absence of trades
2. bid-ask spread decreases with the trade duration
3. trade durations are endogenous and serially dependent
4. prices do not satisfy the Markov property
5. transaction prices are martingales, hence weak efficiency
6. strong efficiency holds only in the limit
7. positive correlation between volatility and volume

Extensions

1. time-varying probability of uninformed trading
   nonspeculative reasons for uninformed trading
   may depend on the business cycle

2. size effect: block trades $\times$ small trades
   insiders wish to profit as much and quick as
   possible, hence they may prefer block trades

3. option market
   options offer more leverage to the insiders, hence
   it may affect the partial equilibrium conclusions

Informational risk

it is straightforward to estimate all the parameters of the sequential trading model by Easley & O'Hara using transactions data so as to retrieve the **unconditional probability of insider trading**

$$\text{PIN} = \frac{\alpha\,\mu}{\alpha\,\mu + \epsilon_S + \epsilon_B}$$

$\longrightarrow$ measure of adverse selection cost

the **arbitrage pricing theory** says that one must pay a premium for all sources of risk, hence it follows that expected returns must increase with PIN

Investment Analysis

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Lecture 10 [BMK04, chapter 20]

Performance evaluation

eternal debate: active $\times$ passive investment strategy

we know that expected return is a function of risk and hence to evaluate the **relative performance** of active portfolio managers, we must somehow **control for the risk** of their portfolio

tools: comparison groups
risk-adjusted performance statistics
measures based on a hypothetical portfolio
performance attribution procedures

$\longrightarrow$ How to choose the right measure of risk?

Comparison groups

the simplest and most popular way to adjust returns for portfolio risk is to compare rates of returns with those of other investment funds with **similar risk characteristics**

example: each portfolio manager receives a ranking according to the relative performance within the **comparison universe**

drawback: it is a daunting task to define the comparison universe for there are always subgroups within every particular universe, but it serves as a useful first step in evaluating performance

example: within the universe of stocks with low P/E, one manager could concentrate on stocks with small market cap

Risk-adjusted performance statistics

there are three main methods to gauge risk-adjusted performance using the mean-variance approach

1. Sharpe ratio

2. Treynor measure

3. Jensen's alpha measure

example:

	portfolio	market index	risk-free
average return	16%	14%	6%
standard deviation	20%	24%	0
beta	0.8	1	0

Sharpe ratio

it considers the **incremental return and volatility** of the portfolio relative to the risk-free alternative investment in order to gauge the **reward-to-variability ratio**

$$S_i = \frac{\bar{r}_i - \bar{r}_f}{\widehat{\sigma}_i}$$

benchmark: risk-free asset

example: the Sharpe ratio of the portfolio is $(16 - 6)/20 = 1/2$, whereas for the market index is $(14 - 6)/24 = 1/3$

Treynor measure

it gives the average excess return per unit of systematic risk, hence the denominator equals the beta rather than the volatility (i.e., total risk) of the portfolio

$$T_i = \frac{\bar{r}_i - \bar{r}_f}{\widehat{\beta}_i}$$

benchmark: risk-free asset

example: the Treynor ratio of the portfolio is $(16 - 6)/0.8 = 12.5\%$, whereas for the market index is $(14 - 6)/1 = 8\%$

Jensen's alpha measure

it is the average return on the portfolio over and above that predicted by the CAPM as a function of the portfolio's beta and the average return on the market index

$$\alpha_i = \bar{r}_i - \bar{r}_f - \beta_i \left(\bar{r}_M - \bar{r}_f \right)$$

benchmark: market index

example: the portfolio's alpha is $16 - 6 - 0.8\,(14 - 6) = 3.6\%$

M-squared measure

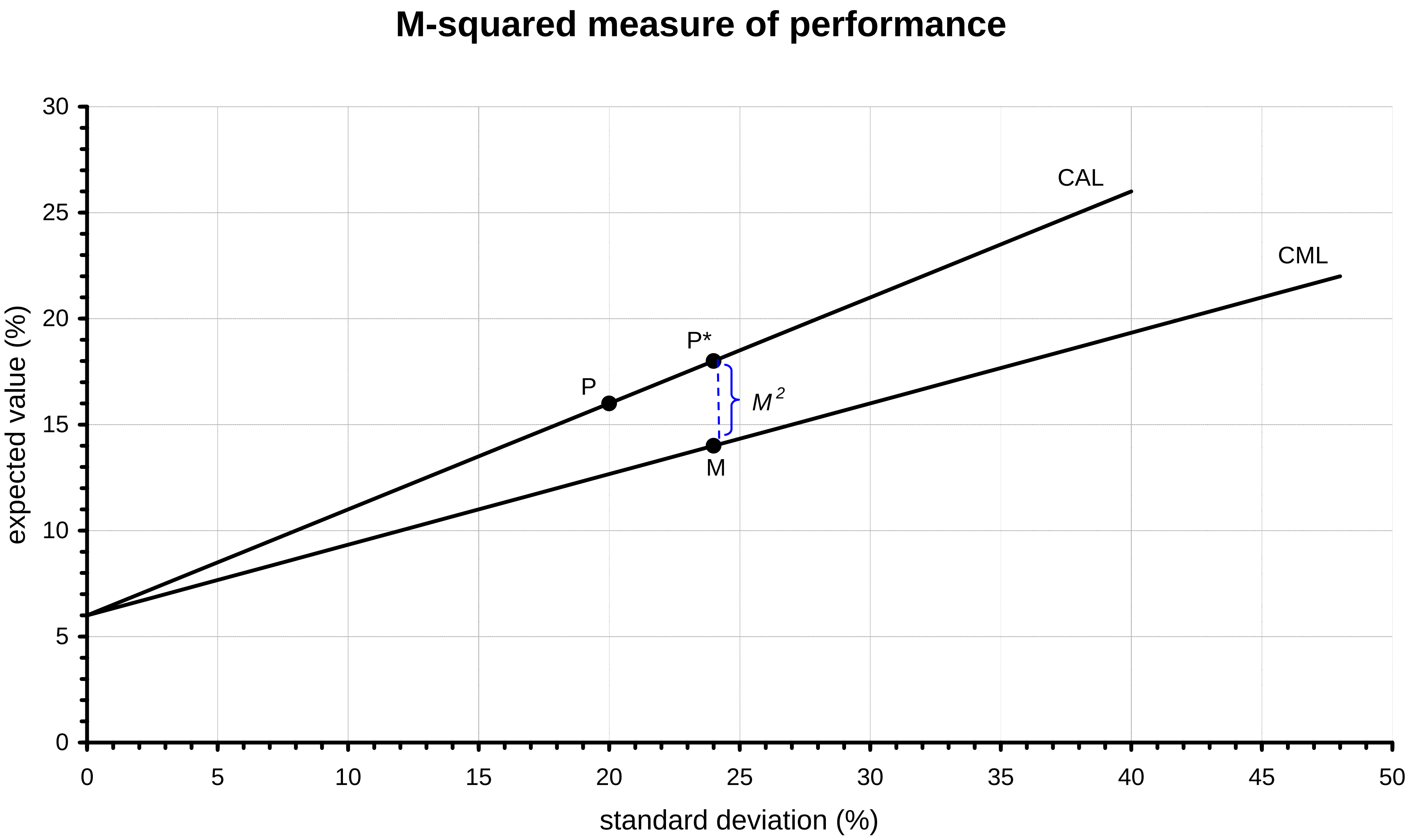
it is not easy to appreciate whether the difference in the Sharpe ratio is **economically meaningful** $\longrightarrow$ Modigliani & Modigliani, 1997

goal: to compute the differential return relative to the index rather than comparing the CAL and CML slopes

hypothetical portfolio that combines the portfolio with a position in T-bills (i.e., the risk-free asset) so as to match the volatility of the benchmark index $\longrightarrow$ $M^2 = r_P^* - r_M$

example: the portfolio volatility is 20%, hence one must short the risk-free asset and invest the proceeds in the portfolio to match the market index volatility of 24% $\longrightarrow$ $w_P^* = 24/20 = 1.2$

$$M^2 = (1.2\times 16 - 0.2\times 6) - 14 = 4\%$$


M-squared measure of performance
expected value (%)
standard deviation (%)
CAL
CML
P*
P
M
M^2
0
5
10
15
20
25
30
35
40
45
50

Variant of the Treynor measure

one may apply the same idea to express the difference in portfolio performance, as measured by the Treynor ratio, in terms of rates of excess return $\longrightarrow$ **T-squared measure**

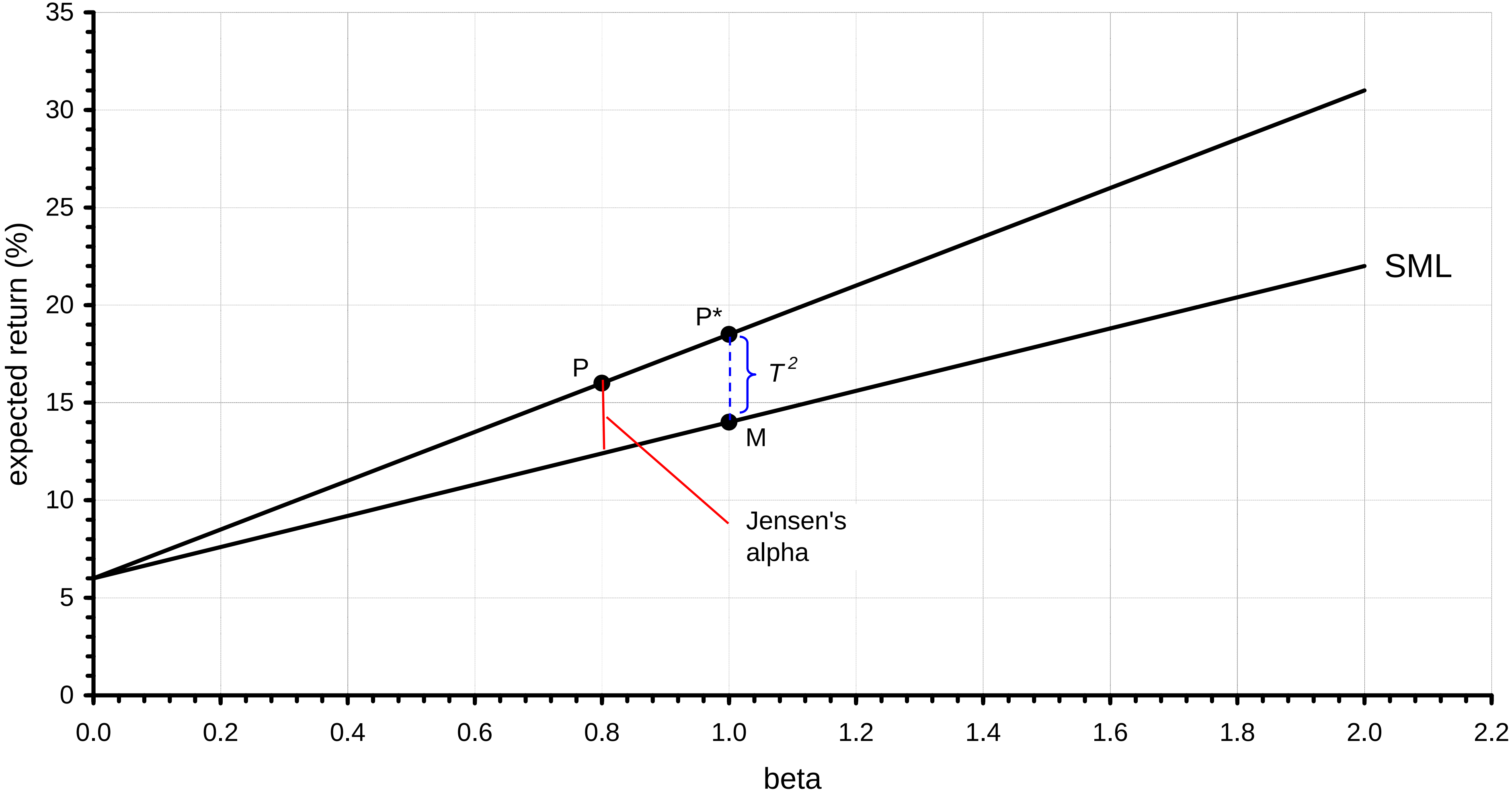
hypothetical portfolio that combines the portfolio with a position in T-bills so as to match the beta of the market index ($\beta_M = 1$)

graphical interpretation: instead of comparing the SML slopes, it looks at the differential excess return relative to to the index

example: as the portfolio beta is 0.8, one must short the risk-free asset to increase the beta $\longrightarrow w_P^* = \beta_P^{-1} = 1.25$

$$T^2 = 1.25\,(16-6) - (14-6) = 6.25\%$$

Treynor-squared measure of performance



Choosing the right measure

different risk adjustment procedures can yield distinct implications for performance evaluation, hence one must choose the most appropriate measure for the task

example 1: if you are hiring someone to manage the entire portfolio of a pension fund, then you must assign substantial weight to the variability of investment performance given the lack of diversification across managers $\longrightarrow$ Sharpe ratio or M-squared measure

example 2: if hiring several portfolio managers, diversification across them ensures that the residual non-systematic risks of each portfolio become irrelevant $\longrightarrow$ Treynor-type measure

Portfolio composition

one potential problem with risk-adjustment techniques is that they all assume that the portfolio risk is constant over the period under consideration

example: if a manager decides to increase the portfolio beta to profit from a bullish market, the Sharpe ratio may give misleading results for it does not account for the strategy change

excess return per quarter: first year (-1, 3, -1, 3)
second year (-9, 27, -9, 27)

Sharpe ratio: first year = second year = 0.5
aggregate = 5/13.42 = 0.37

Potential pitfalls in performance evaluation

Sharpe's measure does not recognize shifts in the average excess return as a result of a strategy change, hence it is paramount to keep track of portfolio composition and **changes in risk-return profile**

when assessing the performance of the most successful mutual fund over a given period, one must account for the fact that, even if all portfolio managers have the same skill, a winner would emerge by sheer chance $\longrightarrow$ **distribution of the maximum**

example: Fidelity's Magellan Fund outperformed the S&P500 for eleven years from 1977 to 1989 $\longrightarrow$ **failure of the EMH?**

Performance attribution procedures

rather than focus on risk-adjusted returns, one could also think of **decomposing** overall performance into **discrete components** that relate to particular levels of the portfolio selection process

example: (1) broad asset market allocation *across* asset classes
(2) industry/sector allocation *within* each asset class
(3) security allocation *within* each industry/sector

bogey: benchmark level of performance that measures the returns the portfolio manager would earn under a passive strategy

example: neutral allocation across asset classes/sectors
passive index within asset classes/sectors

How it works in practice?

focus on **intentional bets** on market performance, that is to say, deviations from the neutral allocation implied by the investor's degree of risk aversion **across** and **within** markets

market	portfolio	bogey	excess weight	return	contribution
equity	70%	60%	10%	5.81%	0.5810%
fixed-income	7%	30%	-23%	1.45%	-0.3335%
money	23%	10%	13%	0.48%	0.0624%
contribution of asset allocation to performance					0.3099%

market	portfolio	index	excess performance	weight	contribution
equity	7.28%	5.81%	1.47%	70%	1.03%
fixed-income	1.89%	1.45%	0.44%	7%	0.03%
contribution of selection within markets to performance					1.06%

Contribution summary

one must also perform a similar assessment for the security selection within the equity and fixed-income markets

task		weight	contribution in basis points
asset allocation			31
security selection			
equity excess return	147	0.70	102.9
sector analysis	(129)		
security allocation	(18)		
fixed-income excess return	44	0.07	3.1
bond-class analysis	(39)		
security allocation	(5)		
total excess return of portfolio			137

Market timing

asset allocation strategy in which one increases the equity investment in response to forecasts of relative performance to bills

example:

investment strategy	January 1926	December 31
rolling 30-day T-bills	$1	$16.98
S&P500	$1	$1,987.01
perfect timer	$1	$115,233.89

timer's standard deviation **overestimates** the risk because the perfect timer never does worse than all-equity and all-bills strategies

how to value market timing? it is as if the perfect foresight investor were investing 100% in bills and holding a call option on the equity portfolio with strike price $S_0(1+r_f) \longrightarrow$ **value of the call option**

Imperfect forecasting

while managers who are right most of the time presumably do very well, "right most of the time" does not mean merely the percentage of time a manager is right

goal: examine the proportions π_1 and π_2 of bull markets ($r_M > r_f$) and bear markets ($r_M < r_f$) correctly forecast

$$\begin{aligned}(\text{imperfect timer value}) &= (\text{timing ability}) \times (\text{call option value}) \\ (\text{timing ability}) &= \pi_1 + \pi_2 - 1\end{aligned}$$

Market timing performance

the pure form of market timing involves shifting funds fully between a market index portfolio and a safe asset depending on whether the market is bullish or bearish, **but**. . .

in practice, most managers do not shift fully and the most we observe is an increase in the portfolio beta

implication: if one plots the excess return of the portfolio against the excess return of the market index, a straight line emerges in the absence of market timing, whereas a convex curve arises with market timing

Treynor-Black model

active managers must strike a balance between aggressive exploitation of security mispricing and diversification considerations that dictate against restricting attention to few stocks

assumptions: security markets are nearly efficient
abnormal return as measured by CAPM's alpha

1. estimate $\left(\alpha_k, \beta_k, \sigma_k^2\right)$ for a small number of securities
2. build the active portfolio A and estimate $\left(\alpha_A, \beta_A, \sigma_A^2\right)$
3. optimally combine the active portfolio and the market index

$\longrightarrow$ resulting Sharpe ratio depends on the magnitude of the **appraisal ratio**, i.e., the ratio of alpha to nonsystematic standard deviation