

FIN3080: Investment Analysis and Portfolio Management

SCHOOL OF MANAGEMENT AND ECONOMICS

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Tips: 开个股票帐户

Basic questions

- What is financial asset?
 - Financial assets vs real goods
 - Verifiable and implementable
- How do investors make money?
 - Beta vs alpha → 投资者自身能力
 - Efficient market or not?
- Why hedge fund is more risky?
 - Hedge means reducing risk but why hedge fund is more risky?

$$\tilde{r}_1 = \tilde{x} + \tilde{y} \quad \tilde{r}_2 = \tilde{x}$$

$$\tilde{r}_p = \tilde{r}_1 - \tilde{r}_2 = \tilde{y}$$

bet more, earn more (lose more)
可能赚得更多，也可能亏的更多.

看大盘 ↪

Approaches to Valuation

- **Intrinsic valuation**, relates the value of an asset to its intrinsic characteristics: its capacity to generate cash flows and the risk of the cash flows. In its most common form, intrinsic value is computed with a discounted cash flow valuation, with the value of an asset being the present value of expected future cash flows on that asset.
- **Relative valuation or pricing**, estimates the value of an asset by looking at the pricing of 'comparable assets' relative to a common variable like earnings, cashflows, book value or sales.

Misconceptions about Valuation

- Myth 1: A valuation is an objective search for true value
 - Truth 1.1: All valuations are biased. The only questions are “how much” and in which direction.
- Myth 2.: A good valuation provides a precise estimate of value
 - Truth 2.1: There are no precise valuations.
 - Truth 2.2: The payoff to valuation is greatest when valuation is least precise.
- Myth 3: The more quantitative a model, the better the valuation
 - Truth 3.1: One’s understanding of a valuation model is inversely proportional to the number of inputs required for the model.
 - Truth 3.2: Simpler valuation models do much better than complex ones.

Basis for all valuation approaches

- The use of valuation models in investment decisions (i.e., in decisions on which assets are under-valued and which are over-valued) are based upon
 - a perception that markets are inefficient and make mistakes in assessing value
 - an assumption about how and when these inefficiencies will get corrected
- In an efficient market, the market price is the best estimate of value. The purpose of any valuation model is then the justification of this value.

Discounted Cash flow Valuation (DCF)

- What is it: In discounted cash flow valuation, the value of an asset is the present value of the expected cash flows on the asset.
- Philosophical Basis: Every asset has an intrinsic value that can be estimated, based upon its characteristics in terms of cash flows, growth and risk.
- Information Needed: To use discounted cash flow valuation, you need
 - to estimate the life of the asset
 - to estimate the cash flows during the life of the asset
 - to estimate the discount rate to apply to these cash flows to get present value
- Market Inefficiency: Markets are assumed to make mistakes in pricing assets across time, and are assumed to correct themselves over time, as new information comes out about assets.

Advantages of DCF Valuation

- Since DCF valuation, done right, is based upon an asset's fundamentals, it should be less exposed to market moods and perceptions.
- If good investors buy businesses, rather than stocks (the Warren Buffet adage), discounted cash flow valuation is the right way to think about what you are getting when you buy an asset.
- DCF valuation forces you to think about the underlying characteristics of the firm, and understand its business. If nothing else, it brings you face to face with the assumptions you are making when you pay a given price for an asset.
- If you buy into the notion of value being driven by a company's cash flows, you are immunized (to the extent that you have a long time horizon) from what the market thinks about your investment..

DCF与市场信息无关

Disadvantages of DCF valuation

- Since it is an attempt to estimate intrinsic value, it requires far more explicit inputs and information than other valuation approaches
- These inputs and information are not only noisy (and difficult to estimate), but can be manipulated by the analyst to provide the conclusion he or she wants. The quality of the analyst then becomes a function of how well he or she can hide the manipulation.
- In an intrinsic valuation model, there is no guarantee that anything will emerge as under or over valued. Thus, it is possible in a DCF valuation model, to find every stock in a market to be over valued. This can be a problem for
 - equity research analysts, whose job it is to follow sectors and make recommendations on the most under and over valued stocks in that sector
 - equity portfolio managers, who have to be fully (or close to fully) invested in equities

When DCF Valuation works best

- At the risk of stating the obvious, this approach is designed for use for assets (firms) that derive their value from their capacity to generate cash flows in the future.
- It works best for investors who
 - have a long time horizon, allowing the market time to correct its valuation mistakes and for price to revert to “true” value or
 - are capable of providing the catalyst needed to move price to value, as would be the case if you were an activist investor or a potential acquirer of the whole firm
 - are not easily swayed or affected by market movements that are contrary to their “value” views

Relative Valuation (Pricing)

- What is it?: The value of any asset can be estimated by looking at how the market prices “similar” or ‘comparable’ assets.
- Philosophical Basis: The intrinsic value of an asset is impossible (or close to impossible) to estimate. The price of an asset is whatever the market is willing to pay for it (based upon its characteristics)
- Information Needed: To do a relative valuation, you need
 - an identical asset, or a group of comparable or similar assets
 - a standardized measure of value (in equity, this is obtained by dividing the price by a common variable, such as earnings or book value)
 - and if the assets are not perfectly comparable, variables to control for the differences
- Market Inefficiency: Pricing errors made across similar or comparable assets are easier to spot, easier to exploit and are much more quickly corrected.

Advantages of Relative Valuation

- In sync with the market: Relative valuation is much more likely to reflect market perceptions and moods than discounted cash flow valuation. This can be an advantage when it is important that the price reflect these perceptions as is the case when
 - the objective is to sell an asset at that price today (IPO, M&A)
 - investing on “momentum” based strategies
- With relative valuation, there will always be a significant proportion of securities that are under valued and over valued. Since portfolio managers are judged based upon how they perform on a relative basis (to the market and other money managers), relative valuation is more tailored to their needs
- Relative valuation generally requires less explicit information than discounted cash flow valuation.

Disadvantages of Relative Valuation

- A portfolio that is composed of stocks which are under valued on a relative basis may still be overvalued, even if the analysts' judgments are right. It is just less overvalued than other securities in the market.
- Relative valuation is built on the assumption that markets are correct in the aggregate, but make mistakes on individual securities. To the degree that markets can be over or under valued in the aggregate, relative valuation will fail
- Relative valuation may require less information in the way in which most analysts and portfolio managers use it. However, this is because implicit assumptions are made about other variables (that would have been required in a discounted cash flow valuation). To the extent that these implicit assumptions are wrong the relative valuation will also be wrong.

When relative valuation works best

- This approach is easiest to use when
 - ▣ there are a large number of assets comparable to the one being valued
 - ▣ these assets are priced in a market
 - ▣ there exists some common variable that can be used to standardize the price
- This approach tends to work best for investors
 - ▣ who have relatively short time horizons
 - ▣ are judged based upon a relative benchmark (the market, other portfolio managers following the same investment style etc.)
 - ▣ can take actions that can take advantage of the relative mispricing; for instance, a hedge fund can buy the under valued and sell the over valued assets

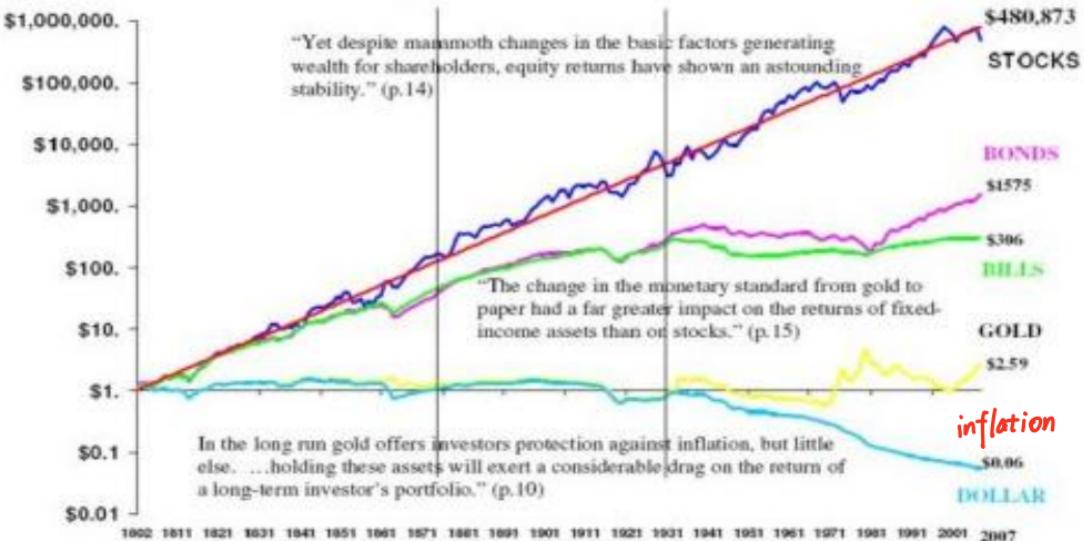
Valuation: Lecture Note Packet 1

Intrinsic Valuation

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Total Real Return Indexes

January 1802 – December 31, 2008



Source: Siegel, Jeremy, *Stocks for the Long Run* (2008).

The essence of intrinsic value

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- In intrinsic valuation, you value an asset based upon its fundamentals (or intrinsic characteristics). *future cash flow*
- For cash flow generating assets, the intrinsic value will be a function of the magnitude of the expected cash flows on the asset over its lifetime and the uncertainty about receiving those cash flows.
- Discounted cash flow valuation is a tool for estimating intrinsic value, where the expected value of an asset is written as the present value of the expected cash flows on the asset, with either the cash flows or the discount rate adjusted to reflect the risk.

Risk Adjusted Value: Two Basic Propositions

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- The value of an asset is the risk-adjusted present value of the cash flows:

$$\text{Value of asset} = \frac{E(CF_1)}{(1+r)} + \frac{E(CF_2)}{(1+r)^2} + \frac{E(CF_3)}{(1+r)^3} \dots + \frac{E(CF_n)}{(1+r)^n}$$

$$\text{Value of asset} = \frac{CE(CF_1)}{(1+r_f)} + \frac{CE(CF_2)}{(1+r_f)^2} + \frac{CE(CF_3)}{(1+r_f)^3} \dots + \frac{CE(CF_n)}{(1+r_f)^n}$$

- If IT does not affect the expected cash flows or the riskiness of the cash flows, IT cannot affect value.
- For an asset to have value, the expected cash flows have to be positive some time over the life of the asset.
- Assets that generate cash flows early in their life will be worth more than assets that generate cash flows later; the latter may however have greater growth and higher cash flows to compensate.

discount 次數少

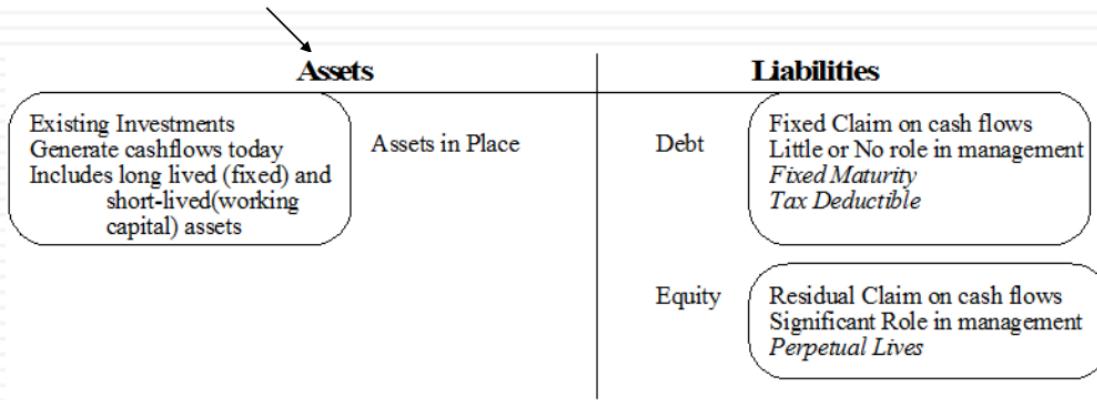
whether to pay dividend: ① Any good opportunity to invest
② No opportunity \Rightarrow pay dividend

> affect stock price.

DCF Choices: Equity Valuation versus Firm Valuation

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Firm Valuation: Value the entire business



现有(账面价值)
Book Value & Market Value 未来(市场价值)
discounted future cash flow

Equity Valuation

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Assets	Liabilities
<p>Cash flows considered are cashflows from assets, after debt payments and after making reinvestments needed for future growth</p>	<p>Assets in Place</p> <p>Debt</p> <p>Equity</p> <p>Discount rate reflects only the cost of raising equity financing</p> <p>Present value is value of just the equity claims on the firm</p>

Firm Valuation

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Figure 5.6: Firm Valuation

Assets		Liabilities
Cash flows considered are cashflows from assets, prior to any debt payments but after firm has reinvested to create growth assets	Assets in Place Growth Assets	Debt Equity
		Discount rate reflects the cost of raising both debt and equity financing, in proportion to their use

Present value is value of the entire firm, and reflects the value of all claims on the firm.

Cash Flows and Discount Rates

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- Assume that you are analyzing a company with the following cash flows for the next five years.

Year	CF to Equity	Interest Exp <i>← debt holder</i>	CF to Firm
1	\$ 50	\$ 40	\$ 90
2	\$ 60	\$ 40	\$ 100
3	\$ 68	\$ 40	\$ 108
4	\$ 76.2	\$ 40	\$ 116.2
5	\$ 83.49	\$ 40	\$ 123.49
Terminal Value	\$ 1603.0		\$ 2363.008

- Assume also that the cost of equity is 13.625% and the firm can borrow long term at 5%. The current market value of equity is \$1,073 and the value of debt outstanding is \$800.

Equity versus Firm Valuation

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- Method 1: Discount CF to Equity at Cost of Equity to get value of equity
 - Cost of Equity = 13.625%
 - Value of Equity = $50/1.13625 + 60/1.13625^2 + 68/1.13625^3 + 76.2/1.13625^4 + (83.49+1603)/1.13625^5 = \1073
- Method 2: Discount CF to Firm at Cost of Capital to get value of firm
 - Cost of Debt = 5%
 - Cost of Capital = $13.625\% (1073/1873) + 5\% (800/1873) = 9.94\%$
 - PV of Firm = $90/1.0994 + 100/1.0994^2 + 108/1.0994^3 + 116.2/1.0994^4 + (123.49+2363)/1.0994^5 = \1873
 - Value of Equity = Value of Firm - Market Value of Debt
 $= \$1873 - \$800 = \$1073$

Capital 来自 Debt + Equity

First Principle of Valuation

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- Discounting Consistency Principle: Never mix and match cash flows and discount rates.
- Mismatching cash flows to discount rates is deadly.
 - ▣ Discounting after debt cash flows (equity cash flows) at the weighted average cost of capital will lead to an upwardly biased estimate of the value of equity
 - ▣ Discounting pre-debt cashflows (cash flows to the firm) at the cost of equity will yield a downward biased estimate of the value of the firm.

The Effects of Mismatching Cash Flows and Discount Rates

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- Error 1: Discount CF to Equity at Cost of Capital to get equity value
 - ▣ $PV \text{ of Equity} = 50/1.0994 + 60/1.0994^2 + 68/1.0994^3 + 76.2/1.0994^4 + (83.49+1603)/1.0994^5 = \1248
 - ▣ Value of equity is overstated by \$175.
- Error 2: Discount CF to Firm at Cost of Equity to get firm value
 - ▣ $PV \text{ of Firm} = 90/1.13625 + 100/1.13625^2 + 108/1.13625^3 + 116.2/1.13625^4 + (123.49+2363)/1.13625^5 = \1613
 - ▣ $PV \text{ of Equity} = \$1612.86 - \$800 = \$813$
 - ▣ Value of Equity is understated by \$ 260.
- Error 3: Discount CF to Firm at Cost of Equity, forget to subtract out debt, and get too high a value for equity
 - ▣ Value of Equity = \$ 1613
 - ▣ Value of Equity is overstated by \$ 540

Discounted Cash Flow Valuation: The Steps

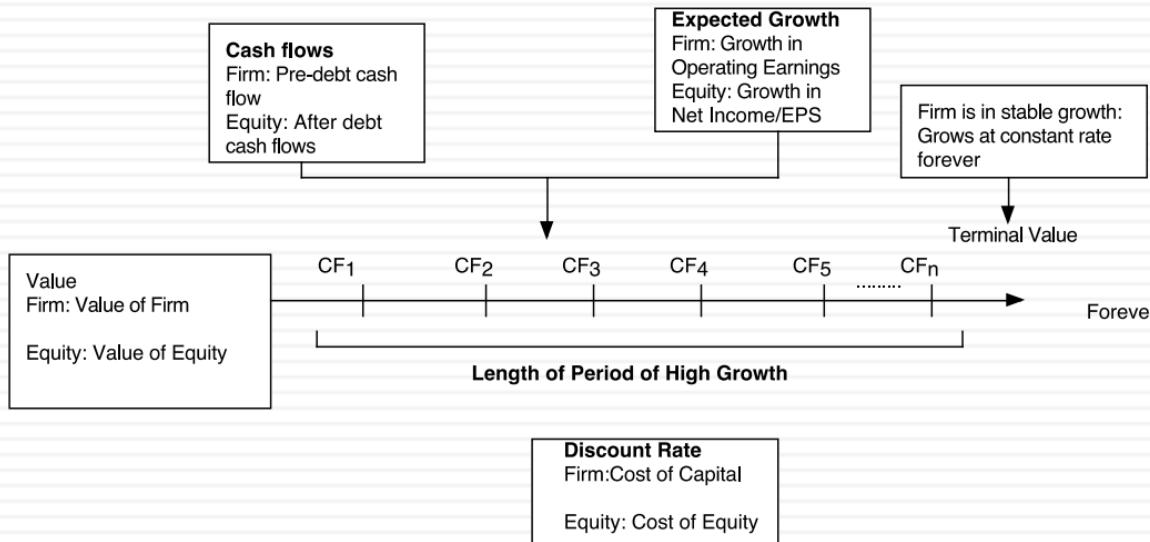
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1. Estimate the discount rate or rates to use in the valuation
2. Estimate the current earnings and cash flows on the asset, to either equity investors (CF to Equity) or to all claimholders (CF to Firm)
3. Estimate the future earnings and cash flows on the firm being valued, generally by estimating an expected growth rate in earnings.
4. Estimate when the firm will reach “stable growth” and what characteristics (risk & cash flow) it will have when it does.
5. Choose the right DCF model for this asset and value it.

Generic DCF Valuation Model

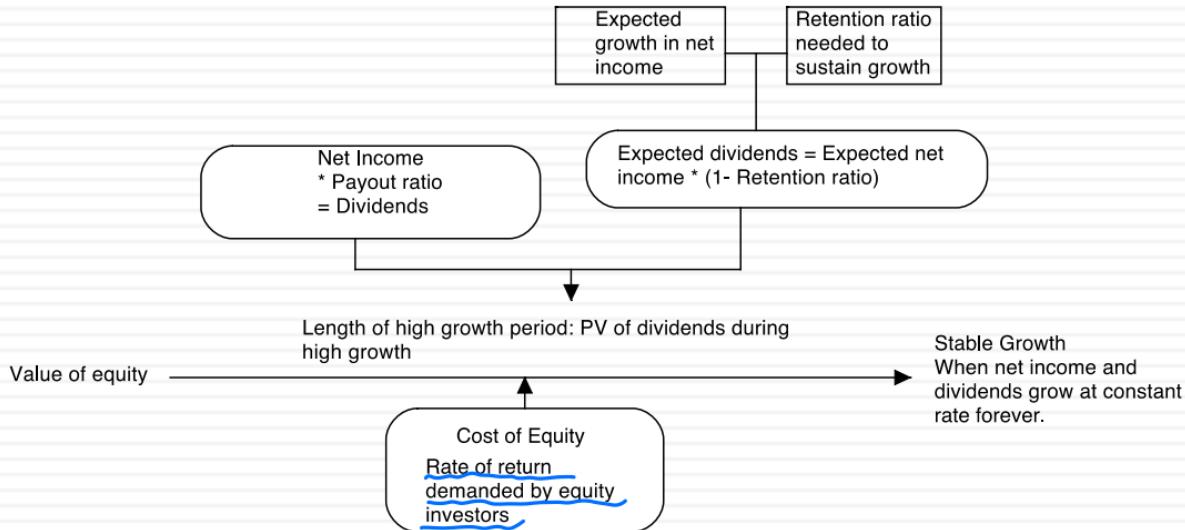
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DISCOUNTED CASHFLOW VALUATION



Start easy: The Dividend Discount Model

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What does a stock analyst look like

Philosophical Problems: Do you REALLY know the value of the company that you invest in



• 全都是泡沫
• 只一刹的花火

The Accounting Basis

◆ Some important financial data

- Earnings before Interest, Taxes, Depreciation and Amortization (EBITDA)

» $=\text{EBIT} + \text{Depreciation and amortization (DA)}$

» $\text{EBITDA Margin} = \text{EBITDA}/\text{Sales Revenue}$

- Net Income

» $=\text{EBIT} - \text{Interest} - \text{Taxes} - \text{Non-controlling Interest (NCI)}$

– Preferred Dividend 优先股红利 (股息较高)

» It is customary to calculate net income as earning per share (EPS)

» P/E ratio = Share price/ EPS

E/P : 利率 (年收益率) 国债：

» $\text{ROE} = \text{Net Income}/\text{Net Asset}$

Earning Per Share I/P 3%
Interest

» $\text{ROA} = \text{Net Income}/\text{Total Asset}$

房地产： $R/S = 1\% - 2\% <$ 国债

↑
Book Value

$$\text{Net Asset} + \text{Debt} = \text{Total Asset}$$

The Accounting Basis

◆ Some important financial data

– enterprise value (EV) 收购某公司所需价格

$$\gg = \text{stock market value} + \text{total liability} + \underline{\text{preferred dividend}}$$

占较多其他
公司股权 ← + non-controlling interest – value of associate company
- cash and cash equivalents → 占较少其他公司股权

A simplified version: $EV = \text{Stock market value} + \text{Total liability}$

-cash and cash equivalents

–Interest coverage ratio

$$\gg = EBIT \text{、EBITDA / Interest}$$

Bankrupt of a company: out of cash (没有钱付股息)

Asset Price

- ◆ Present Value of all Capitals:

$$PV = \frac{CF_1}{(1+k)} + \frac{CF_2}{(1+k)^2} + \dots + \frac{CF_n}{(1+k)^n}$$

\downarrow *Expected Return*

$$= \sum_{t=1}^n \frac{CF_t}{(1+k)}$$

- ◆ If CF remains unchanged: $PV = \frac{CF_1}{k}$
- ◆ If CF is growing at a rate g :

$$PV = \frac{CF_1}{k-g}$$

估价量

Asset Price

Earnings of a firm: ① Dividend

② Cash in balance sheet
③ reinvestment

◆ CF Unchanged $PV = \frac{CF}{k}$

◆ CF grows at a rate g $PV = \frac{CF}{k - g}$

- ◆ Suppose CF of a company equals 100 each year,
discounted rate =20%, then:

If $g=0$, $PV=100/0.20=500$

$g=5\%$, $PV=100/0.15=667$

$g=18\%$, $PV=100/0.02=5000$

$g=19\%$, $PV=100/0.01=10000$

$g=19.5\%$, $PV=100/0.005=20000$

Estimate Value are Extremely Sensitive to Growth Rate.

CAPM

- ◆ Generally Speaking, for any security i,

$$E(r_i) - r_f = \beta_i [E(r_M) - r_f]$$

$$\text{where } \beta_i = \frac{\text{Cov}(r_i, r_M)}{\sigma_M^2}.$$

- ◆ This model demonstrates the relationship of expected rate of return between particular securities and whole market;

Example: Assume the risk free rate is 4%, the stock market average return is 11%. Firm A's Beta is 1.2.

According to the CAPM theory, the expected return (or the discount factor, or cost of equity) of firm A should be

$$R = 4\% + 1.2 * (11\% - 4\%) = 12.4\%$$

Dividend discounted Model

- ◆ Gordon Model, also known as Constant Growth Model, assumes that dividend on shares are increasing on a constant rate of g :

- $(r > g)$

$$V_0 = \frac{D_0(1+g)}{(1+r)} + \frac{D_0(1+g)^2}{(1+r)^2} + \dots = \frac{D_0(1+g)}{r-g} = \frac{D_1}{r-g}$$

Example: Constant Growth Model (CGM)

- ◆ This is 2009. In 2008, American Electric Power (AEP) paid a dividend of \$1.64 per share. From 2006 to 2008, the average dividend increased 3.3% a year.
- ◆ From 1927 to 2008, the average market return in U.S was 11.4%. The historical average risk-free rate is 6.4%.
According to the data, a valuation of the market risk premium is 5%.
- ◆ AEP's beta is 0.62 (defensive stock). The yield of 10-year bond is 3.32%..
- ◆ What's the discounted rate?
– $r = 3.32\% + 0.62 \times 5\% = 6.42\%$.
不准确
- ◆ What is the valuation?
$$V = \frac{D_0 \times (1 + g)}{k - g} = 54.30$$

10年期国债的回报率也可看为 k

D_0 $(1 + 0.033)$
↑ ↗
 k g
- ◆ The price was \$31.06 on September 25, 2009.

Applicable conditions & limitations of CGM

◆ Applicable conditions

- Mature companies that pay stable dividends.
 - » Dividends can represent cash flow.
- A company whose growth rate is close to or below economic growth.
- A company that is not cyclical.
周期性的

◆ Limitations

- Very sensitive to growth rates.
- Undervalued company, which scarcely pays dividend.
- Not applicable to unstable companies, cyclical industries.

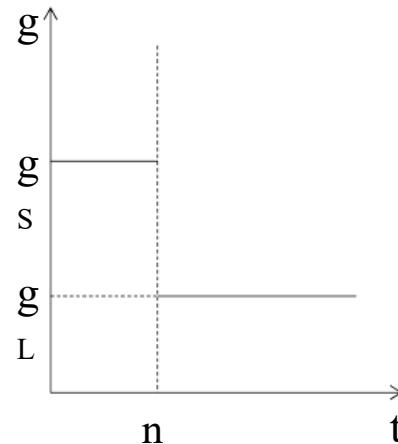
↓
年与年间盈利不稳定

Two-stage Dividend Growth Model

Two-stage model assumes that the company's dividend growth experienced two stages.

In the first stage, dividend increases every year by a higher (or lower) growth rate.

After that time, growth of dividend becomes stable at a low (or high) level (as shown on the right) :



Two-stage Dividend Growth Model

Two-stage Dividend Growth Model

$$P_0 = \sum_{t=1}^n \frac{D_t}{(1+k_{hg})^t} + \frac{P_n}{(1+k_{hg})^n}$$

$$P_0 = \frac{D_0 \times (1+g) \times \left[1 - \frac{(1+g)^n}{(1+k_{hg})^n} \right]}{(k_{hg} - g)} + \frac{D_0 \times (1+g)^n \times (1+g_n)}{(k_{st} - g_n) \times (1+k_{hg})^n}$$

g = The growth rate of the first n years

k_{hg} = discounted rate of high growth period

k_{st} = discounted rate of stable growth period

g_n = Stable growth rate after n years

The Choice of Long-term Growth Rate

- ◆ Long-term reinvestment ratio, growth rate and ROA must be consistent.

e.g

A

100+25

$$g = b \times ROE$$

B

$$60 + 10 \cdot \frac{60}{40}$$

$$\text{Earnings} = 30$$

$$\text{Dividend} = 20$$

C

$$40 + 10$$

$$\text{Retained Earnings} = 10$$

$$\Rightarrow b = \frac{1}{3}$$

CUHK(Shenzhen)

Leverage of B/C

$$g = \frac{\text{Earnings} \cdot b}{\text{Book Equity}} = b \cdot ROE$$

- ① 部门 Equity 成一定比例 (leverage)
- ② 所有的收益：1. Dividend 2. Retained
张劲帆 Not hold in Balance sheet
- ③ 只通过扩大生产来增加收益

Case: Consolidated Edison

One of the largest energy companies in the U.S.

About \$14 billion in sales.

\$36 billion in assets.

Pricing is required in August 2008.

Last 12 months:

EPS: \$3.17

DPS: \$2.32

Beta: 0.8

The U.S. 10-year Treasury rate: 4.1% → r_f

U.S market risk premium : 4.5%

Companies' leverage : 70% equity, 30% debt, stable for several decades.



Which Model should We Choose?

- ◆ Why choose the simple dividend discount model?

- Stable growth

- » Regulated utility companies, with limited growth,
are subject to population.

- Pricing for what company?

- » Leverage is very stable.

- Dividend

- » The company has paid out 97% of its free cash flow in
dividends over the past five years.

If high growth \Rightarrow Two stage



某一阶段 $k < g$ 也
适用

我们认为 $ROE \approx r$ (discount rate)

Pricing

- ◆ Discount rate
 - $=4.1\%+0.8*4.5\%=7.7\%$
- ◆ Stable discount rate
 - $b=27\%$ *对于该种类型公司适用 (utility company)*
 - $ROE=discount\ rate=7.7\%$
 - $g=ROE*b=2.1\%$
- ◆ Price
 - $=2.32 * (1.021) / (0.077 - 0.021)$
 - $=42.30$
- ◆ August 12, 2008, the market price is \$40.76.

$$\frac{3.17 - 2.32}{3.17}$$

Case: ABN AMRO

The largest bank in the Netherlands
Total asset is about 600 billion euros

In December of 2003

EPS: 1.85 euro *Earning per share*

DPS: 0.90 euro *Dividend per share*

European Banks' average beta at the time : 0.95

Euro long-term risk-free interest rate: 4.35%

Mature market's risk premium: 4%

ROE: 16%



Pricing

- ◆ Consider applying two-stage model due to extremely high ROE:
- ◆ Discount Rate 若一个公司较大，则理论上 $ROE = \text{Discount rate}$
 - $= 4.35\% + 0.95 * 4\% = 8.15\%$
- ◆ The First Stage
 - $b = \frac{1.85 - 0.9}{1.85} = 51.35\%$
 - ROE=16%
 - $g = 51.35\% * 16\% = 8.22\%$ $\rightarrow k < g$, 故分两期计算
- ◆ The Second Stage
 - $g = 4\%$ ← 假设，可在4%-5%间为正常
 - Discount Rate $= 4.35\% + 1 * 4\% = 8.35\%$
 - ROE=8.35% // \hookrightarrow firm big enough to have market beta = 1
 - Dividend Rate $= \underbrace{1 - 4}_{\downarrow} / 8.35 = 0.521$
$$b = \frac{g}{ROE}$$

Pricing

- ◆ Terminal Value

$$EPS_6 = 1.85 \times (1.0822)^5 \times 1.04 = 2.86$$

$$P_5 = EPS_6 \times 0.521 / (0.0835 - 0.04) = 34.20$$

- ◆ Price

$$\frac{EPS \times (1 - b_{hg}) \times (1 + g_{hg}) \times \left(1 - \frac{(1 + g_{hg})^5}{(1 + k_{hg})^5} \right)}{k_{hg} - g_{hg}} + \frac{P_5}{(1 + k_{hg})^5}$$

$$= \frac{1.85 \times 48.65\% \times (1 + 8.22\%) \times \left(1 - \frac{(1 + 8.22\%)^5}{(1 + 8.15\%)^5} \right)}{8.15\% - 8.22\%} + \frac{34.20}{(1 + 8.15\%)^5}$$

$$= 27.62$$

- ◆ In December 2003: market price was 18.55 Euro
End of the year 2007: RBS offered 38.5 Euro per share to takeover ABN AMRO

A Method to Adjust Free Cash Flow

- ◆ American companies are more likely paying dividends by repurchasing shares.
 - Now, over 50% of dividends are paid by repurchasing shares.
 - » Why? *decreasing tax payment*
- ◆ An adjusting method:
 - “Dividend” =dividend + Buy-Back
 - Dividend Ratio= $(\text{Dividend} + \text{Share Repurchase}) / \text{net earnings}$

Case: S&P500 Index (S&P500:January, 2009)

The dividend during last 12 months: 28.05

Estimated value of $g = 4\%$ in next 5 years

Treasury Bond Long-term Risk-free Rate: 2.21%

Current Market Risk Premium: 6%

Pricing

- ◆ Consider applying two stage model
 - Current expected growth rate is much greater than current interest rate
- ◆ Discount rate
 - $=2.21\% + 1 * 6\% = 8.21\%$
- ◆ First Stage
 - $g=4\%$
- ◆ Last Stage
 - $g=2.21\%$
 - Assuming market risk premium gets back to 4%

Pricing

- ◆ Result
 - Present value of high growth stage: 124.71
 - Terminal Value: 587.75
 - Value: 712.46
- ◆ On January 1st 2009:
 - Actual Index Price: 903
- ◆ Any questions?

Pricing

- ◆ Adjust Dividend pricing Model, plus repurchasing shares
 - ◆ Dividends during last 12 months + repurchasing Shares = 52.58
-
- ◆ Result
 - Present value of high growth stage: 233.76
 - Terminal Value: 1101.75
 - Value: 1335.51

Case: S&P500 Index (S&P500: January, 2010)

Dividends during last 12 months + Repurchasing Shares : 40.38
Estimated value of $g = 7.2\%$ in next 5 years

Treasury Bond Long-term Risk-free Rate : 3.84%
Current Market Risk Premium : 5%

Pricing

- ◆ Considering two stage model
 - At this stage the expected growth rate is far higher than interest rates.
- ◆ discounted rate
 - $=3.84\% + 1 * 5\% = 8.84\%$
- ◆ The first stage
 - $g=7.2\%$
- ◆ The last stage
 - $g=3.84\%$
 - Assume the market risk premium goes back to 4%

Pricing

- ◆ The result
 - The present value of high growth stage: 192.95
 - The present value of ultimate stage : 971.63
 - The price: 1164.59

- ◆ 2010.1.1
 - The actual point of the index: 1115

Three-Stage model

- ◆ The high growth stage were divided into high growth and middle growth stage, the last is the stable growth phase
 - the transformation of stable growth phase and the middle growth stage can be little by little.

Case: Goldman Sachs: 2008.8

2008.8

EPS: 16.77 dollar

DPS: 1.40 dollar

Average Beta of Investment Bank: 1.40

Risk free rate of T-Bills: 4.10%

Risk premium of mature market: 4.5%

ROE: 13.19%

↓
4~5% in common



ONN/FILE

Pricing

- ◆ Considering three-stage model
 - The dividend payout and the growth pattern of the company shows the potential of the company.
- ◆ discounted Rate
 - $=4.10\% + 1.40 * 4.5\% = 10.4\%$
- ◆ The first stage
 - $b = (1 - 1.4 / 16.77) = 91.65\%$
 - ROE = 13.19%
 - $g = 91.65\% * 13.19\% = 12.09\%$
- ◆ The last stage
 - $g = 4\%$
 - discounted rate = $4.10\% + 1.2 * \overset{\sim}{4.5\%} = 9.5\%$
 - ROE = 10%

should be closed

assumption , also can be 1.

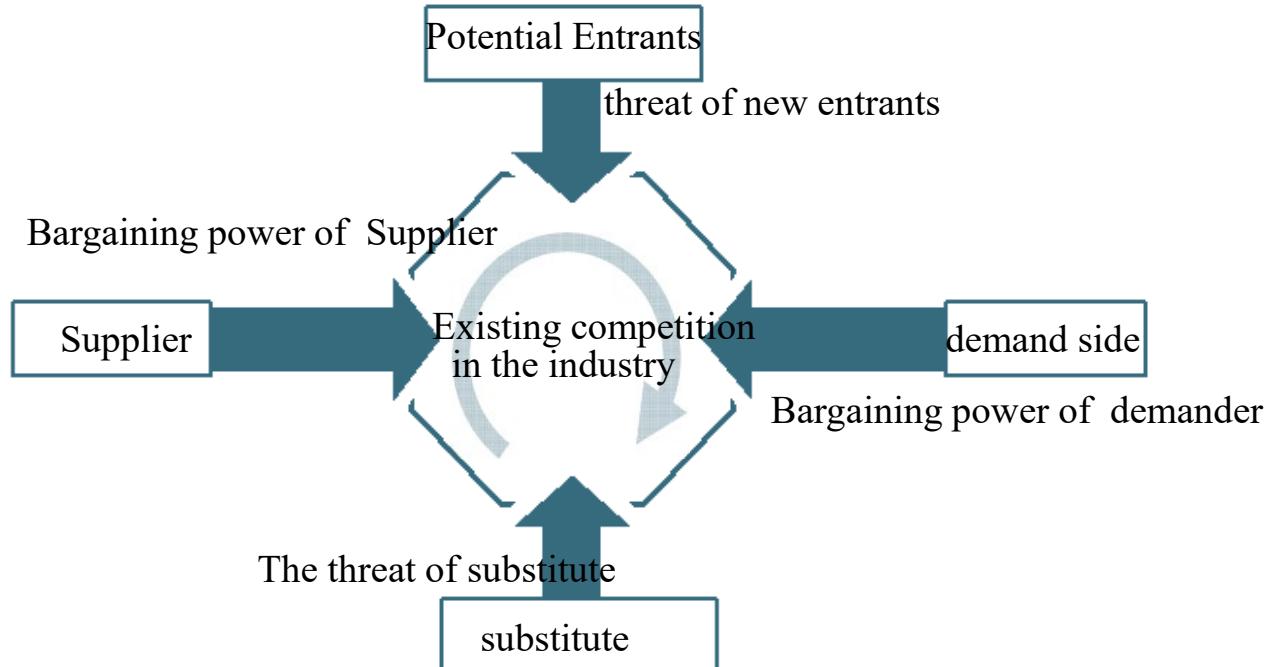
Pricing

- ◆ The secondary stage
 - growth rate、dividend payout ratio and beta are all gradually move to stable stage in the period from year 6 to 10.
 - Price after calculation=222.49 dollar
 - 2008.8:the price of Goldman Sachs169 dollar

What factors decide the earning growth rate?

↓
g

- The Five-force Model



Why companies do not pay dividend?

- ◆ risk control
- ◆ the future need for investment
- ◆ tax rate
- ◆ the signal for long-term profitability
- ◆ management benefit

DCF model: calculating equity value using FCFE

- ◆ Equity present value
 - discount rate
 - » same as calculating dividend
 - cash flow
 - » free cash flow of equity (FCFE) =
net income + depreciation-capital expenditure-
the change of working capital
 - final value
 - » assuming the company has a permanent steady growth rate
$$\text{the final value at } n = FCFE_{n+1} / (k_e - g_n)$$

Market Capitalization Management and Valuation

- ◆ Why investing?

$$\frac{P}{E} = \frac{(1 - b)}{r - b \times ROE}$$
$$\frac{P}{B} = \frac{ROE (1 - b)}{r - b \times ROE}$$

Book Value $\leftarrow B$

cash hold rate

- ◆ How much should investment rate b be to create value?

Market Capitalization Management and Valuation

◆ When to invest?

- the investment (b) would decrease the cash flow ($1-b$)
 - » with all other factors the same, firms with heavy asset are 较差的 inferior to firms with light asset
- The investment only creates value when the ROE is high enough

◆ Critical point:

- $ROE=r$: cash cow
- $ROE>r$: high growth company
- $ROE<r$: investment ruins the wealth
 - » the market value drops below book value

$$\text{P/B} > 1, \quad P/E > \frac{1}{r}$$
$$\frac{P}{E} = \frac{(1-b)}{r - b \times ROE} - \frac{1}{r}$$

Market Capitalization Management and Valuation

- ◆ The high growth on company earnings is hard to maintain, even if it can, it is not necessary create true value
 - ROE may be too low (lower than cost of capital)
 - » the weakness of business model
 - Many companies have low profit margin, but they keep issuing new shares to finance new capital expenditure.
 - IPO provides a platform for many companies to ruin the value of their shareholders

毛利率

Market Capitalization Management

- ◆ The stock price is the running machine of expectation
 - force the management level to pursue risky investment
 - » large M&A
- ◆ McKinsey: Return of growth

the value created by a dollar increase in the consumer good company

Growth type	Value
New product released	1.75-2.00
Expand current market	0.30-0.75
Expand market share on the current market	0.10-0.50
Compete in a mature market	-0.25 - 0.4
Merger	0-0.20

Return on Input Capital (ROIC) measures the efficiency of capital utility

$\text{ROIC} = \text{Net Operating Profit after Tax} / (\text{Average Total Invested Capital})$

ROIC Template					
Income Statement	2017	2018	2019	2020	2021
Revenue	102,007	118,086	131,345	142,341	150,772
Cost of Goods Sold (COGS)	39,023	48,004	49,123	52,654	56,710
Gross Profit	62,984	70,082	82,222	89,687	94,062
Expenses					
Salaries and Benefits	26,427	22,658	23,872	23,002	25,245
Rent and Overhead	10,963	10,125	10,087	11,020	11,412
Depreciation & Amortization	19,500	18,150	17,205	16,544	16,080
Operating Earnings	6,094	19,149	31,058	39,122	41,325
Interest	2,500	2,500	1,500	1,500	1,500
Earnings Before Tax	3,594	16,649	29,558	37,622	39,825
Taxes	1,120	4,858	8,483	10,908	11,598
Net Earnings	2,474	11,791	21,075	26,713	28,227
<i>Tax rate assumption</i>	<i>31%</i>	<i>29%</i>	<i>29%</i>	<i>29%</i>	<i>29%</i>
NOPAT	4,195	13,561	22,145	27,779	29,290
ROIC Analysis					
Book Value of Debt	50,327	50,330	30,331	30,342	30,350
Book Value of Equity	175,029	186,720	207,795	234,508	262,735
Goodwill	3,580	3,460	3,910	3,870	3,850
Cash	170,853	183,995	186,501	213,866	242,355
Book Value of Invested Capital	50,923	49,595	47,715	47,114	46,881
ROIC	-	0.27	0.45	0.58	0.62

(Generate money in
the market to get
the earnings)
Weighted Average

Cost of Capital
↑

If $\text{ROIC} < \text{WACC}$,
the firm is wasting
capital.

Operating Earnings
 $\times (1 - \text{tax})$

Life Cycle and Shareholders

- ◆ The best shareholders:
 - create value for the firm (channeling, operating, marketing, corporate governance, government relationship and so on)
 - start-up stage: founder
 - » creative, passionate, responsible
 - growing stage: PE fund and professional management team
 - » manage big companies
 - internationalization: may sell to a giant company
 - mature stage: split, privatize, reorganize

The Value of Growth

- ◆ If dividends are omitted, the growth value comes from

$$\frac{P_2}{P_1} = \frac{P_2 / E_2}{P_1 / E_1} \times \frac{E_2}{E_1}$$

e.g. Borrow money to build factory:

$$= \frac{P_2 / E_2}{P_1 / E_1} \times \frac{ROE_2}{ROE_1} \times \frac{B_1}{B_0}$$

Return ↑ → Equity holders' profit ↑
→ ROE ↑ & Book value ↑

P/E
ratio

P : market value

E : earnings

B : book value

$$ROE_1 = E_1 / B_0$$

The Value of Growth

◆ Example 1:

- first round of start-up business: 如果一个公司经营时间长，P/E会适当上升
 $B=100, E=20, ROE=20\%, PE=6$ Market value=20*6=120;
- assume the similar company has PE equal to 10 → 代表该公司下一年
» a year later, the company's market value goes to 240 稳定的PE

$$\frac{P_2}{P_1} = \frac{P_2 / E_2}{P_1 / E_1} \times \frac{ROE_2}{ROE_1} \times \frac{B_1}{B_0} = \frac{10}{6} \times \frac{20\%}{20\%} \times \frac{120}{100} \xrightarrow{\text{Book Value + Earnings}} 2$$

» conclusion: value created by valuation and capital accumulation

The Value of Growth

◆ Example 2:

- first round of start-up business:

$B=100, E=20, ROE=20\%, PE=120/20=6$; Market value = 120

- assume that by leverage on the second year, $ROE=40\%$

- assume the similar company has PE equal to 8 (lower than without leverage)

» a year later, create a company with market value of 384 $\leftarrow 120 \times 3.2$

$$\frac{P_2}{P_1} = \frac{P_2 / E_2}{P_1 / E_1} \times \frac{ROE_2}{ROE_1} \times \frac{B_1}{B_0} = \frac{8}{6} \times \frac{40\%}{20\%} \times \frac{120}{100} = 3.2$$

» conclusion: value created by valuation, earnings and leverage

The Value of Growth

◆ Example 3:

- first round of start-up business:
 $B=100, E=20, \text{ ROE}=20\%, \text{ PE}=120/20=6;$
 - assume that similar company has PE equal to 10
 - » a year later, the company's market value becomes 240
 - assume a PE fund chip in based on the PE equal to 10 at the end of second year for 50% share

$$\Rightarrow \frac{P_3}{P_1} = \frac{P_3 / E_3}{P_1 / E_1} \times \frac{ROE_3}{ROE_1} \times \frac{B_2}{B_0} = \frac{10}{6} \times \frac{20\%}{20\%} \times \frac{192}{100} = 3.2 \quad ROE = E/B$$

- » the value at the end of second year is $(100+20+24+240)*0.2*10=768$,
in which 384 belongs to the original shareholders $\frac{120 \times 20\%}{\uparrow}$
- » conclusion: value created by the combination of valuation,
earnings and financing \uparrow P/E

The Value of Growth

- ◆ the growth of value comes from
 - higher earnings
 - » enhance efficiency
 - » leverage
 - higher valuation
 - favorable equity financing
- ◆ Companies can increase their asset through capital market (equity, debt, loan)

Growth Path

- ◆ growth path of a company
 - value created by valuation, earnings and leverage

$$\frac{P_2}{P_1} = \frac{P_2 / E_2}{P_1 / E_1} \times \frac{ROE_2}{ROE_1} \times \frac{B_1}{B_0}$$

- DuPont decomposition:
$$ROE_1 = \frac{E_1}{B_0} = \frac{E_1}{S_1} \times \frac{S_1}{A_0} \times \frac{A_0}{B_0}$$

$$ROE = ROA \times \frac{A_0}{B_0}$$

$$\frac{E_1}{S_1}$$
: sales margin; $\frac{S_1}{A_0}$: capital turnover rate; $\frac{A_0}{B_0}$ equity multiplier

(Book value)
Capital of the firm → Total Asset

Book Value of the equity

firm
Money from Equity Holder
Money from Bank loan
Money from Debt holder

The starting point of the analysis:

$$PB = \frac{ROE \cdot d}{(r - ROE) + ROE \cdot d}$$

dividend payout ratio
 $1-d=b$

Where does it come from?

$$\frac{P}{B} = \frac{ROE (1-b)}{r - b \times ROE} = 1 + \frac{ROE - r}{r - g}$$

Remember?

根据PB估值公式，决定PB高低的，其实是r与ROE比大小。当r大于ROE时，即破净。当r大幅超过ROE时，股票就破净很深。折现率r是一个不容易掌握的指标，并且相对外生，我们暂不展开讨论。因此，决定估值的，其实是市场对银行股未来ROE的预期。然后我们再展开ROE：

$$ROE = \frac{PB \cdot r}{d - PB \cdot d + PB}$$

discount rate

Given $PB=0.8$, dividend payout ratio $d=25\%$, if we assume $r=10\% \Rightarrow ROE=9.4\%$

Compare it to the current banking industry average $ROE=12\%$, ROE should go down by 2.6%, ROA should go from 1% to 78bps(given the leverage is 12)

$$1\% \times \frac{9.4\%}{12\%} \quad \text{do not change}$$

22bps decline of ROA is significant, whether it is reasonable or not depends on one's insight of the banking industry. According to the report this translates into the loan interest rate cut by 44bps, which is unlikely. Another perspective is that in other countries, ROA is around 1%

Pricing Model of Company

- ◆ free cash flow of the company
 - =FCF to all shareholders and debt holders
 - $FCFF = EBIT(1-t) + \text{depreciation} - \text{capital expenses} - \text{change of operating capital}$

Equity PU:

- ① Discount rate: same as calculating dividend
- ② free cash flow of equity ($FCFE$) = Net Income + depreciation
- capital expenditure - change of working capital (Accounts Receivable, inventory, etc).
- ③ Final value = $\frac{FCFE}{r-g}$
 \uparrow
Value of the equity

Pricing Model of Company

- ◆ Company with stable growth

$$V = \frac{FCFF_1}{WACC - g_n} \rightarrow \text{Value of the firm}$$

$$\text{WACC} = r_d \times (1 - t) \times \frac{D}{D + E} + r_e \times \frac{E}{D + E}$$

2-stage Pricing Model

$$V_0 = \sum_1^n \frac{FCFF_t}{(1 + WACC_{hg})} + \frac{V_n}{(1 + WACC_{hg})^n}$$
$$V_0 = \frac{FCFF_0 \times (1 + g) \times \left[1 - \frac{(1 + g)^n}{(1 + WACC_{hg})^n} \right]}{(k_{hg} - g)} + \frac{FCFF_0 \times (1 + g)^n \times (1 + g_n)}{(k_{st} - g_n) \times (1 + k_{hg})^n}$$

g = the growth rate of previous n years

k_{hg} = the discounted rate of high growth period

k_{st} = the discounted rate of stable growth

g_n = the stable growth rate after n years

Relative Pricing

Relative Pricing

- ◆ Determine the price of an asset by comparing the market value of similar or comparable assets
- ◆ Important steps
 - Determine the comparable assets
 - Convert the market price of comparable assets into a ratio relative to the fundamentals
 - Acquire the pricing ratio by comparison
 - » Adjust all possible deviations

The Importance of Relative Pricing

- ◆ Relative pricing gains its popularity in the Wall Street
 - Almost 85% of the stock research reports are based on the multiple of comparable stocks
 - More than 50% of M&A pricing is based on multiples
 - Multiples are usually the basis for making final investment decisions
- ◆ Why relative pricing
 - Pricing is often a bargain.

Demands for Pricing

- 初次发售** **股票 ↵**
- ◆ On February 3, 2012, the director of the relevant departments of the CSRC said that the CSRC will study the supervision of the underwriting process, and will direct it to **rationally** set IPO prices. The CSRC is working on a measure to promote the fair pricing of new shares, which is to entrust a third party to publish the average P/E ratio of listed companies in various industries for investors' reference. The report will cover mainboard, SME board and GEM.
 - ◆ IPO pricing is generally no more than 125% of the industry's P / E ratio.
 - ◆ Since 2014, with a P/E ratio of 23 times, regulators have almost ensured that every investor subscribing to new shares is profitable.

Understanding Multiples

- ◆ The definition of multiples
 - How to figure out the multiples
- ◆ Analyzing multiples
 - Know the distribution of multiples
- ◆ The factors of multiples
 - What determines the multiples?
- ◆ Using multiples
 - Determining comparable collections and adjusting deviations is not easy.

The Calculation of Multiples

Some important financial data

– Sales Revenue

» The first row of the Income Statement

– Gross Profit

» $= \text{Sales} - \text{COGS}$

» Gross Profit Margin = Gross Profit / Sales Revenue

– Earnings before Interest and Taxes (EBIT)

» $= \text{Gross Profit} - \text{Selling, general and administrative expenses}$

$\text{expenses} - \text{Depreciation and amortization} - \text{Other expenses}$

» $\text{EBIT Margin} = \text{EBIT} / \text{Sales Revenue}$

CUHK(Shenzhen)

SG&A

Revenue	
Sales Revenue	\$20,438
Operating Expenses	
Cost of goods sold <i>COGS</i>	\$7,943
Selling, general and administrative expenses	\$8,172
Depreciation and amortization	\$960
Other expenses	\$138
Total operating expenses	\$17,213
Operating income	\$3,225
Non-operating income	\$130
Earnings before Interest and Taxes (EBIT)	\$3,355
Financial income	\$45
Income before Interest Expense (IBIE)	\$3,400
Financial expense	\$190
Earnings before income taxes	\$3,210
Income taxes	\$1,027
Net Income	\$2,183

如中葡股份2016年实现营业收入2.65亿元，归属于上市公司股东的净利润0.13亿元，而其理财收益高达0.56亿元，占总营收的比例为21%

张劲帆

The Calculation of Multiples

◆ Some important financial data

- Earnings before Interest, Taxes, Depreciation and Amortization (EBITDA)
 - » $=\text{EBIT} + \text{Depreciation and amortization (DA)}$
 - » $\text{EBITDA Margin} = \text{EBITDA}/\text{Sales Revenue}$
- Net Income
 - » $=\text{EBIT} - \text{Interest} - \text{Taxes} - \text{Non-controlling Interest(NCI)}$
 - Preferred Dividend
 - » It is customary to calculate net income as earning per share(EPS)
 - » P/E ratio = Share price/ EPS
 - » $\text{ROE} = \text{Net Income}/\text{Net Asset}$ *(Equity)* } Book value on 分母
 - » $\text{ROA} = \text{Net Income}/\text{Total Asset}$

The Calculation of Multiples

- ◆ Updating recent financial data.
 - Data for the past 12 months (LTM, TTM)
 - » = Data for last financial year + Data for the current year – Corresponding data for last financial year

*Last 12
month* *Trading 12 month*

Update Recent Financial Data

EXHIBIT 1.25 Calculation of LTM 9/30/08 Sales

(\$ in millions)

Fiscal Year Ending December 31						
2007				2008		
Q1 3/31	Q2 6/30	Q3 9/30	Q4 12/31	Q1 3/31	Q2 6/30	Q3 9/30
		\$750			\$850	
Prior Fiscal Year						
Plus: Current Stub						
Less: Prior Stub						
Last Twelve Months						
		\$600				\$1,000

The Calculation of Multiple

- ◆ Adjust the income statement
 - adjust the extraordinary items in the income statement
 - example of expense
 - » caused by reorganization event
 - ◆ store closures, layoffs 裁员
 - » loss on sale of assets
 - » changes in accounting rules
 - » inventory cancellation
 - » derogation of goodwill
 - » litigation loss
 - there are "non-recurring," "extra," and "disposable" in the annual and quarterly reports.

Adjust the income statement

EXHIBIT 1.29 Adjusted Income Statement

(\$ in millions, except per share data)

Income Statement			
	Reported 2007	Adjustments	Adjusted 2007
		+	-
Sales	\$1,000.0		\$1,000.0
Cost of Goods Sold	625.0	(5.0) ←	620.0
Gross Profit	\$375.0		\$380.0
Selling, General & Administrative	230.0		230.0
Restructuring Charges	10.0	(10.0) ←	-
Operating Income (EBIT)	\$135.0		\$150.0
Interest Expense	35.0		35.0
Pre-tax Income	\$100.0		\$115.0
Income Taxes	40.0	6.0 ←	46.0
Net Income	\$60.0		\$69.0
Operating Income (EBIT)	\$135.0	15.0 →	\$150.0
Depreciation & Amortization	50.0		50.0
EBITDA	\$185.0		\$200.0
Weighted Avg. Diluted Shares	30.0		30.0
Diluted EPS	\$2.00		\$2.30
\$15.0 million add-back of total non-recurring items			

Inventory write-down

Restructuring charge related to severance from downsizing the sales force

= (Inventory write-down + Restructuring charge) x Marginal Tax Rate
= (\$5.0 million + \$10.0 million) x 40.0%

D&A is typically sourced from a company's cash flow statement although it is sometimes broken out on the income statement

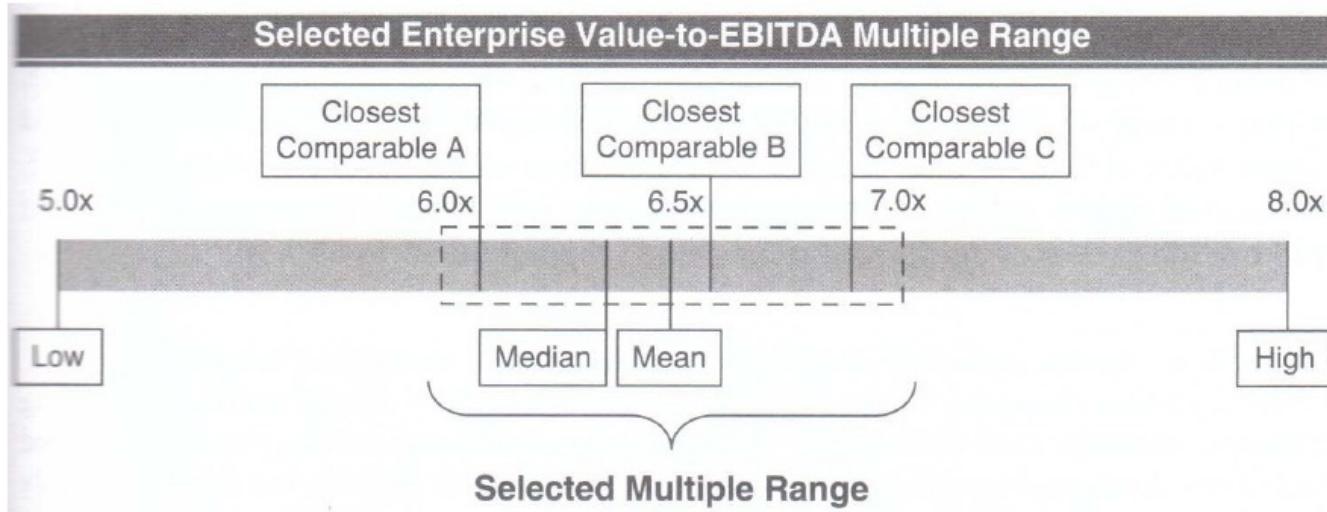
The Calculation of Multiple

- ◆ Multiples
 - P/E ratio
 - » =share price/earnings per share
 - P/B ratio
 - » =share price/Book value per share
 - enterprise value and EBITDA
 - » =EV/EBITDA
 - enterprise value and EBIT
 - » =EV/EBIT
 - enterprise value and sales
 - » =EV/Sales

Benchmarking

- ◆ Choose a comparable company
 - calculate key financial ratios and multiples
 - calculate the range of financial ratios and multiples of comparable company
 - » average, median, highest and lowest
 - » investigate and understand differences
- ◆ Benchmarking
 - Establish the range of valuation
 - » in general, to find the mean and median of the most relevant industries

Benchmarking



Benchmarking

(\$ in millions, except per share data)

EBITDA	Financial Metric	Multiple Range	Implied Enterprise Value	Less:		Implied Equity Value	Fully Diluted Shares	Implied Share Price
				Net Debt	Difference			
LTM	\$200	6.50x – 7.50x	\$1,300 – \$1,500	(500)	\$800 – \$1,000	100	\$8.00 – \$10.00	
2008E	215	6.00x – 7.00x	1,290 – 1,505	(500)	790 – 1,005	100	\$7.90 – \$10.05	
2009E	230	5.50x – 6.50x	1,265 – 1,495	(500)	765 – 995	100	\$7.65 – \$9.95	

Multiple range : 分母代表整个公司还是 equity holder , 决定结果是
Benchmarking equity or enterprise.

EXHIBIT 1.36 Valuation Implied by P/E – Share Price

(\$ in millions, except per share data)

Net Income	Financial Metric	Multiple Range	Implied Equity Value	Fully Diluted Shares	Implied Share Price
LTM	\$70	12.00x – 15.00x	\$840 – \$1,050	100	\$8.40 – \$10.50
2008E	75	11.00x – 14.00x	825 – 1,050	100	\$8.25 – \$10.50
2009E	80	10.00x – 13.00x	800 – 1,040	100	\$8.00 – \$10.40

Benchmarking

(\$ in millions)

Net Income	Financial Metric	Multiple Range		Implied Equity Value		Plus: Net Debt	Implied Enterprise Value		
		12.00x	– 15.00x	\$840	– \$1,050		\$1,340	– \$1,550	
LTM	\$70	12.00x	– 15.00x	\$840	– \$1,050	500	\$1,340	– \$1,550	
2008E	75	11.00x	– 14.00x	825	– 1,050	500	1,325	– 1,550	
2009E	80	10.00x	– 13.00x	800	– 1,040	500	1,300	– 1,540	

Summary

The advantages of relative pricing

- Utilization of market information
 - » Considering market growth, risk estimates, and market sentiment 情绪
- Relativity
 - » Easy to be measured and compared with other companies
- Fast and convenient
 - » Easy to build a computing platform
- In time
 - » Market information: updated every day

Summary

- ◆ The disadvantages of relative pricing
 - Utilize market information
 - » Market sentiment can lead to pricing bias.



Summary

The disadvantages of relative pricing

- Lack of comparable companies
 - » Baidu
- The price could be very different from DCF.
- Corporate individual factors

先例

Precedent Transaction Cases Analysis

- ◆ Pricing by using multiples of comparable companies in previous M&A cases to price.
Mergers and Acquisitions 企业并购
- ◆ It is a challenge to find comparable companies
 - Sometimes different industries can be considered when there is similar:
 - » Final product market
 - » Distribution channels
 - » Financial characteristics

Google bought Motorola Mobility LLC

- ◆ August 15, 2011 *In order to get its patent asset, not consider its financial asset (e.g. stocks).*
 - Google bought MOTOROLA with \$12.5 billion
 - 63% premium
 - How did they figure out \$12.5 billion?



Google bought Motorola Mobility LLC

- ◆ MOTOROLA has 24,500 patents.
- ◆ In October 2010, Novel sold 882 patents that are worth \$450 million.
 - How much is each patent worth?

Comparable case

0.5 million / patent

- ◆ If Google buys 24,500 patents for \$12.5 billion.
 - How much is each patent worth?
- ◆ Conclusion
 - Google bought 24,500 patents plus a free mobile phone company.

How Are Patents Priced?

- ◆ Pricing of Kodak
 - Market value: On November 24, 2011, \$310 million.
 - There are 1000 patents
 - If each patent can be sold for \$510,204
 - » \$510 million

How Are Patents Priced?

- ◆ [Kodak's proposed \$525 million patent sale plan was approved by a bankruptcy judge]

On January 11th, kodak proposed a price of \$525 million to Intellectual.

Proposal for Ventures and RPX to sell digital imaging patents was approved by bankruptcy judges, which made the company closer to coming out of bankruptcy protection.

Precedent Transaction Cases Analysis

- ◆ Steps
 - Select relevant M&A comparable companies
 - Collect relevant M&A and financial information
 - Calculate key data, ratios, and transaction multiples
 - Benchmark related mergers and acquisitions
 - Pricing

Precedent Transaction Cases Analysis

◆ Transaction details

- Is the buyer a strategic investor or a financial investor?
 - » Strategic investors are generally willing to pay higher prices
- What are the motivations of buyers and sellers?
 - » Is the seller in urgent need of cash?
 - To get other assets rather than financial assets
- Transaction procedures and nature
 - » The auction
 - » A hostile takeover
 - » Equal participation
- Buying patterns
 - » Cash
 - » Stock

Calculate Multiples

- ◆ Stock Price are decided by published purchasing price
 - Not Market Price
- ◆ Multiples
 - P/E Ratio = Price per Share/EPS
 - Market Value to LTM EBITDA Ratio
 - Market Value to LTM EBIT Ratio
 - Market Value to LTM Sales Ratio

Last 12 months

Calculate Multiples

- ◆ Adjusted Synergy Multiples
- ◆ Examples:
 - Market Value = \$1.2 Billion
 - EBITDA = \$ 0.15
 - Market Value to EBITDA Ratio = 8
 - Assume that **协同作用** synergy effect will increase EBITDA for \$30 Million
 - » Market Value to EBITDA Ratio = $12/(1.8 + 0.3) = 6.67$

Summary

- ◆ Advantages of Precedent Pricing
 - Leveraging Market Information
 - » Take Actual Acquisition Price into Consideration.
 - Timely
 - » Reflect market's current M&A price, circumstances of capital market, and current financial situation.
 - Easiness
 - » Easy to compare with other transactions.
 - Objectiveness
 - » No need of hypothesis on future performance.

Summary

- ◆ Disadvantages of Precedent Pricing
 - Leveraging Market Information
 - » Market Sentiment may cause option pricing deviation.
 - Time Delay
 - » May not be applicable to current situation.
 - Lack of Comparable Transactions
 - Missing Transaction Details

Comparasion and Reflection of Pricing Method

Understand P/E Ratio

- ◆ Why do P/E ratios differ from nations, industries, companies?

good Company → high P/E Ratio

- ◆ What factors decide P/E ratio?

- ◆ How to know whether the current P/E ratio sustains?

Back to DCF Model——Gordon Growth Model

- ◆ Gordon model, also known as constant growth model, which assumes dividends grow at a constant rate g :

– $\underbrace{(r - g)}$

$$P_0 = \frac{D_0(1+g)}{(1+r)} + \frac{D_0(1+g)^2}{(1+r)^2} + \dots = \frac{D_0(1+g)}{r-g} = \frac{D_1}{r-g}$$

$$\frac{P_0}{E_0} = \frac{\frac{D_0}{E_0}(1+g)}{r-g} = \frac{z(1+g)}{r-g}$$

Dividend Payout Ratio

Life Cycle and Growth Rate at Different Stages

TABLE 18.2

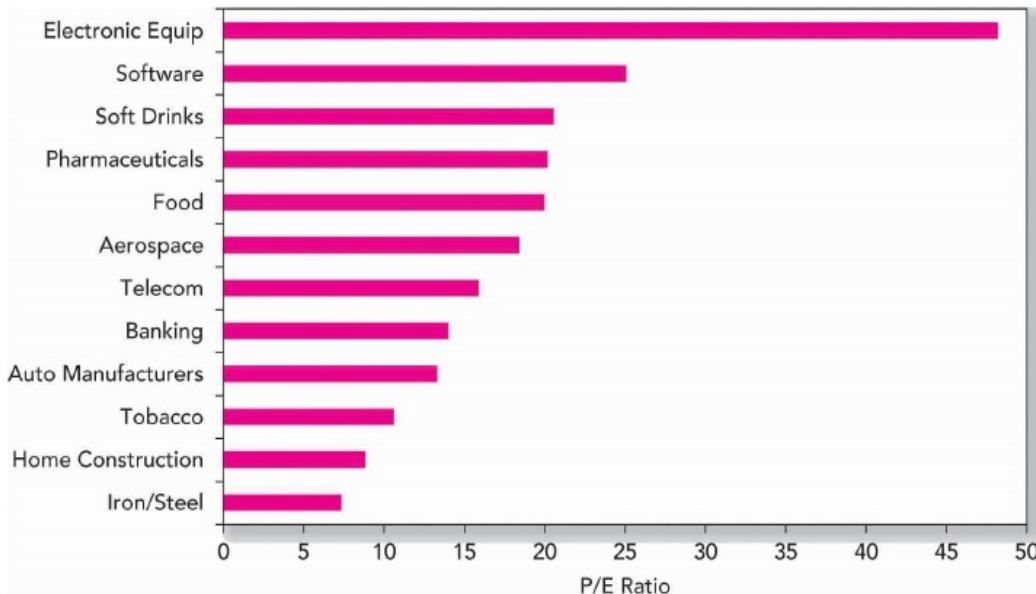
Financial ratios
in two industries

	Return on Assets	Payout Ratio	Growth Rate 2005–2008
Computer Software			
Adobe Systems	21.5%	1.0%	8.2%
Cognizant	19.0	0.0	22.8
Compuware	10.5	0.0	17.6
Intuit	19.0	0.0	8.0
Microsoft	31.5	35.0	15.4
Novell	8.5	0.0	51.8
Oracle	33.0	0.0	18.6
Red Hat	17.0	0.0	17.6
Parametric Tech	20.0	0.0	33.9
SAP	22.5	18.0	13.8
Median	19.5%	0.0	17.6%
Electric Utilities			
Central Hudson G&E	6.0%	78.0%	5.1%
Central Vermont	7.5	60.0	8.0
Consolidated Edison	5.0	75.0	1.0
Duquesne Light	8.0	85.0	7.7
Energy East	6.0	74.0	4.1
Northeast Utilities	5.0	59.0	14.0
Nstar	8.5	61.0	3.2
Pennsylvania Power	11.0	52.0	9.3
Public Services Enter.	7.0	62.0	1.7
United Illuminating	5.0	113.0	1.3
Median	6.5%	68.0%	4.6%

Source: Value Line Investment Survey, 2006. Reprinted with permission of Value Line Investment Survey. © 2006 Value Line Publishing, Inc. All rights reserved.

Growth Opportunity and P/E Ratio

- ◆ the more growth opportunities, the higher P/E



P/E Ratio

- ◆ From the definition, P/E ratio is affected by
 - growth rate
 - discounted rate
 - dividend payout ratio (or reinvestment ratio)

$$P_0 = \frac{D_0(1+g)}{(1+r)} + \frac{D_0(1+g)^2}{(1+r)^2} + \dots = \frac{D_0(1+g)}{r-g} = \frac{D_1}{r-g}$$

$$\frac{P_0}{E_0} = \frac{\frac{D_0(1+g)}{(1+r)}}{r-g} = \frac{z(1+g)}{r-g}$$

\uparrow
profitability affect r, g

What kind of Chinese companies have high P/E ratio?

$$\text{PE} = 24.08 - 7.50 * \text{beta} + 2.62 * \text{payratio} + 6.95 * \text{exp_5y_growth_in_EPS} - 1.19 * \underline{\text{std}}$$

Std → (7.23) ↑ (2.58) (3.43) *expected* (0.45) ↑
CAPM Standard Deviation

R-square: 20%

- ◆ Conclusion: the Chinese companies with high P/E
– weak cyclical
– relatively high dividend payout ratio → *正常公司* *lower growth rate*
– high expected growth rate on profit
– but have no close relationship with
» volatility of stocks

What can explain the P/E ratio of a country?

- ◆ $PE = 16.16 - 7.94 \text{ Interest Rates} + 154.40 \text{ Growth in GDP} - 0.1116 \text{ Country Risk}$

R Squared = 73%

- ◆ Conclusion

- a country would have a high P/E if
 - » it has low interest rates
 - » it has high GDP growth rate
 - » it has low risks

If Predicted PE > Actual PE , we can jump in to get profit.

PEG

- ◆ Is a company having a high P/E ratio due to its high price or high growth?
- ◆ The definition of PEG
 - =P/E ratio/ expected growth rate

P/B Ratio (Can be applied when P/E is inaccurate)

near 0 / negative

- ◆ PB=price/book value of asset per share
 - Pros Problems: No relationship between earning and book value.

We need to generate the profit in

–Cons

Factors Affecting P/B Ratio

$$P_0 = \frac{D_1}{(k - g_n)}$$

$$\frac{P}{BV} = \frac{ROE \times z}{k - g_n}$$

$$\frac{P}{BV} = \frac{ROE - g_n}{k - g_n}$$

k = discounted rate; z = dividend payout ratio; P_0 = price;
 g_n = the growth rate of earning and dividends

D_1 = dividend next year, BV = book value

Select Stocks through P/B

$$PBV = 2.21 + 8.22 \text{ ROE} - 2.63 \text{ Standard deviation} \quad R^2 = 52\%$$

[2.16] [2.92] [1.21]

Good opportunity or Trick?

Company Name	Price-to-Book Ratio	Predicted PBV	Under- or Overvalued
Crown Central Petroleum "A"	0.29	-0.56	NMF
Giant Industries	0.54	<u>maybe other</u> <u>1.80</u>	-69.74%
Harken Energy Corp.	0.64	<u>factors that</u> 0.24	166.59%
Getty Petroleum Mktg.	0.95	<u>you don't</u> 1.19	-19.67%
Pennzoil–Quaker State	0.95	<u>consider into</u> 1.19	-19.93%
Ashland Inc.	1.13	<u>the model</u> 2.48	-54.28%
Shell Transport	1.45	2.48	-41.56%
USX–Marathon Group	1.59	2.12	-25.11%
Lakehead Pipe Line	1.72	2.78	-38.03%
Amerada Hess	1.77	2.87	-38.33%

ROE may look high because of a high Accounts Receivable
Jinfan Zhang
tend to be a bad signal

Price/Sales Ratio

◆ Pros

- less likely to be manipulated, compared the earnings and book value
- earnings may be negative or close to zero
- more stable than P/E
- more suitable to price mature, cyclical company with close zero profit

Price/Sales Ratio

- ◆ Cons
 - large sales is not equal to high profit
 - stock price should not tightly related to sales
- ◆ If there are two stocks having the same P/E, which one would have higher price/sales ratio?

Luxury goods : $P/S \approx$ small \Rightarrow Higher P/S

Grocery : $P/S \approx$ big \Rightarrow Lower P/S

Price/Sales Model: 1-stage Model

$$P_0 = \frac{D_1}{(k - g_n)} \Rightarrow \frac{P}{S} = \frac{PM \times z \times (1 + g_n)}{k - g_n}$$

k = discounted rate; z = dividend payout ratio; P_0 = price;

g_n = the growth rate of earning and dividends

D_1 = dividend next year; S = sales; PM = net profit margin = E/S

$$\frac{\text{Earnings}}{\text{Sales}}$$


2-Stage Model

$$\frac{P_0}{S_0} = PM \times \left\{ \frac{z_n \times (1+g) \times \left[1 - \frac{(1+g)^n}{(1+k_{hg})^n} \right]}{(k_{hg} - g)} + \frac{z \times (1+g)^n \times (1+g_n)}{(k_{st} - g_n) \times (1+k_{hg})^n} \right\}$$

PM = net profit margin

g = growth rate in the previous n years

k_{hg} = discounted rate during high growth period

k_{st} = discounted rate during stable growth period

z = dividend payout ratio during high growth period

g_n = growth rate after the first n years

z_n = dividend payout after the first n years

Price/Sales Model: 1-stage Model

$$V_0 = \frac{EBIT \times (1-t) \times z}{k - g_n}$$

$$\frac{V_0}{S_0} = \frac{ATOM \times z}{k - g_n}$$

k = discounted rate; t = tax rate; S = Sales

ATOM=EBIT* (1-t) /S;

z = dividend payout ratio;

V_0 = enterprise value; g_n = earning growth rate

整个企业

2-stage Model

$$\frac{V_0}{S_0} = ATPM \times \left\{ \frac{z_n \times (1+g) \times \left[1 - \frac{(1+g)^n}{(1+k_{hg})^n} \right]}{(k_{c,hg} - g)} + \frac{z \times (1+g)^n \times (1+g_n)}{(k_{c,st} - g_n) \times (1+k_{c,hg})^n} \right\}$$

ATPM = after – tax profit margin

g = growth rate in the previous n years

k_c, hg = discounted rate during high growth period

k_c, st = discounted rate during stable growth period

z = dividend payout ratio during high growth period

g_n = growth rate after the first n years

z_n = dividend payout after the first n years

How much does the brand worth?

$$\text{Brand value} = (VS_b - VS_g) \times S$$

VS_b = VS of company with impressing brands

VS_g = VS of company without impressing brands

VS: Enterprise Value / Sales

What is the brand value of Coca-Cola?

May 2001: Coca-Cola

	<i>High-Growth Period</i>	<i>Stable-Growth Period</i>
Length	10 years	Forever after year 10
Growth rate	8.92%	5%
After-tax operating margin	16.31%	16.31%
Cost of capital	9.71%	8.85%
Reinvestment rate	40%	31.25%

$$VS = 0.1631 \times \left\{ \frac{0.60 \times (1.0892) \times \left[1 - \frac{(1.0892)^{10}}{(1.0971)^{10}} \right]}{(0.0971 - 0.0892)} + \frac{0.6875 \times (1.0892)^{10} \times (1.05)}{(0.0885 - 0.05)(1.0971)^{10}} \right\} = 3.79$$

What is the brand value of Coca-Cola?

Cott, an ordinary baverage producing company in Canada

$$VS = 0.0482 \times \left\{ \frac{0.60 \times (1.0397) \times \left[1 - \frac{(1.0397)^{10}}{(1.0971)^{10}} \right]}{(0.0971 - 0.0397)} + \frac{0.4958 \times (1.0397)^{10} \times (1.05)}{(0.0885 - 0.05)(1.0971)^{10}} \right\} = 0.60$$

The sales of Coca-Cola in 2000 was \$20.458 B

FV of Coca-Cola=3.79*20.458=\$77.535B

FV of Ordinary company Cott=0.6*20.458=12.274B

Brand value=\$65.261 billion

What is the brand value of Coca-Cola?

$$VS = 0.0482 \times \left\{ \frac{0.60 \times (1.0397) \times \left[1 - \frac{(1.0397)^{10}}{(1.0971)^{10}} \right]}{(.0971 - .0397)} + \frac{0.4958 \times (1.0397)^{10} \times (1.05)}{(.0885 - .05)(1.0971)^{10}} \right\} = 0.60$$

The sales of Coca-Cola in 2000 was \$20.458 billion

Coca-Cola price=3.79*20458=77535

Ordinary company price=0.6*20458=12274

Brand value=\$65.261 billion

What is the brand value of Coca-Cola?

◆ Conclusion

- The most value of Coca-Cola comes from the brand value
- Brand could help the firm operate at a high margin for a long period of time

Specific Ratio in Different Industries

Commodity Company (oil refining, gold mining companies)

$$\text{unit commodity value} = \frac{\text{Stock value + debt value - cash}}{\text{commodity inventory}} = \text{Enterprise Value}$$

商品、货物

If manufacturer produce products with identical quality:

$$\text{unit product value} = \frac{\text{stock value + debt value - cash}}{\text{product units (or capacity)}}$$

Specific Ratio in Different Industries

Internet company、 information provider、 power cable company, etc:

$$\text{Unit user value} = \frac{\text{stock value} + \text{debt value} - \text{cash}}{\text{number of users}}$$

Amazon:

$$\text{unit customer value} = \frac{\text{stock value} + \text{debt value} - \text{cash}}{\text{number of effective customers}}$$

$$\text{unit visitor value} = \frac{\text{stock value} + \text{debt value} - \text{cash}}{\text{number of visitors}}$$

Company with patents: the price when Google bought Motorola

Examples of Valuation Application

苏宁

Price (RMB)	10.95
Shares	6,996,211,900
RMB' 000	
Equity	76,608,520
Debt	35,348
Cash	21,568,655
EV	55,075,213
Store	962
Area (Sqm)	4,058,300
RMB	57,250,741
EV/Store	57,250,741
Sales/Store	61,955,525
EV/Sqm → care about location	13,571
Sales/Sqm	14,602

国美

Price (RMB)	2.00
Shares	15,055,332,000
RMB' 000	
Equity	30,110,664
Debt	3,524,909
Cash	6,029,059
EV	27,606,514
Store	726
Area (Sqm)	2,675,000
RMB	
EV/Store	38,025,501
Sales/Store	58,771,350
EV/Sqm	10,320
Sales/Sqm	15,951

EV can be manipulated. (贪污等).

Which one had higher estimated value in May 2010?

CUHK (Shenzhen)

We should use EV/Sales → 苏宁 is more expensive

Jinfan Zhang

Examples of Valuation Application

沃尔玛

Price (USD)	50.02
Shares(Million)	3,786
USD Million	
Equity	189,376
Debt	33,754
Cash	7,907
EV	215,223
Store	8,416
Area (Sqm)	
RMB	
EV/Store	174,689,987
Sales/Store	328,677,519

Best Buy

Price (USD)	40.56
Shares(Million)	419
USD Million	
Equity	16,995
Debt	1,802
Cash	1,826
EV	16,971
Store	4,027
Area (Sqm)	
RMB	
EV/Store	28,787,385
Sales/Store	84,283,591

物美

Price (RMB)	16.37
Shares	1,251,274,116
RMB'000	
Equity	20,483,357
Debt	456,086
Cash	1,171,575
EV	19,767,868
Store	472
Area (Sqm)	542,241
RMB	
EV/Store	41,881,077
Sales/Store	24,961,883

The most expensive one

Which one is the most expensive?

Also use EV/Sales

Growth Opportunity and Return

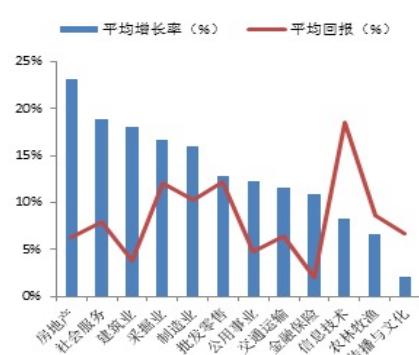
- ◆ The growth rate of American computer software companies is 17.6%, while that of electricity companies is only 4.6%. Hence should we buy stocks of computer software companies?

The price of high-growth company is higher.
So it won't be much profit for the late incomers.

Growth Opportunity and Return

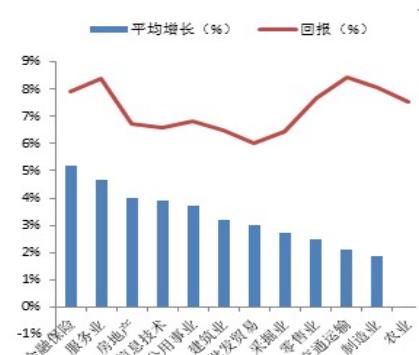
There is no obvious pattern for the growth and return rates in industries of China. The industry with high growth does not mean high return. Take agricultural and real estate industries as examples, the average annual growth rate of real estate is 23.13%, and that of agriculture is 6.69%. If you invest in real estate and agriculture in 1997, you should have returns of 6.27% and 8.58% separately in 2010. The similar things also appear in IT, retail, mining and construction industries. The returns of low growth industry are higher than that of high growth industry.

图 1 中国 1997~2010 各行业增长及年均回报率(增加值)



数据来源：中国增加值数据来源于历年统计年鉴；回报率数据根据CSMAR数据库数据计算而得，行业分类采用国民经济行业分类。

图 2 美国 1947~2010 各行业增长及年均回报率(增加值)



说明：农业平均增长率太低，为-0.03%。

数据来源：美国增加值数据来源于 CEC 数据库；回报率数据根据 CRSP 数据库数据计算而得，行业分类采用美国 NASIC 分类标准。

Growth Opportunity and Return

If we take a feasible strategy, which rebalances the portfolio according to the growth rate of the industry last year, no return pattern could be discovered.

High Growth ≠ High return (除非因增速过快造成股价重新计算而上涨的股价)

图 5 中国每年按上一年各行业增长（增加值）情况投资..

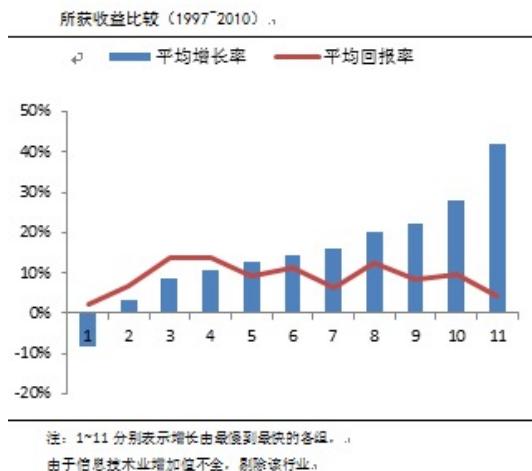
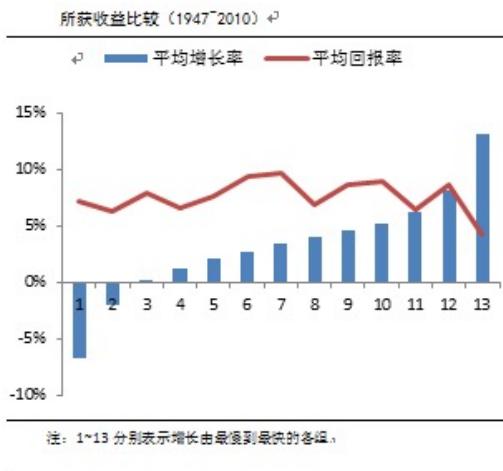


图 6 美国每年按上一年各行业增长（增加值）情况投资..



Growth Opportunity and Return

We do not see the solid relationship between high growth and high return.
Why? Two factors may hinder the high growth transform into high return:

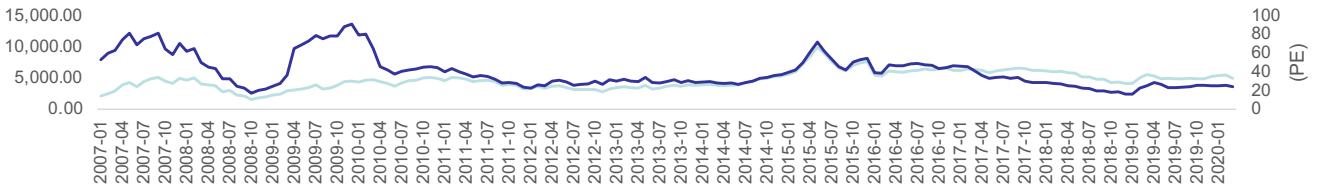
1. competition could dilute the profit.
2. market may over expect the growth

2005：股权分置改革

沪深300 (000300.SH) No. 1 - 300



中证500 (399905.SZ)

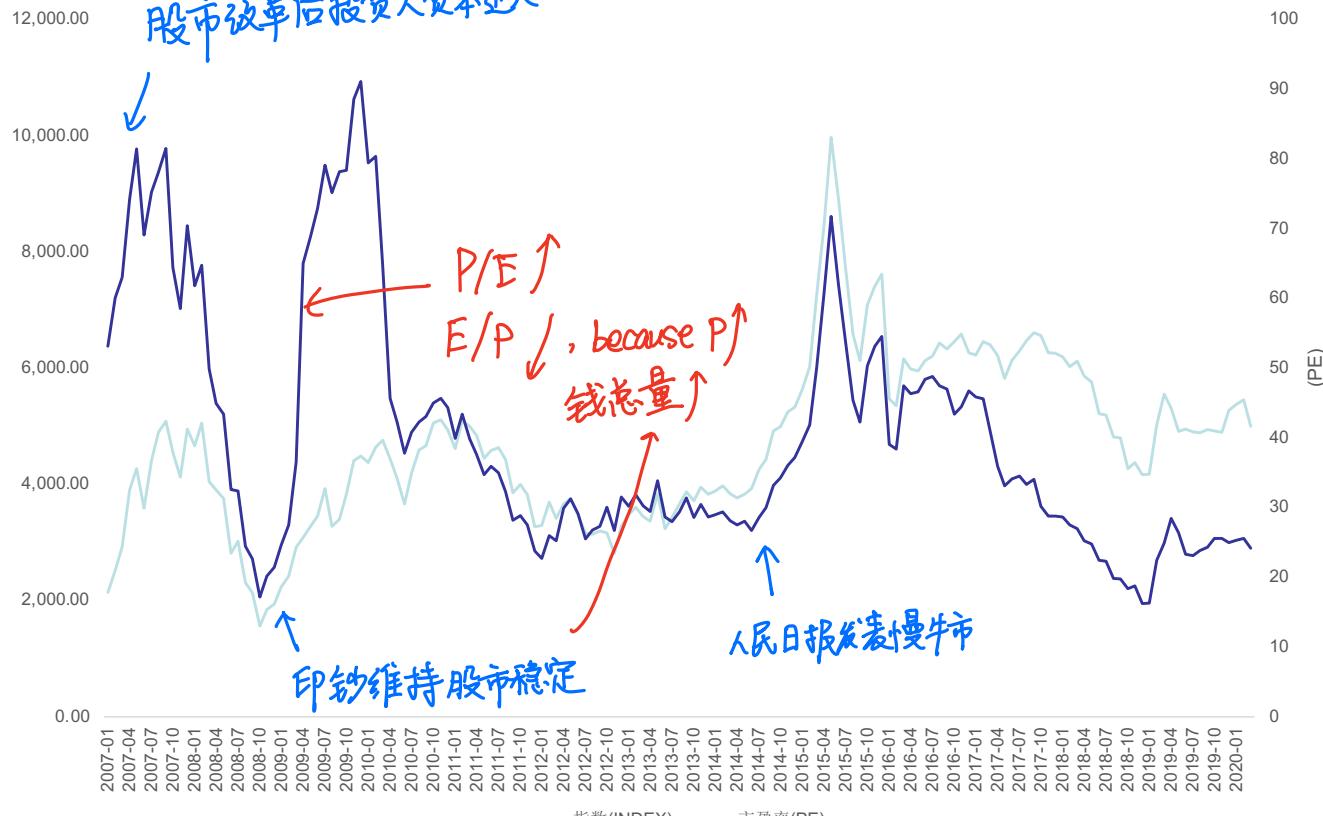


(乐观)

股市改革后投资人资本进入

中证500 (399905.SZ)

No. 301 - 800



Can the return of China stock market be estimated?

Time Series Estimation vs Cross Sectional Estimation

Private Placement : 定向增发 (一般给机构增发)
IPO & SEO (Seasoned Equity offerings)
相比 IPO 更多资本收获

Can the return of China stock market be estimated?

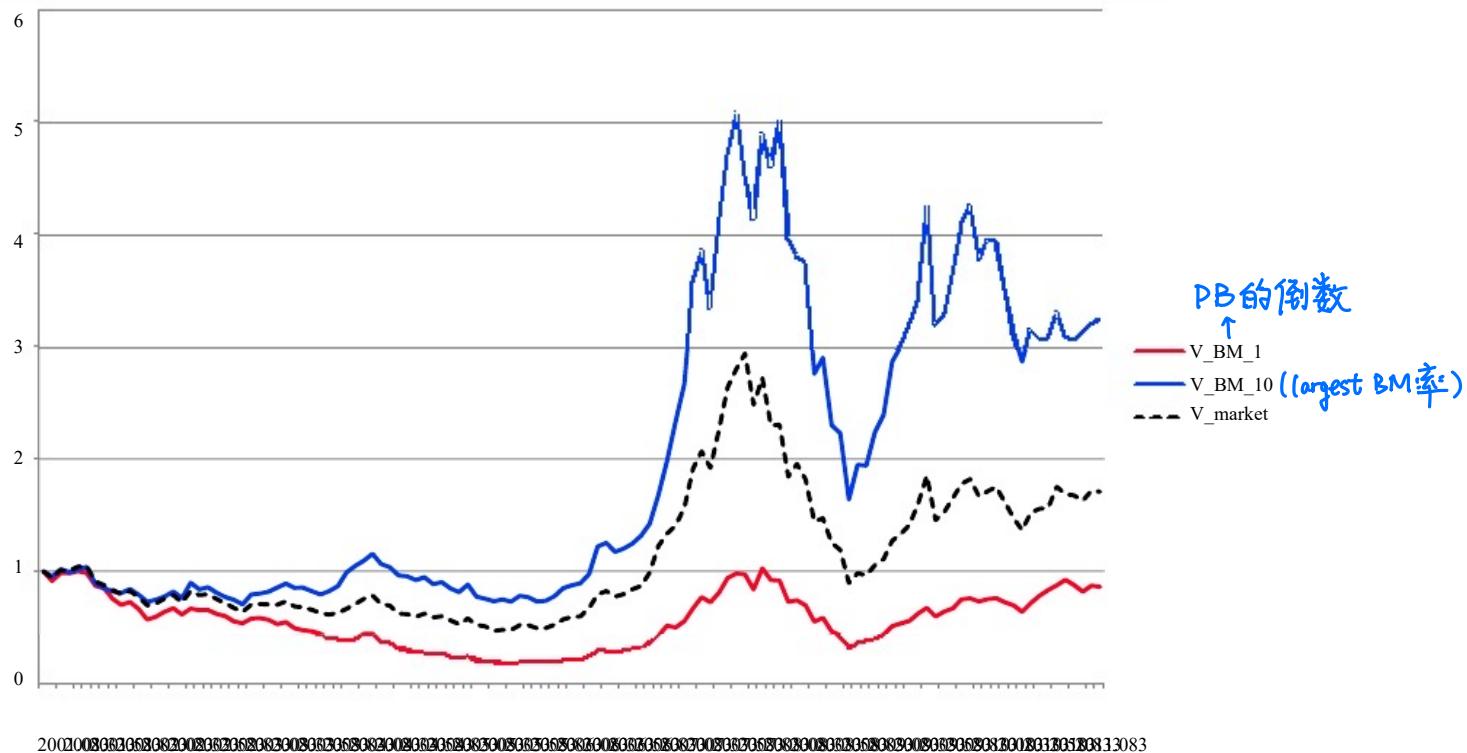
Stock return consists of two parts, dividends and capital gains

$$R = \frac{P_1 + D_1}{P_0} \approx 1 + g_{pb} + bROE + \frac{B_0}{P_0}(1 - b)ROE \quad (1)$$

Obviously, valuation level (PB), earning ability (ROE) and dividend payout ratio (1-b) are factors that affect returns

P_i : ith period stock price, D_i : ith period dividends, B_i : ith period book value of assets, b retention ratio, g_{pb} is the growth of PB ratio

Value Stocks Won the Market: China (2001-2010)



2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

越便宜的公司回报率高 (可能有较大风险, from CAPM)
(也有可能是定价低了, 后价格回到真值)

张劲帆

Dividend yield Predicts Return

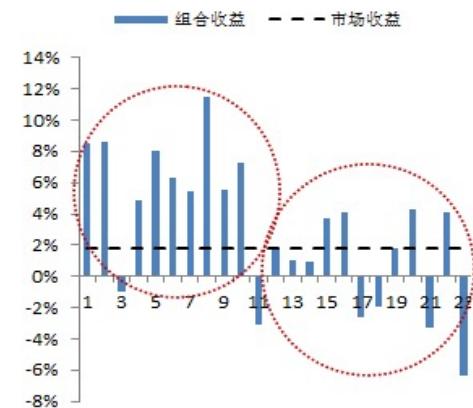
Can the dividend payout ratio predict the return?

At the end of each year, we rank the industries or individual stocks with their dividend yields, calculate the average return from 2000 to 2012, and compare it with the market. High dividend yield stocks beat the market.

能发 Dividend 说明能赚钱，股东人好，(ROE 饱和了)

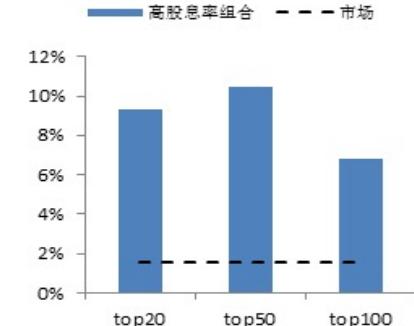
不发 Dividend 也有可能被股东私吞，不为公司前景，为自己谋利。

2000~2012 中国每年持有上年按各行业股息率高低排序的平均回报。



在中国适用。
国外不适用

2000~2012 中国每年持有上年股息率最高的股票组合取得的回报



股息率为减去各行业前 5 年平均值后的值；1~23：股息率从高到低；

Top20 为当年股息率最高的 20 只股票，其余以此类推。

张劲帆

Stock Market Fluctuation and Market Expectation

- ◆ In the long run, stock must reflect a firm's profitability (the fundamentals of the firm)
(price)
- ◆ If the stock price deviates from its fundamental, it must return
 - the larger the price fluctuation, the easier to estimate
波动
 - the stock price looks like a randomly flying pollen, but in fact subject to gravity and will fall eventually
花粉

Final Words on PE : PE很大 (P很大或E很小)

E can be different: Static PE, Forward/dynamic PE, and Trailing PE

过去

预测

过去12个月

Pay attention to the quality of E: One time items must be adjusted: hidden tricks include depreciation; research cost capitalization, *cyclicalty of earning* (e.g. 石油行业,
高收益不持续)

PEG: Some practitioners think that $PEG > 1$ is overvalued; $PEG = 1$ is fairly valued. It is not entirely correct, but provides an angle to understand that high PE ratio is driven by high growth or not

The CAPM

Jinfan Zhang

Chinese University of Hong Kong
(Shenzhen)

Overview

- The “fundamental value”, “fair value”, of asset is given by

$$FV_t = \frac{E[CF_{t+1}]}{1+r} + \frac{E[CF_{t+2}]}{(1+r)^2} + \frac{E[CF_{t+3}]}{(1+r)^3} + \dots$$

- use all available information to make the best possible cash-flow forecast
- use a discount rate r that is appropriate for the risk

The discount rate

老师推荐：10年国债无风险利率 (risk-free rate)

- This lecture note is about the discount rate, r

反映通胀率、
GDP 增速
增速大, $r \uparrow$

$$r = \text{riskless rate} + \text{risk premium}$$

E(r) 基本利率
 (无风险) 风险利率

- The CAPM measures the risk of an asset
 - provides the fair discount rate r for that risk
- Other applications include
 - Capital budgeting
 - Evaluating investment performance

Why do we hold the market portfolio?

- Suppose:
 - Everyone knows the same set of information. All have the same estimates of expected returns, variances, covariances, etc
 - Everyone has the same preference. All use risk-reward analysis (mean-variance analysis)

Why is covariance the right measure?

假设市场只有一个人

- Suppose you are holding a portfolio with return r_p
- Add a small amount δ of a new security with return r_i , how does this affect the riskiness of your portfolio?

$$\text{var}((1 - \delta)r_p + \delta r_i)$$

$$= (1 - \delta)^2 \text{var}(r_p) + \delta^2 \text{var}(r_i) + 2\delta(1 - \delta)\text{cov}(r_p, r_i)$$

$$\approx \text{var}(r_p) + 2\delta\text{cov}(r_p, r_i)$$

- We should measure the risk of a security by how much its inclusion in your portfolio affects your *portfolio's* risk
- A security's risk is therefore driven by its *covariance* with your existing portfolio

The CAPM argument

- A security's risk is its covariance with the rest of the portfolio
 - Variance is a good measure of overall *portfolio* risk
 - For an individual security, *covariance* is the right measure of risk
- The rest of your portfolio is the market portfolio (under some assumptions)
- Risk is covariance with the market portfolio
- **A security's fair average return is determined by its covariance with the market**

Summary of the CAPM argument

- Finance theory says a security's fair average return is determined by its risk
 - We determined a security's "risk" is measured by its covariance with our portfolio
 - And we determined that our portfolio was the market portfolio
 - A security's fair average return is determined by its covariance with the market portfolio, because this measures risk

More details on the CAPM argument

- A security's fair average return is determined by its covariance with the market

- This relationship is linear, that is for any asset, i , we have

$$\underbrace{E[r_i] - r_f}_{\text{risk premium (补偿) }} = a + b \operatorname{cov}(r_i, r_m)$$

- To find a and b , let's apply this formula to:

- The risk-free asset, which gives $a=0$
 - The market portfolio itself

$$E[r_m] - r_f = b \operatorname{cov}(r_m, r_m) = b \operatorname{var}(r_m)$$
$$b = \frac{E[r_m] - r_f}{\operatorname{var}(r_m)}$$

More details on the CAPM argument

- Putting this all together,

$$E[r_i] - r_f = \frac{E[r_m] - r_f}{\text{var}(r_m)} \text{cov}(r_i, r_m)$$

- Written slightly differently
风险度量

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

where $\beta_i = \text{cov}(r_i, r_m)/\text{var}(r_m)$ 风险单位价格

The CAPM Equation

$\beta_i > 0$: 涨时也涨，亏时也亏，investor 不喜欢， $E(r)$ 大，价格低（锦上添花）

$\beta_i < 0$: 保险， $E(r)$ 小，出高价（雪中送炭）

- The CAPM says: for any asset, i , the expected return of that asset is

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

- r_f is the riskless rate 局限性：e.g. 彩票（不符合 CAPM）
- $\beta_i = cov(r_i, r_m) / var(r_m)$ tells you about the assets co-variance with the market, our measure of risk
- $E[r_m] - r_f$ is the *market risk premium* or *equity premium*

The CAPM and discount rate

- The expected return (aka discount rate, required return, fair average return) is:

$E[r] = \text{riskless rate} + \text{risk premium}$

- The CAPM formalizes this:

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

Riskless rate (Amount of risk) \times (Price of risk)
(股票给 market 带来的 risk)
cov \neq 而是自己的 Var

CAPM Intuition

- A high beta stock is riskier, and must therefore offer higher returns to compensate for risk. Why?
- Because by moving in the same direction as the rest of your portfolio, it adds variance to your portfolio
- A stock with a beta of 2 means if the market falls by 10% the stock on average falls by 20%, amplifying your losses during **bad time**
- Beta is also known as “systematic risk”

CAPM Intuition

- Systematic vs Idiosyncratic:
- Suppose an asset with only firm specific uncertainty
 - i.e., zero covariance with the market
- CAPM says a fair average return is the risk free rate
- Only uncertainty related to the overall market deserves compensation because you can diversify the rest away

Implementing the CAPM Equation

CAPM 预计: $\alpha = 0 : E(r_i) - r_f = \beta_i(E(r_m) - r_f)$

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

- r_f is the riskless rate (historically $\approx 4.5\%$)
- $E[r_m] - r_f$ is the equity premium ($\approx 6.5\%$)
- β_i needs to be *estimated*, typically $0 \leq \beta_i \leq 2$, but in principle can be anything
- You estimate β_i and the CAPM tells you what the fair expected return, or discount rate, should be for the asset
- We then use this discount rate to discount future cash flows in the present value formula (next lecture)

Where does beta come from?

- Typically we estimate beta using a regression:

$$r_{i,t} - r_{f,t} = \alpha_i + \beta_i(r_{m,t} - r_{f,t}) + \varepsilon_{i,t}$$

- The coefficient β_i is the stocks beta
- We use “excess returns” in the regression
 - Accounts for fact that risk free rate changes over time
- Let’s do an example with actual data from GM
 - We will use 12 months of data, in practice, it is more common to use 5 years (60 months)

What is “alpha” (α)?

- Our regression: $r_{i,t} - r_{f,t} = \alpha_i + \beta_i(r_{m,t} - r_{f,t}) + \varepsilon_t$
- Take averages of both sides

$$\bar{r}_i - \bar{r}_f = \alpha_i + \beta_i(\bar{r}_m - \bar{r}_f)$$

- The error term ε_t is zero on average
- Rearranging,

$$\alpha_i = \underbrace{\bar{r}_i}_{\text{Actual average return}} - \underbrace{\left(\bar{r}_f + \beta_i(\bar{r}_m - \bar{r}_f) \right)}_{\text{CAPM implied expected return}}$$

- α = the *actual* average historical return - the *fair* expected return implied by the CAPM
- missing risk factors*

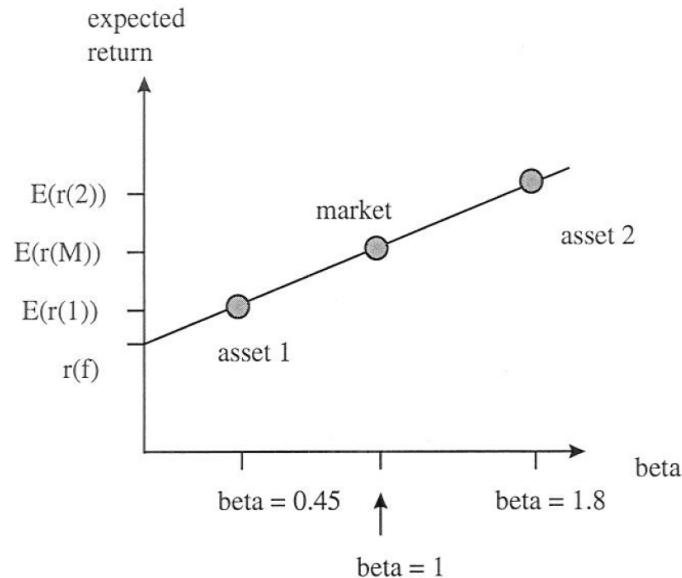
What is “alpha”?

- The CAPM says **alpha should be zero**
- If a stock or asset has positive alpha (α) it means its average return *historically* has exceeded the fair return implied by the CAPM

窗口时期长：公司变化，对现状估计有偏差
短：数据不够多，估计不准确
- The security may have been mispriced historically
 - Over- or under-priced?
- It may have also just been luck

Does the CAPM work in practice?

- The CAPM says expected returns should line up perfectly with betas



- Let's see if this is true...

Does the CAPM work in practice?

- Black Jensen Scholes 1972 get mixed results
- The fit is reasonable but not perfect

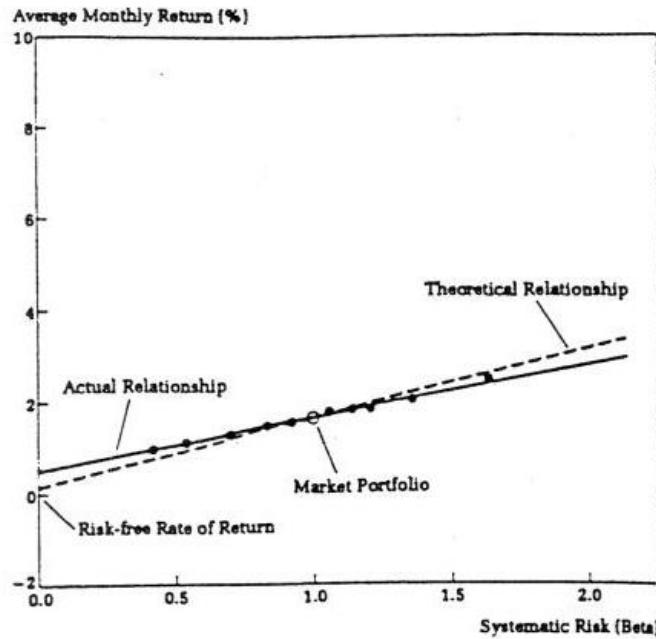
提高 β :

① 借钱 X

② 买高 β stock

↓
price ↑
↓

Actual $r <$ theoretical r



Does the CAPM work in practice?

- Higher beta does correspond to higher return
- But...
 - **low beta stocks have higher average returns than the CAPM predicts**
 - High beta stocks have lower average returns than the CAPM predicts

Does the CAPM work in practice?

- Other work by Fama and French 1992
 - Find no relationship between beta and average returns!
 - Declare “**beta is dead**”
- We will use it when we compute fundamental values in the next lecture note

Assumptions of the CAPM

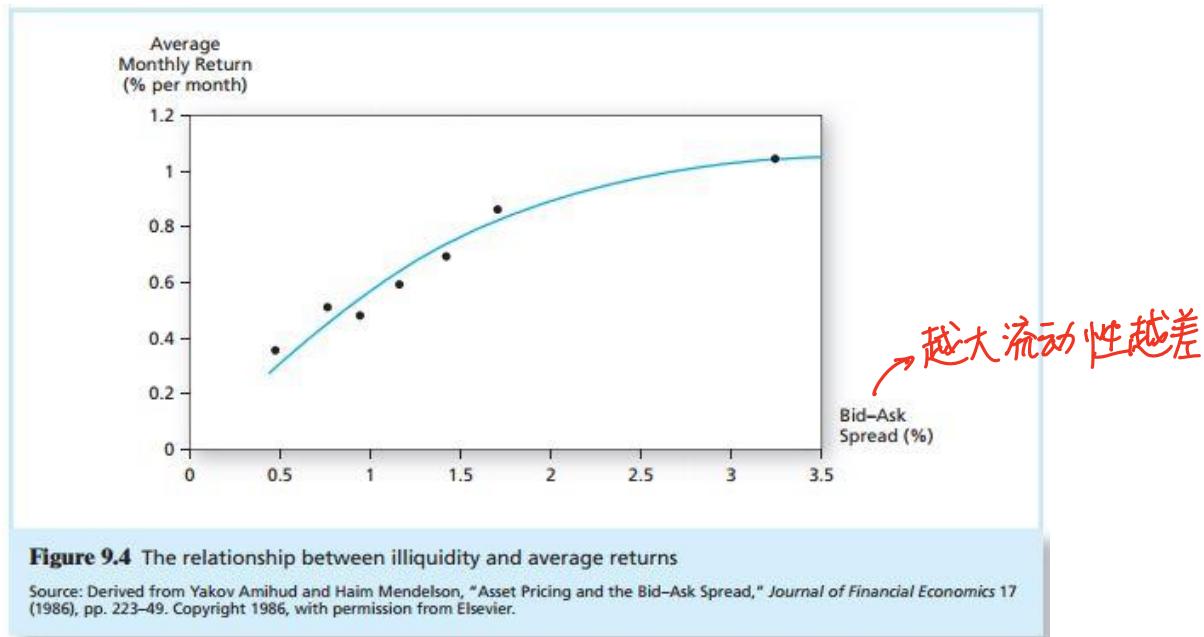
- Individuals
 - ❑ Mean-variance optimizers
 - ❑ Homogeneous expectations
 - ❑ All assets are publicly traded

- Markets
 - ❑ All assets are publicly held
 - ❑ All information is available
 - ❑ No taxes
 - ❑ No transaction costs

Liquidity and the CAPM

- Liquidity: The ease and speed with which an asset can be sold at fair market value
- Illiquidity Premium: Discount from fair market value the seller must accept to obtain a quick sale. 非流动性资产
 - Measured partly by bid-asked spread
 - As trading costs are higher, the illiquidity discount will be greater.

The Relationship Between Illiquidity and Average Returns



Liquidity Risk

- In a financial crisis, liquidity can unexpectedly dry up.
- When liquidity in one stock decreases, it tends to decrease in other stocks at the same time.
 - This is systemic
- Investors demand compensation for liquidity risk
 - Liquidity betas

Multifactor Models and the Arbitrage Pricing Theory

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Systematic versus Non-systematic Risk

- Asset returns can be decomposed into two sources:
 1. A small number of common factors which proxy for economic events that affect a large number of assets.
 - Example: changes in interest rates, inflation, and productivity.
 - These represent **Systematic risk**, which cannot be diversified away.
 2. A risk component that is unique to the asset.
 - Example – new product innovations, changes in management, lawsuits, labor strikes, etc.
 - These are **Non-systematic idiosyncratic, or firm-specific risk**, which typically is diversifiable.

The One Factor Model

- Sometimes convenient to think of the one factor as the market, hence, we can refer to this model as the **market model**.
- However, the market model and the CAPM are NOT the same.

Market Model

- To illustrate this model, let's regress the returns of a stock, say Microsoft, on the market index.

- The regression equation is the following:

$$\tilde{r}_{Micro} = \alpha_{Micro} + \beta_{Micro} \tilde{R}_{S&P} + \tilde{\epsilon}_{Micro}$$

将后面两项减去各自 mean.
又可代表平均收益率 ↑

dependent var. = intercept + (slope) independent var. + residual

- By the properties of regression, the residuals have a mean of zero, and are uncorrelated with the returns on the S&P 500.

Market Model

- Thus, the return on Microsoft is decomposed into:
 1. A constant term.
 2. Movements in the S&P 500 index return.
 3. Movements in a component unrelated to market movements.
- Decomposing the variance of Microsoft

$$\begin{aligned} \text{var}(\tilde{r}_{\text{Micro}}) &= \text{var}(\beta_{\text{Micro}} \tilde{R}_{S&P}) + \text{var}(\tilde{\epsilon}_{\text{Micro}}) \\ &\quad + \underbrace{2\text{cov}(\beta_{\text{Micro}} \tilde{R}_{S&P}, \tilde{\epsilon}_{\text{Micro}})}_{=0} \\ &= \text{var}(\beta_{\text{Micro}} \tilde{R}_{S&P}) + \text{var}(\tilde{\epsilon}_{\text{Micro}}) + 0 \end{aligned}$$

Market Model

■ Variance decomposition

we can cancel it through making
the sums 0.

$$\text{var}(\tilde{r}_{\text{Micro}}) = \beta_{\text{Micro}}^2 \text{var}(\tilde{R}_{S&P}) + \text{var}(\tilde{\epsilon}_{\text{Micro}})$$

- = systematic risk + non-systematic risk
- = non-diversifiable risk + diversifiable risk
- = market risk + unique or firm-specific risk

Market Model vs. CAPM

- The difference between the Market Model and the CAPM:
 - The CAPM describes expected or mean returns.
 - The market model describes realized returns.
- If the market model is true, then

$$\tilde{r}_i = \alpha_i + \beta_i \tilde{R}_M + \tilde{\epsilon}_i \quad \forall i$$

- Key assumption: The residuals, $\tilde{\epsilon}_i$, are independent across stocks. Hence, they are firm specific, and diversifiable

Multi-factor Model

- However, aren't there other sources of risk that affect a group of assets, which are not picked up by an asset's sensitivity to the market?
- Example, interest rate changes.
 - Changes in interest rates affect the return on Microsoft, as well as almost all assets in the economy.
 - Some of these effects will be accounted for by the market factor, but not all.
 - The remaining effects show up in the residual of Microsoft.
 - But, because interest rate changes are not “firm specific”

Multi-factor Model

- Hence, residuals cannot be diversified away. We can no longer view them as diversifiable risk
- How can we account for this common factor?
- **Multifactor Models:** Add additional common factors to the return process:

$$\tilde{r}_i = \alpha_i + \beta_{i1}\tilde{F}_1 + \beta_{i2}\tilde{F}_2 + \dots + \beta_{iK}\tilde{F}_K + \tilde{\epsilon}_i$$

$$\tilde{r}_i = \alpha_i + \sum_{k=1}^K \beta_{ik}\tilde{F}_k + \tilde{\epsilon}_i$$

- \tilde{F} 's are a small number of **common factors** (1...K), for which different assets have different sensitivities, or loadings, β_{ik}

Multi-factor Model (cont'd)

- With enough common factors, the residuals are now truly firm-specific.
- We can think of the common factors as representing new information about macroeconomic variables.
 - Example: interest rates, industrial production, inflation, market volatility.
- Think of these as **surprises** in the macroeconomy (i.e., they cannot be predicted).
- Therefore, the means of the factors must be zero.
- This means, that the α 's are the **expected returns** of the asset.

Tracking Portfolios

- A **tracking portfolio** is a portfolio that is designed to “track” the movements of an asset or investment.
- Under a factor model, this portfolio is designed to **load** on all the factors in the same way as the asset.
- That is , the tracking portfolio and the asset have the same β_{ik}

Tracking Portfolios

■ Applications

1. Hedging – to track exposures to interest rates, currencies, etc.
2. Benchmarking – to minimize deviations from a benchmark such as the S&P 500 index.
3. Arbitrage – to exploit mispricing among securities or investments.

Designing tracking portfolios

1. Determine the number of factors and their identity
(very difficult!)
2. Compute factor betas or loadings
3. Form a portfolio which has the same factor betas as the investment you wish to track.
 - This can be done by setting up one equation for each factor beta, and then solving the equations simultaneously.

One example

- Imagine a two factor model.
- Goal: Track an asset, which has a loading of 2 on the first factor and a loading of 1 on the second factor
- Using the following three securities.

$$\begin{aligned}\tilde{r}_A &= 0.04 + \underbrace{2\tilde{F}_1}_{E(r_i)} - 2\tilde{F}_2 + \tilde{\epsilon}_A \\ \tilde{r}_B &= 0.03 - 1\tilde{F}_1 + 2\tilde{F}_2 + \tilde{\epsilon}_B \\ \tilde{r}_C &= 0.11 + 3\tilde{F}_1 + \tilde{\epsilon}_C\end{aligned}$$

One example (cont'd)

- We need to find a portfolio with weights that sum to one such that the portfolio weighted average of the betas equals 2 for factor one and 1 for factor two.

$$2 w_A - 1 w_B + 3 w_C = 2$$

$$-2 w_A + 2 w_B = 1$$

$$w_A + w_B + w_C = 1$$

$$\rightarrow w_A = -0.2; w_B = 0.3; w_C = 0.9$$

↑
shortsell 做空

- Note: we need K+1 securities to track an investment under a K factor model.

Pure factor portfolios

- Tracking portfolios designed to track a factor.
- Portfolio has a loading of 1 on the factor, and loadings of zero on all other factors.
- Note: these are well-diversified portfolios. Hence, they have no firm-specific risk.

Factor 1 portfolios

- Portfolio construction

$$2 w_A - 1 w_B + 3 w_C = 1$$

$$-2 w_A + 2 w_B = 0$$

$$w_A + w_B + w_C = 1$$

→ $w_A = 0.4; w_B = 0.4; w_C = 0.2$

- Expected return

- $0.4*0.04 + 0.4*0.03 + 0.2*0.11=5\%$

Factor 2 portfolios

- Portfolio construction

$$2 w_A - 1 w_B + 3 w_C = 0$$

$$-2 w_A + 2 w_B = 1$$

$$w_A + w_B + w_C = 1$$

→ $w_A = 0.2; w_B = 0.7; w_C = 0.1$

- Expected return

- $0.2*0.04 + 0.7*0.03 + 0.1*0.11=4\%$

Risk free asset

■ Portfolio construction

$$\begin{aligned} 2 w_A - 1 w_B + 3 w_C &= \underline{0} \\ -2 w_A + 2 w_B &= \underline{0} \\ w_A + w_B + w_C &= 1 \end{aligned}$$

→ $w_A = 0.6; w_B = 0.6; w_C = -0.2$

■ Asset return (risk free rate)

□ $0.6*0.04 + 0.6*0.03 - 0.2*0.11 = 2\%$

Interpretation

- The risk premiums of factor portfolios are usually denoted as λ_k for factor k.
- Premium depends on aggregate supply of the factor in the economy and the tastes of investors.

Interpretation (cont'd)

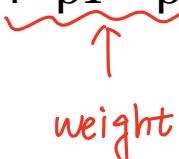
- We can use the factor portfolios to track any investment.
- To track the asset in the earlier example, we would simply buy two of factor portfolio one and buy one of factor portfolio two.
- Since pure factor portfolios are themselves portfolios of individual assets, we can further break down the tracking portfolio for the asset.

Interpretation (cont'd)

- We can create tracking portfolios from factor portfolios or from individual securities to track any investment.

Tracking Portfolio	Portfolio Weights			
	Security A	Security B	Security C	Sum
(2) Pure Factor 1	0.40	0.40	0.20	1
(1) Pure Factor 2	0.20	0.70	0.10	1
(-2) Risk-Free Port.	0.60	0.60	-0.20	1
(1) Asset ($= 2F_1 + F_2$)	-0.20	0.30	0.90	1

- The position in the risk-free asset is $1 - \beta_1 - \beta_2$

weight

Interpretation (cont'd)

- If the tracking portfolio's expected return differs from the investment's, then there is **arbitrage**.
- We can buy the one with the higher expected return, and sell the one with the lower, and make money with no risk and no initial cash expenditure!
△ △

Arbitrage and Arbitrage Pricing

- Previously, we tracked the asset by forming a portfolio with the same factor beta configuration. This implied,

$$\tilde{R}_{asset} = \alpha_{asset} + 2\tilde{F}_1 + 1\tilde{F}_2$$

做多 → 当 $\beta_1 - \beta_2$ 确定时，
asset 被确定

$$\tilde{R}_P = \alpha_P + 2\tilde{F}_1 + 1\tilde{F}_2$$

做空 →

⇒ 获得 asset - α_P

- where portfolio P is the tracking portfolio
- Since both portfolios are **well-diversified**, idiosyncratic risk is eliminated.
- Thus, the only difference in the equations are the α 's or expected returns.

Arbitrage and Arbitrage Pricing

- What happens if $\alpha_{asset} \neq \alpha_P$?
- Thus the expected return of the tracking portfolio is

$$\alpha_P = (1 - \beta_1 - \beta_2)E[R_{f*}] + \beta_1 E[R_{FP1}] + \beta_2 E[R_{FP2}]$$

$$\begin{aligned}\underline{\alpha_P} &= (1 - \beta_1 - \beta_2)r_f + \beta_1(r_f + \lambda_1) + \beta_2(r_f + \lambda_2) \\ &= r_f + \beta_1\lambda_1 + \underline{\beta_2\lambda_2} \quad \text{承担一单位风险所获得的补偿}\end{aligned}$$

- In our example, it is

$$\alpha_P = 0.02 + 2(0.03) + 1(0.02) = 0.10$$

\hookrightarrow *rf portfolio return*

Arbitrage and Arbitrage Pricing

- Suppose the expected return on the asset is 11%. Is there arbitrage? And, how do we exploit it?
- No matter what happens in the macroeconomy, we are perfectly hedged, since our arbitrage strategy takes exactly opposite positions on the factors, which are the sole source of risk for every investment.

Arbitrage Pricing Theory

- The use of tracking portfolios and the possibility to exploit arbitrage is the basis for the Arbitrage Pricing Theory (APT)

APT 假设:X

- The APT only requires three assumptions:
 1. Returns follow a factor model 未限制 factor 数量
 2. There are no arbitrage opportunities
 3. **There are many securities, so that we can form well-diversified portfolios that eliminate firm-specific risk**

$$E(\varepsilon_i) = 0$$

Arbitrage Pricing Theory

- If we assume no arbitrage, and returns follow a factor model, then every asset must have the same expected return as its tracking portfolio.
- The expected return of the tracking portfolio, α_P , is

$$r_f + \beta_{i1}\lambda_1 + \dots + \beta_{iK}\lambda_K$$

- where the λ 's are the risk premiums on the K factors,

APT equation:

- Then, we have the APT equation:

$$E[\tilde{r}_i] = \alpha_i = \alpha_P = r_f + \beta_{i1}\lambda_1 + \dots + \beta_{iK}\lambda_K$$


碰巧, 因为 Assumption 不同

- Reminder: In CAPM: $E[r_i] = r_f + \beta_i(E[r_m] - r_f)$
一维的 APT, 且 risk premium
类型被固定
- Thus, we now have a statement about expected returns. In other words, we now have a pricing model.

CAPM vs. APT

- Note: unlike the CAPM, the only assumption here is that no arbitrage exists.
- Thus, the APT is much less restrictive than the CAPM.
- However, this comes at a cost, because the APT is also **less specific**.
 - the APT does not tell us how many factors
 - or what those factors are
 - the CAPM tells us there is one factor, and it is the market portfolio

General Ideas in Asset Pricing

- A security's expected return depends on when it makes its payments
- A security is attractive if it pays up when times are bad
 - that's exactly when you need the money!
 - you are prepared to accept a low expected return on these securities
- A security is not attractive if it pays up when times are good
 - you don't need any more money at these times
 - you require a high expected return on these securities

Another explanation of high returns, high risk

General Ideas in Asset Pricing

- In the CAPM, good and bad times are captured by the market return
 - Good times: market return is high, and vice-versa
- Securities with a high beta tend to pay up (i.e., earn high returns) when the market is doing well
 - What use is that?
 - The security is unattractive
 - It must earn a high expected return

Risk and Return Revisit

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Definition of return

- Return=(what you get tomorrow)/what you paid today
or, $R=(\text{value at time } t+1)/(\text{value at time } t)$

$$R_{t+1} = \frac{P_{t+1} + CF_{t+1}}{P_t}$$

e.g. Dividend

- What you get tomorrow is the price of the asset plus any cash flow it pays off
 - Ex: for a stock $CF=$ dividend, for a bond $CF=$ coupon payment
- This is often called gross return

Gross vs. net return

- We will typically work with net returns, r

$$r_{t+1} = \frac{P_{t+1} + CF_{t+1}}{P_t} - 1$$

- Example, suppose you buy a stock at $P=\$100$, tomorrow's price is $\$101$ and it pays a $\$3$ dividend
 - Gross return = $(101+3)/100=1.04$
 - Net return = $1.04-1=0.04$ or 4%
 - 4%, the net return, is often a more convenient number to think about than 1.04

Expected Return

- Actual returns are not known ahead of time, so we will often compute **expected returns**

$$E[r_{t+1}] = \frac{E[P_{t+1}] + E[CF_{t+1}]}{P_t} - 1$$

- This tells us what the return is likely to be on average
- Realized returns** (what you actually get) are often very different from expected returns
 - Example: stock price today is \$100, equal chance it will go up to either \$150 or down to \$50. Realized return will be either +50% or -50%. Expected return is $E[r] = 0.5*(50\%) + 0.5*(-50\%) = 0$.

Multi-period returns and compounding

- $R_{t,t+1}$ gross return from time t to t+1
- $R_{t+1,t+2}$ gross return from time t+1 to t+2
- $R_{t,t+2}$ gross return from time t to t+2
- $r_{t,t+2} = R_{t,t+2} - 1$ net return from t to t+2

Multi-period returns and compounding

- Then $R_{t,t+2} = R_{t,t+1}R_{t+1,t+2}$
 $(1 + r_{t,t+2}) = (1 + r_{t,t+1})(1 + r_{t+1,t+2})$
- This is the standard compounding formula
 - Example: Suppose you earn **10%** in year 1 and **20%** in year 2.
 - Your 2-year net return is $(1+0.1)(1+0.2)-1=32\%$

Multi-period returns and compounding

■ For a stock

Assumption: Dividend is reinvested.

$$R_{t,t+2} = \frac{P_{t+2} + D_{t+2} + D_{t+1} \left(\frac{P_{t+2} + D_{t+2}}{P_{t+1}} \right)}{P_t}$$

$$R_{t,t+2} = \frac{P_{t+2} + D_{t+2}}{P_{t+1}} \frac{P_{t+1} + D_{t+1}}{P_t} = R_{t,t+1} R_{t+1,t+2}$$

Real vs. nominal returns

- So far we have been working with nominal returns
Investment : To increase the purchasing power (购买力)
- To convert a nominal return to a real return we divide by the rate of inflation, π 考慮通膨率

$$\underbrace{(1 + r_{real})}_{\text{real}} = \frac{(1 + r_{nom})}{(1 + \pi)}$$

- Approximation $r_{real} \approx r_{nom} - \pi$

Historical Returns

- What have the real, annual, realized returns on securities been historically?

Period	T-Bills	T-Bonds	Stocks (S&P500)
1870-1925	2.6%	2.8%	6.5%
1926-2014	0.6%	2.2%	6.6%

- Equity premium is the average return of stocks minus the average return on T-Bills: It is around 6% historically.

Risk and Return

- Risk is uncertainty about the future
- Over the long run stocks do better on average, but year to year their annual returns are more volatile or uncertain

	T-Bills	T-Bonds	Stocks (S&P500)
Average return	0.6%	2.2%	6.6%
Volatility	3.0%	6.1%	19.1%
Worst year	-15.2%	-16.0%	-48.0%

- Stocks are “riskier”
- Example: the S&P500 dropped over 40% in 2008

Risk and Return

- Human beings are *mostly risk averse*, i.e. dislike risk
- To be willing to hold a riskier security, they must receive a higher average return as a reward for doing so
 - This is why stocks have higher average returns than bonds
 - Ex ante vs. ex post
- “Average return is compensation for risk” is a good way of thinking about long-term patterns in average returns
- We will discuss how to measure risk more precisely later in the course

Expected Return

■ Expected returns

$$E(r) = \sum_s p(s)r(s)$$

- ❑ $p(s)$ = Probability of a state
- ❑ $r(s)$ = Return if a state occurs
- ❑ s = State

Scenario Returns: Example

<u>State</u>	<u>Prob. of State</u>	r in State
Excellent	.25	0.3100
Good	.45	0.1400
Poor	.25	-0.0675
Crash	.05	-0.5200

$$\begin{aligned}E(r) &= (.25)(.31) + (.45)(.14) + (.25)(-.0675) + (0.05)(-0.52) \\&= .0976 \text{ or } 9.76\%\end{aligned}$$

Standard Deviation

- Variance (VAR):

$$\sigma^2 = \sum_s p(s)[r(s) - E(r)]^2$$

- Standard Deviation (STD):

$$\text{STD} = \sqrt{\sigma^2}$$

VAR and STD: Example

- VAR calculation:

$$\begin{aligned}\sigma^2 &= .25(.31 - 0.0976)^2 + .45(.14 - .0976)^2 \\ &\quad + .25(-0.0675 - 0.0976)^2 + .05(-.52 - .0976)^2 \\ &= .038\end{aligned}$$

- STD calculation:

$$\begin{aligned}\sigma &= \sqrt{.038} \\ &= .1949\end{aligned}$$

Time Series Analysis of Past Rates of Return

- You can only observe a time series of past returns
 - You cannot see all possible states
- True means and variances are unobservable because we don't actually know possible scenarios like the one in the examples
- So we must estimate the means and variances

Arithmetic vs. Geometric Average

- Arithmetic Average

$$E(r) = \frac{1}{n} \sum_{i=1}^n r_i$$

- Arithmetic Average is an unbiased estimate of the **expected future return**

- What is the **actual** performance of the **past** sample?

< Arithmetic , ∀r

- Geometric (Time-Weighted) Average

$$g = ((1+r_1)(1+r_2)\dots(1+r_n))^{1/n} - 1$$

Arithmetic vs. Geometric Average

- Your returns in the last 2 years are 10%, -10%.
- What is your expected return next year?
 - **Arithmetic Average: 0%**
- What was your return over the last two years?
 - $\$1*(1+10\%)*(1-10\%)=0.99$, that is -1% over 2 years,
 - Or, $SQRT(0.99)-1=-0.5\%$ per year
 - **The geometric average return is -0.5%**
- Asymmetry: negative return has a larger effect
 - You had a -50% return last year, what is the return you need this year to break even? *Ans: 100%*

Arithmetic vs. Geometric Average

- What determines the difference between the two?
- Case 1: returns are not volatile: 9%, 11%
 - Arithmetic average: 10% 短期持有
 - Geometric average: 9.995% 长期持有：累计回报率
Cumulative return : 与 std 呈负相关
- Case 2: returns are volatile: -90%, 110%
 - Arithmetic average: 10%
 - Geometric average: -54%
- The difference is larger when returns are more volatile

Estimating Variance and Standard Deviation

- Estimated Variance

$$\hat{\sigma}^2 = \frac{1}{n} \sum_{i=1}^n [r_i - \bar{r}]^2$$

- Unbiased estimated standard deviation

$$\hat{\sigma} = \sqrt{\frac{1}{n-1} \sum_{i=1}^n [r_i - \bar{r}]^2}$$

Sharpe Ratio

■ Excess Return $r - r_f$

- ❑ The difference in any particular period between the **actual** rate of return on a risky asset and the actual risk-free rate

■ Risk Premium $E(r) - r_f$

- ❑ The difference between the **expected** return on a risky asset and the risk-free rate

■ Sharpe Ratio

越大越好
> 1 已经很好

$$\frac{\text{Risk premium}}{\text{SD of excess returns}} = \frac{E(r) - r_f}{\sigma(r - r_f)}$$

The Normal Distribution

- **If returns are normally distributed**
 - Standard deviation is a good measure of risk
 - Portfolio returns are also normal
 - Future scenarios can be estimated using only the mean and the standard deviation
 - The dependence of returns across securities can be summarized using only the pairwise correlation coefficients

Normality and Risk Measures

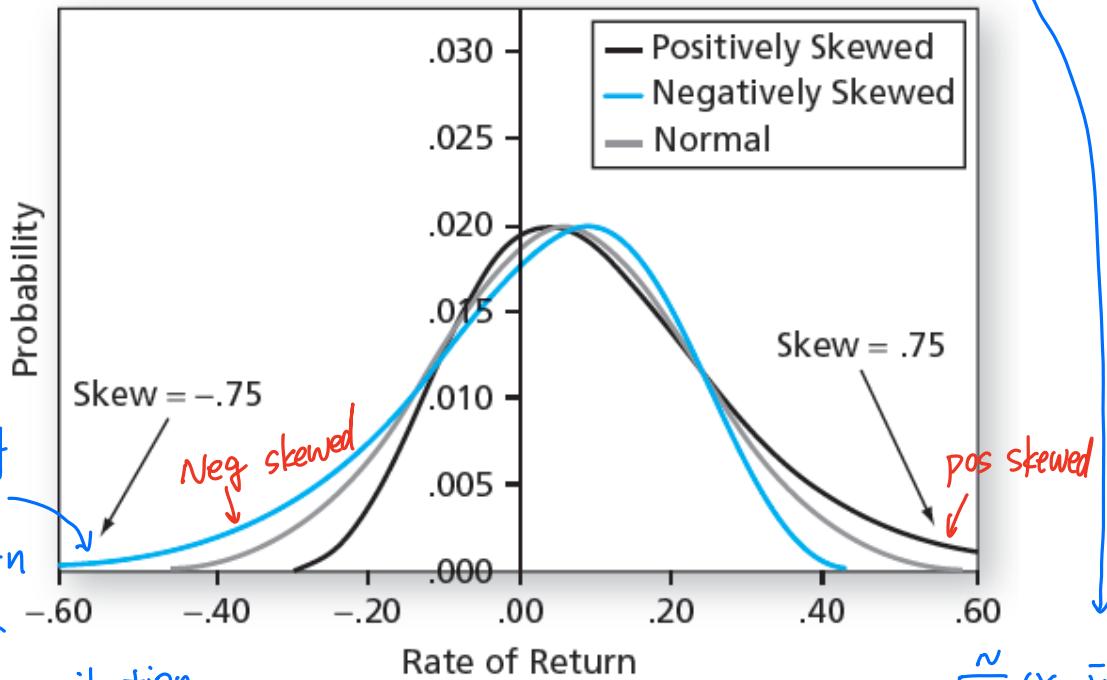
usual situation

- What if excess returns are not normally distributed?
 - Standard deviation is no longer a complete measure of risk
 - Sharpe ratio is not a complete measure of portfolio performance
 - Need to consider skewness and kurtosis

偏斜分布

Normal and Skewed Distributions

Skewness: 三阶矩 (μ^3)



一阶矩 $(\mu)^1$
Mean = 6%, $\bar{Y} = 6\%$
 $(\mu)^2$
SD = 17%
 $(\sigma)^2$

$$g_1 = \frac{\sum_{i=1}^N (Y_i - \bar{Y})^3 / N}{S^3}$$

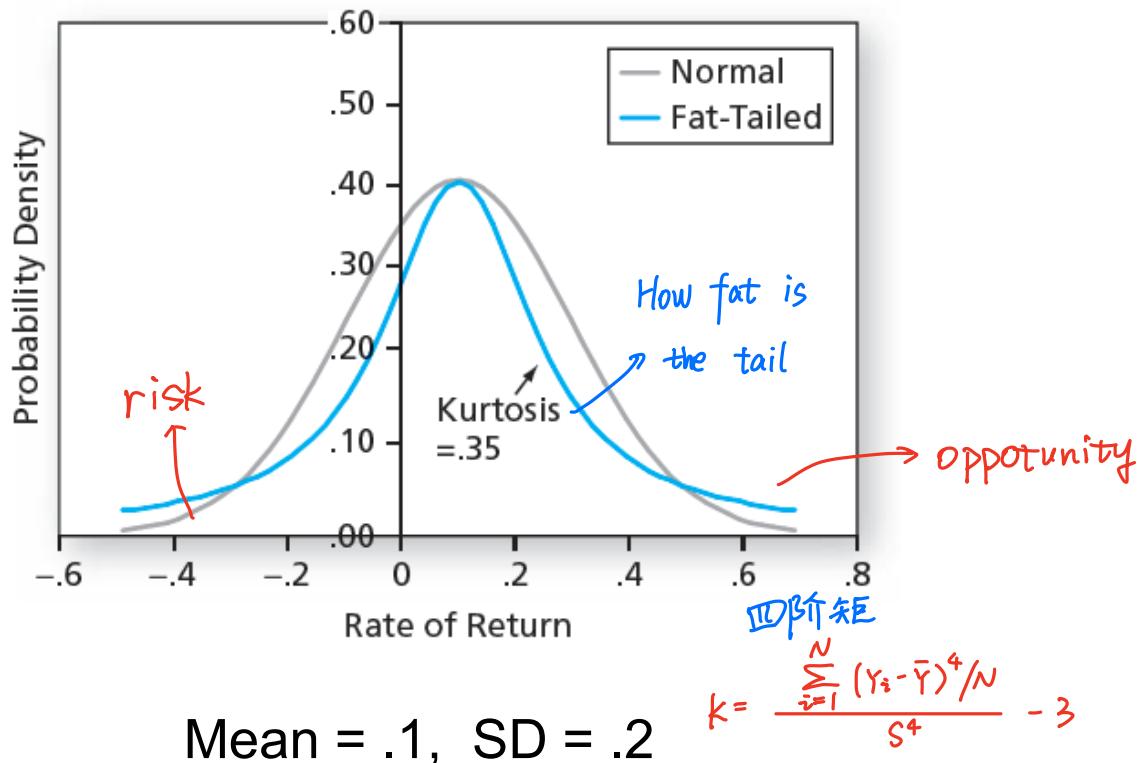
(Stand Deviation)

For Gaussian Dist.

$$g_1 = 0$$

Normal and Fat-Tailed Distributions

Kurtosis ↑
↓
Fatter tail



Normality and Risk Measures

- Value at Risk (VaR) *左侧尾部较小*
 - Loss corresponding to a very low percentile of the entire return distribution, such as the fifth or first percentile return
 - Example: a 5% VaR of \$1M: The chance of losing more than or equal to \$1M is 5%.
↳ At most 5% chance
- Expected Shortfall (ES)
 - Also called conditional tail expectation (CTE), focuses on the expected loss in the worst-case scenario (left tail of the distribution)
 - More conservative measure of downside risk than VaR

Normality and Risk Measures

■ Lower Partial Standard Deviation (LPSD)

- ❑ Similar to usual standard deviation, but uses only negative deviations from the risk-free return, thus, addressing the asymmetry in returns

不对称

$r < r_f$ that
只考虑小于 r_f 的回报率的 Std.

■ Sortino Ratio (replaces Sharpe Ratio)

- ❑ The ratio of average excess returns to LPSD

Historic Returns on Risky Portfolios

- The second half of the 20th century, politically and economically the most stable sub-period, offered the highest average returns
- Firm capitalization is highly skewed to the right: Many small but a few gigantic firms
巨大的
- Average realized returns have generally been higher for stocks of small rather than large capitalization firms

Price: The Present Value Formula

- When investing in an asset, we have in mind an average rate of return that is fair for that asset
 - The “expected return” for an asset $r = E[r_{t+1}]$
 - $r = \text{riskless interest rate} + \text{risk premium}$
 - $= \text{real interest rate} + \text{expected inflation} + \text{risk premium}$
 - ↳ impatience of people 印的越多, inflation↑
 - ↳ 与 GDP Growth 成正比, GDP Growth ↑, 公司借钱发展, interest rate ↑
- r , the fair average return, is also called:
 - the “expected return”
 - the “discount rate” Alternative names
 - the “required return”

The Present Value Formula

- We can rearrange the definition of return to obtain an important pricing formula, the present value formula

$$1 + r_{t+1} = \frac{CF_{t+1} + P_{t+1}}{P_t}$$

$$1 + r = \frac{E[CF_{t+1}] + E[P_{t+1}]}{P_t}$$

$$P_t = \frac{E[CF_{t+1}] + E[P_{t+1}]}{1 + r}$$

$$P_{t+1} = \frac{E[CF_{t+2}] + E[P_{t+2}]}{1 + r}$$

The Present Value Formula

- Substituting, we get

$$P_t = \frac{E[CF_{t+1}]}{1+r} + \frac{E[CF_{t+2}]}{(1+r)^2} + \frac{E[P_{t+2}]}{(1+r)^2}$$

- and so on, until

$$P_t = \frac{E[CF_{t+1}]}{1+r} + \frac{E[CF_{t+2}]}{(1+r)^2} + \frac{E[CF_{t+3}]}{(1+r)^3} + \dots$$

The Present Value Formula

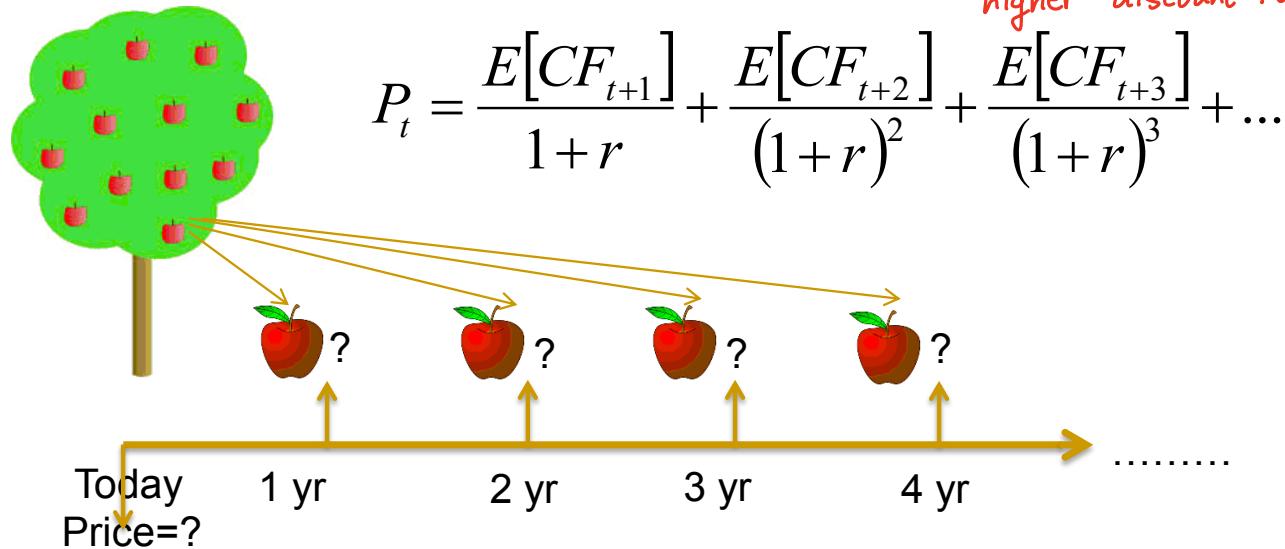
$$P_t = \frac{E[CF_{t+1}]}{1+r} + \frac{E[CF_{t+2}]}{(1+r)^2} + \frac{E[CF_{t+3}]}{(1+r)^3} + \dots$$

- This formula says that the price, or value, of an asset is the sum of its discounted expected future cash flows
 - This is why the expected return r is often called a “discount rate”
- This formula is incredibly useful in finance for a range of applications (i.e., valuation, capital budgeting, etc.)

The Present Value Formula

- Think of a stock like a tree which yields some uncertain amount of fruit each year (“dividends”)

Uncertainty cause a higher discount rat



The Present Value Formula

- What is the price, or value, of the tree?
- It is the present value of all the fruit we expect to get
- We “discount” future fruit because it is risky / uncertain
and because we are impatient

The Present Value Formula

- Special case: cash flows are expected to grow at a constant rate g

$$P_t = \frac{E[CF_{t+1}]}{1 + r} + \frac{E[CF_{t+2}]}{(1 + r)^2} + \frac{E[CF_{t+3}]}{(1 + r)^3} + \dots$$

$$P_t = \frac{CF_t(1 + g)}{r - g}$$

$$P_t = \frac{CF_{t+1}}{r - g}$$

Understanding changes in asset prices

- When the price of an asset moves, it can be due to:
 - Changes in expectations about future cash flows $E[CF_{t+k}]$
 - Changes in the discount rate r
 - Changes in the real interest rate
 - Changes in the rate of inflation $\uparrow \rightarrow r \uparrow \rightarrow g \uparrow$
P_t 不一定增大
 - Changes in the risk premium
 - Changes in the risk premium can be due to:
 - Changes in the amount of risk
 - Changes in the price of risk

$$P_t = \frac{CF_{t+1}}{r - g}$$

Understanding the 1995-2000 surge in stock prices

- From 1995-2000 stock prices nearly tripled
- How can we understand this?
 - An increase in expected future cash flows
 - A fall in the discount rate due to
 - A fall in the risk premium
 - People decided that stocks were less risky
 - People became less risk averse
 - A fall in the real interest rate
 - A fall in inflation
- Note: the fall in real interest rate and inflation were likely small effects

$$P_t = \frac{CF_{t+1}}{r - g}$$

Valuing the stock market with the PV formula

- Given a reasonable risk premium, what is a fair value for the stock market?

$$\frac{P_t}{E_t} \approx \frac{1}{r - g} = \frac{1}{r_f + RP - g}$$

- Given todays prices, what is the likely average risk premium going to be, going forward

$$RP \approx g + \frac{E_t}{P_t} - r_f$$

- Historically, a high D/P or E/P ratio implies significant high stock returns
高增长的股票往往有高回报率

Understanding economic reports

- Inflation news
- Bonds
 - If inflation is higher than expected, bonds fall
 - The discount rate goes up
 - Lenders raise interest rates to cover the rise in inflation
- How about stocks?

Understanding economic reports

- Stocks usually do not react as much to inflation news
- Inflation higher than expected
 - The discount rate goes up
 - Expected cash flows increase (in nominal terms)
while in Bonds, Dividend amount is quite stable.
 - Effects tend to cancel each other out

Understanding economic reports

- Employment reports and bonds
- If unemployment figures are better than expected (i.e., good news), bonds fall
- The discount rate goes up
- Firms borrow more in a stronger economy, pushing the riskless rate up

Bond Prices Post Steep Losses on Strong Economic News

Understanding economic reports

- Employment reports and stocks
- Stocks *typically* do not react as much to employment reports
- If unemployment figures are better than expected (i.e., good news)
 - Again, the discount rate will rise
 - But the stronger economy means that cash flows will rise as well
 - The two effects tend to cancel out (on average)

(In)Efficient Markets

Jinfan Zhang

■ Review of the Market Efficiency Debate

Efficient Market Hypothesis (EMH)

- EMH says stock prices already reflect all available information
- A forecast about favorable *future* performance leads to favorable *current* performance, as market participants rush to trade on new information.
- Result: Prices change until expected returns are exactly commensurate with risk.
相称的

Definition of market efficiency

- Market efficiency means that security prices are right
 - i.e. they fully reflect all available information
- Equivalently, all prices equal their fundamental value

$$FV_0 = \frac{E(CF_1)}{1+r} + \frac{E(CF_2)}{(1+r)^2} + \dots$$

- use all available information to make the best possible cash-flow forecast
- use a discount rate r that is appropriate for the risk

Versions of the EMH

What is information in the Market ?

- Weak
 - Market trading data
- Semi-strong
 - All public information
- Strong
 - All information, including insiders' private information
- All versions assert that prices should reflect *available* information

Implications of the EMH

- Using prices and volume information to predict future prices (Technical Analysis) → 不靠谱
- Success depends on a sluggish response of stock prices to fundamental supply-and-demand factors.
缓慢
- Test of the weak form efficiency

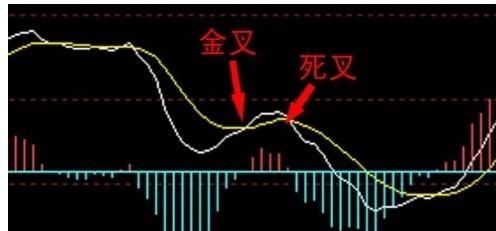
Technical Analysis

{ weak form } EMH Hold \Rightarrow Technical
{ semi-strong } Analysis 无效

K线：滑动平均 (前 K 天)

■ Candle Plot

- Gold Crossing (金叉)
 - Short term moving average line surpass the long term moving average line upward.
- Dead Crossing (死叉)
 - Short term moving average line surpass the long term moving average line downward.



Implications of the EMH

- Fundamental Analysis - using economic and accounting information to predict stock prices
 - Try to find firms that are better than everyone else's estimate.
 - Try to find poorly run firms that are not as bad as the market thinks.
 - Test of the semi strong form efficiency
 - Most of the times hold*

定价：指导社会资源分配

Implications on Asset Management

- Active Management
 - An expensive strategy → Transaction costs are high
- Passive Management:
 - Accept EMH, don't attempt to outsmart the market
 - Index Funds and ETFs with very low costs
Automatically generate a portfolio
- The role of portfolio management in an efficient market
 - Diversification
 - Appropriate risk level

Implications of market efficiency

- Prices react to *new information* quickly and to the right extent 程度
- There is no free lunch:
 - the only way to get higher returns is by taking on more risk
 - there is no information out there that can be used to construct strategies that earn returns higher than required for their risk

How can we tell if markets are inefficient?

Q: ① 市场有效性出现问题, 价格出现差异 or ② 资产定价模型出错

- Can look for stocks whose prices seem wrong
 - but hard to be sure the price is wrong
 - when we say 'prices are wrong', we are **implicitly stating what 'correct' is**

Event - Study:

- Can look to see if new information is **quickly** and fully incorporated into prices : K线图
- ① Market efficient:



normal

② Inefficient:



Undereact

③ Inefficient, overreact



Overreact
- Can look for investment strategies that seem to earn higher average returns than they deserve for their risk
 - but hard to judge their risk, so it is hard to be sure they really are earning more than they deserve

Theoretical argument for market efficiency

■ Milton Friedman (1953)

- If a security becomes mispriced, smart investors should quickly take advantage of it, and the mispricing should disappear quickly
 - this process is often called “arbitrage”
- Anyone who claims markets are inefficient, must explain why the arbitrage process breaks down
 - major challenge for behavioral finance

Why do we care?

- In an efficient market, resources have been allocated efficiently by markets.
- There is no role for intervention
干预
- In an inefficient market, capital is not properly allocated across firms.
- Potentially, there is a role for regulation

What does the evidence suggest?

Evidence for market efficiency

- Professional money managers do not beat the market on average
- What does this mean?
 - There are no market inefficiencies to exploit?

Evidence for market efficiency

- New information appears to be quickly incorporated into prices
 - e.g. suppose “news” is the announcement of a takeover
收购
 - look at the target firm’s stock price reaction to the news
 - average over many companies to see the typical pattern
 - This is called an “event study”

Event Studies

- Empirical financial research enables us to assess the impact of a particular event on a firm's stock price.
- The **abnormal** return due to the event is the difference between the stock's actual return and an estimate of the stock's return **in the absence of the event**.

Event Studies

- Expected Return

$$r_t = a + b r_{Mt} + e_t$$

- Abnormal Return = (Actual - Expected)

$$\tilde{e}_t = r_t - (a + b * r_{Mt})$$

Example: Cumulative Abnormal Returns Before Takeover Attempts: Target Companies

被买的公司

内部交易危害

Insider Trading:

- ① 个人投资者损失，
普通人减少投资。
- ② 原公司高管进行内部交易，
大量收购合并公司股票，
使原公司崩溃。
- ③ 不公平公正

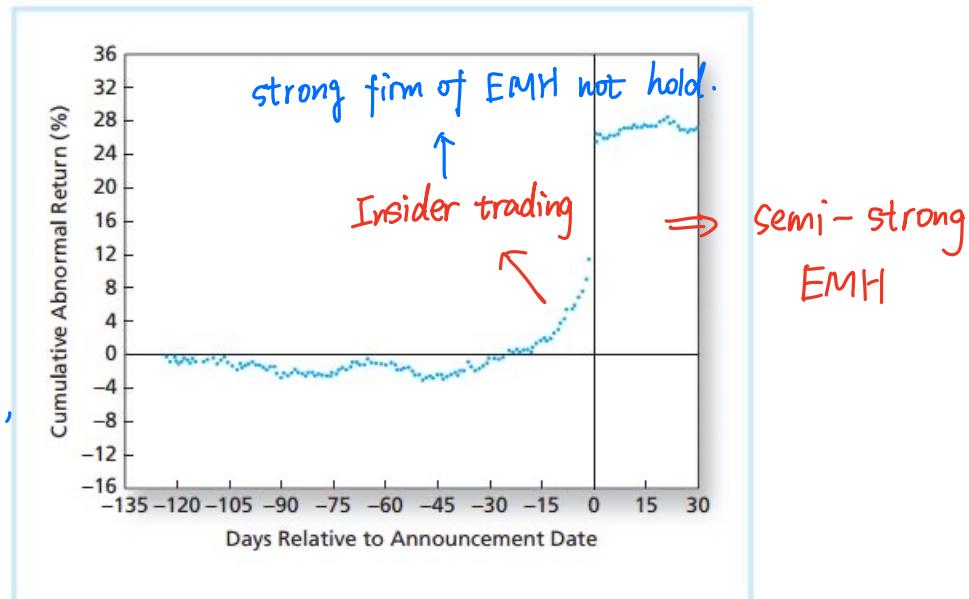


Figure 11.1 Cumulative abnormal returns before takeover attempts: target companies

Source: Arthur Keown and John Pinkerton, "Merger Announcements and Insider Trading Activity," *Journal of Finance* 36 (September 1981). Used with permission of John Wiley and Sons, via Copyright Clearance Center. Updates courtesy of Jinghua Yan.

Evidence against market efficiency

- Cases where prices seem to move even though there is no new information
 - e.g. the 20% drop in the stock market in one day in October 1987 *Black Friday*
No reason
 - The Treasury “flash” rally, occurred on Oct. 15, 2014 and only lasted for about an hour. But the ferocity of the ascent — and the simultaneous eye-popping plunge in the yield — prompted widespread concern about the functioning of the market for Treasury securities.
- There are investment strategies that seem to have earned higher average returns than is consistent with their risk (“beat the market”)
 - these are so called “anomalies”
- Shiller (1981) provided evidence that the stock market prices are too volatile to be explained by changes in fundamentals.

S & P 500 Index:

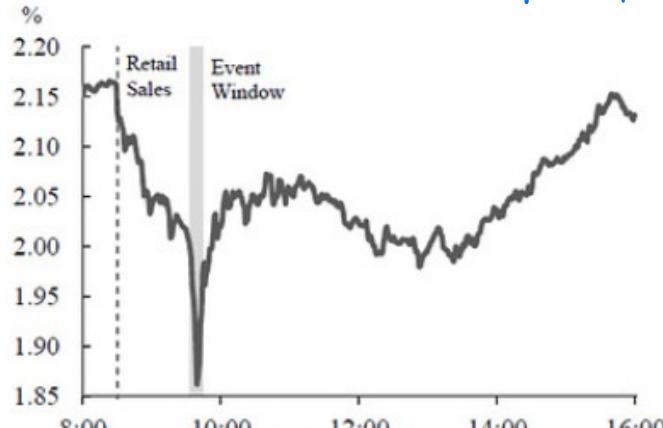
$$\text{Price} = \sum_{k=1}^n \frac{D_k}{(1+r)^k} + \frac{D_{k+1} + \text{Capital}}{(1+r)^{k+1}}$$

Dividend 稳定, $P \rightarrow r$

$$r = r_f + \text{Inflation} + \text{Risk Premium}$$

Specific Examples--The Oct. 15, 2014 “flash rally” in US Treasury bond market : Save Heaven (Nb risk)

Figure 2.1: 10-Year Treasury Yield on October 15
(Cash) 无风险利率



Note: 1-minute observations; Yield is inversely related to price; Unless otherwise noted, intraday figures show October 15 US trading hours
Source: Staff calculations, based on data from Bloomberg.

Yield. return in Bonds: Negative correlated



Joint Staff Report: THE U.S. TREASURY MARKET ON OCTOBER 15, 2014

The report asserts that the banks and principal trading firms took steps to protect themselves from a rise in Treasury prices — and those steps seemed to drive the prices even higher. The banks widened the gap at which they would buy and sell Treasuries, a standard practice in volatile moments in the markets. At one point, they stopped offering to sell Treasuries. The principal trading firms, for their part, reduced the average size of their trades. “Both actions served as risk management strategies by reducing the number and size of orders that could be executed,” the report said.

Specific Examples

Tech bubble

- In March 2000, 3-Com sold 5% of its subsidiary Palm in an initial public offering (IPO)
 - after the IPO, 1 share of the 3-Com would effectively include 1.5 shares of Palm
 - after the first day of trading, Palm was at \$95
 - in an efficient market, 3-Com should have been at \$142, at least!
 - but it was at \$82! \Rightarrow 3-com 股价
 - market value of the 95% of Palm owned by 3-Com was almost \$25 billion greater than the market value of 3-Com.
 - as if all of 3-Com's other assets were worth a negative \$25 billion

$$1.5 \text{ 股 Palm} = 1 \text{ 股 3-com}$$

策略: long 1 股 3-com, short 1.5 股 Palm 套利



很难, 3-com 只 release 5% Palm, 股票数量少

Arbitrage

- One need to borrow the stock in order to short it.
 - Mutual funds, trusts, and asset managers usually lend shares and demand fees.
- It might be hard or impossible to borrow.
- It is costly to borrow shares. If the stock price is \$10, and lending fee is 10%, then one need to return one share plus \$1 if he borrows the stock for a year.
- Cost of shorting was 35% in July 2000 for Palm.

↑
借股利率

Slow incorporation of news into stock prices

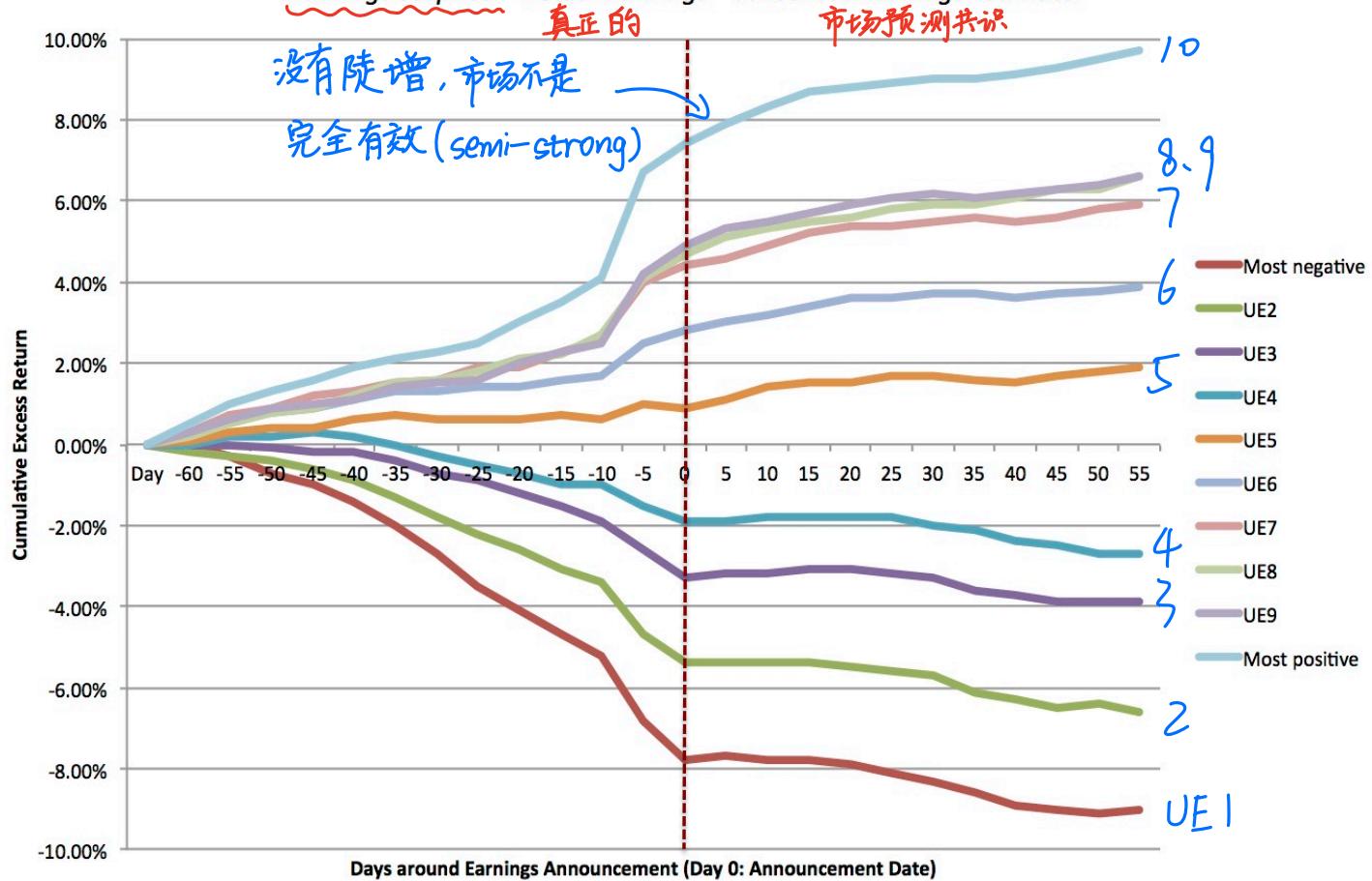
合并

- Earnings news does not appear to be quickly and fully incorporated into prices
- On unexpectedly good news, a firm's stock price jumps up, but continues to drift up in the weeks thereafter
- On unexpectedly bad news, a firm's stock drops in value, but continues to drift down in the weeks thereafter

趋势

Market Reaction to Unexpected Quarterly Earnings Surprises: US Companies from 1988-2002

Earnings Surprise = Actual Earnings - Consensus Earnings Estimate



long-short: 赚相对价差, 去除大盘对个股 return 的影响 (long. short 时有手续费、传播等减少赚钱机会)

Can we come up with a strategy
that makes money?

Investment strategies that seem to beat the market

- These are strategies that seem to earn higher average returns than they should, for their risk
- e.g. if you regress excess strategy returns on excess market returns, you get a positive alpha intercept:

$$r_{P,t} - r_{f,t} = \alpha_P + \beta_P(r_{M,t} - r_{f,t}) + \epsilon_{P,t}$$

Average Annual Return for 10 Size-Based Portfolios, 1926 – 2011

不符合CAPM解釋 $\Rightarrow \beta$ 不能很好解釋



Figure 11.3 Average annual return for 10 size-based portfolios, 1926–2011

Source: Authors' calculations, using data obtained from Professor Ken French's data library at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

Example: Value vs. Growth

- Form portfolios based on prices to fundamentals
 - use price to earnings (P/E) ratio
 - could also look at price to book (P/B) and price to cash-flow (P/CF) ratios
- Over many decades, average return of value stocks is much **higher** than that of growth stocks
 - but doesn't appear to be riskier
- Value stocks (with low ratios) appear to earn higher returns than they "deserve," for their risk
- Growth stocks (with high ratios) appear to earn lower returns than they "deserve," for their risk

e.g. P/B Ratio

Average Return as a Function of Book-To-Market Ratio, 1926–2011

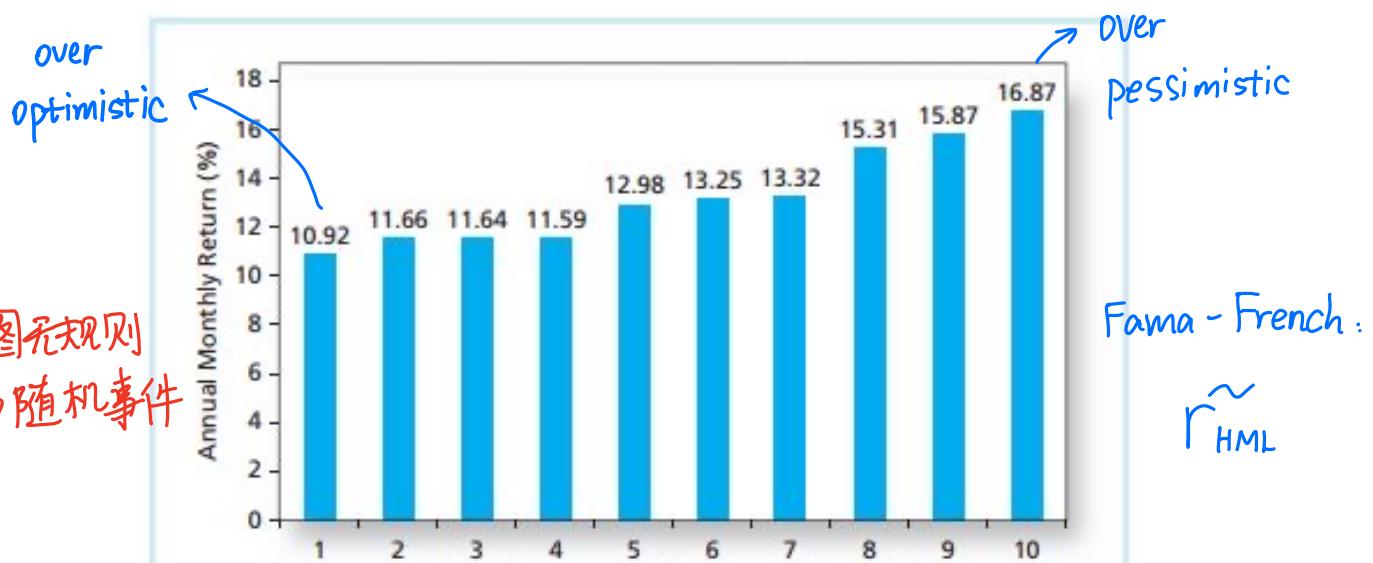


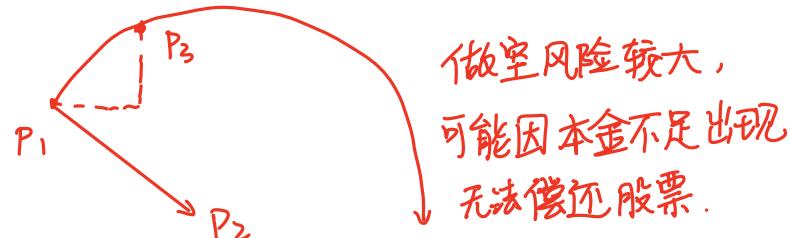
Figure 11.4 Average return as a function of book-to-market ratio, 1926–2011

Source: Authors' calculations, using data obtained from Professor Ken French's data library at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

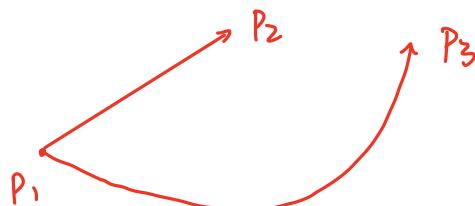
Reactions to the evidence

- Behavioral finance people say:
 - these strategies earn more average return than they should, for their risk
 - they must therefore be exploiting mispricing
利用定价错误
- Rational finance people say:
 - the strategies are risky, but the standard measures of risk fail to capture this
 - look for new ways to measure risk under which the strategies do look risky

Limits to arbitrage



- If stocks are mispriced, why doesn't the arbitrage process eliminate the inefficiency?
 - The risk that mispricing will get worse in the short run
 - Margin Call
 - Fund managers are evaluated frequently
 - The danger is that if the mispricing worsens, even temporarily, investors will withdraw funds 资金撤离
 - Knowing this, the fund managers don't take too aggressive a position against the mispricing, allowing it to survive

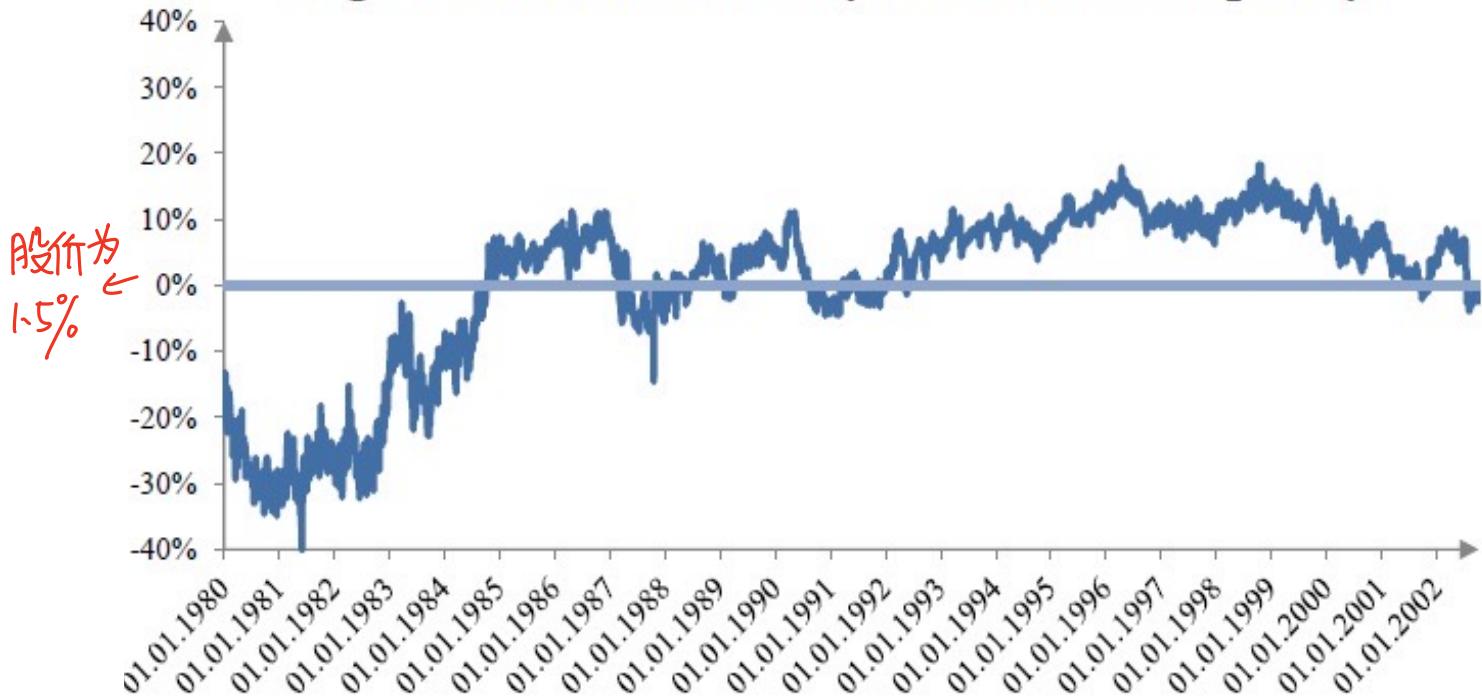


Example: Twin shares (Royal Dutch/Shell)

- Twin shares are shares that are claims to the same cash-flow stream
- Royal Dutch shares
 - Trade in the Netherlands and the U.S.
 - Are a claim to 60% of the combined firm's cash flow
- Shell shares
 - trade in the U.K. and the U.S.
 - are a claim to 40% of the combined firm's cash flow
- In an efficient market, must have:
 - but

$$\frac{\text{Price(Royal Dutch)}}{\text{Price(Shell)}} = \underline{\underline{1.5}}$$

Log deviations from Royal Dutch/Shell parity



- prices can stay wrong, or become even more wrong

Summary

- Debate over market efficiency continues ...
- Both sides agree that there are many examples of “anomalies”

- Disagree on what those “anomalies” mean for market efficiency
- Even if prices are “wrong”, that doesn’t mean it’s easy to beat the market!
- Next time: do hedge funds, mutual funds, etc. beat the market?

Performance Evaluation

Jinfan Zhang
CUHK(Shenzhen)

How impressive is this manager?

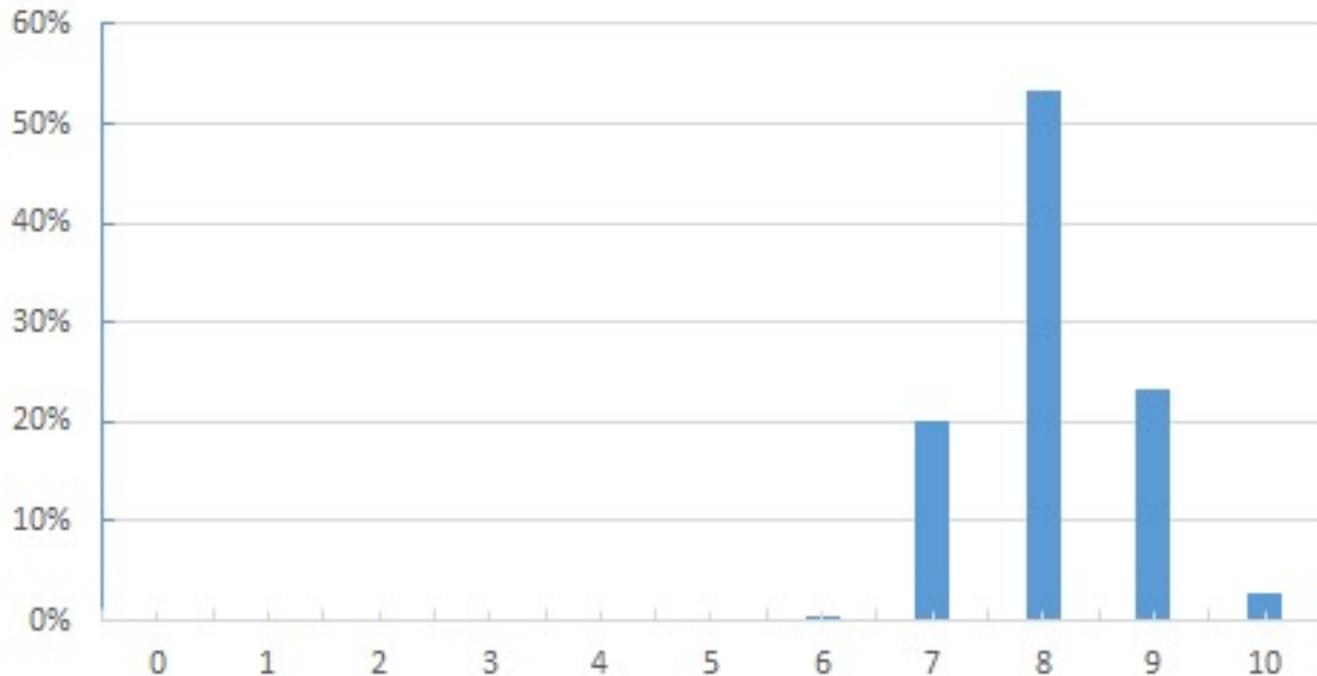
- A manager who beats the markets 10 years in a roll.
- How impressed should you be?
- Let's do one experiment
- If you flip a coin 10 times, what is your probability to get 10 heads in a roll?
 - $=1/2^{10}$, less than one in 1000!

The best performer

- Let's do it now
- What is your number of heads?
- The highest number is
- With n students, the **distribution of the highest** number is

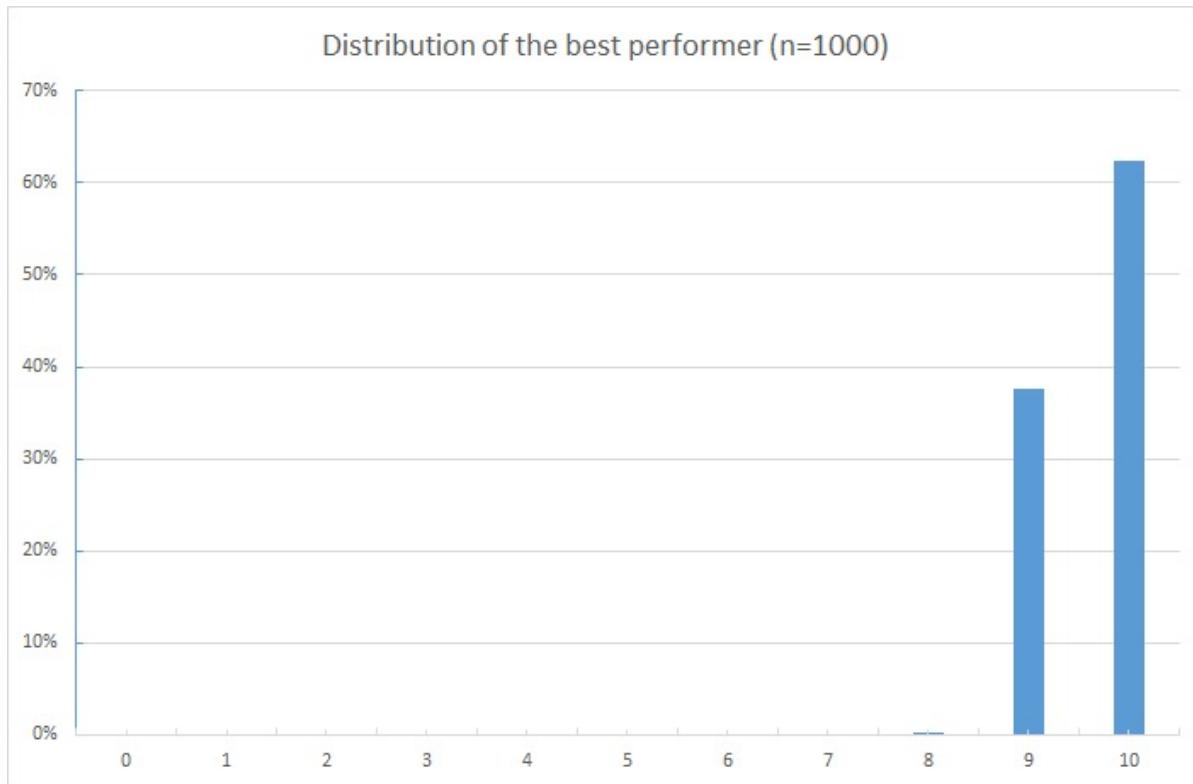
Order statistic ($n=28$)

Distribution of the best performer ($n=28$)

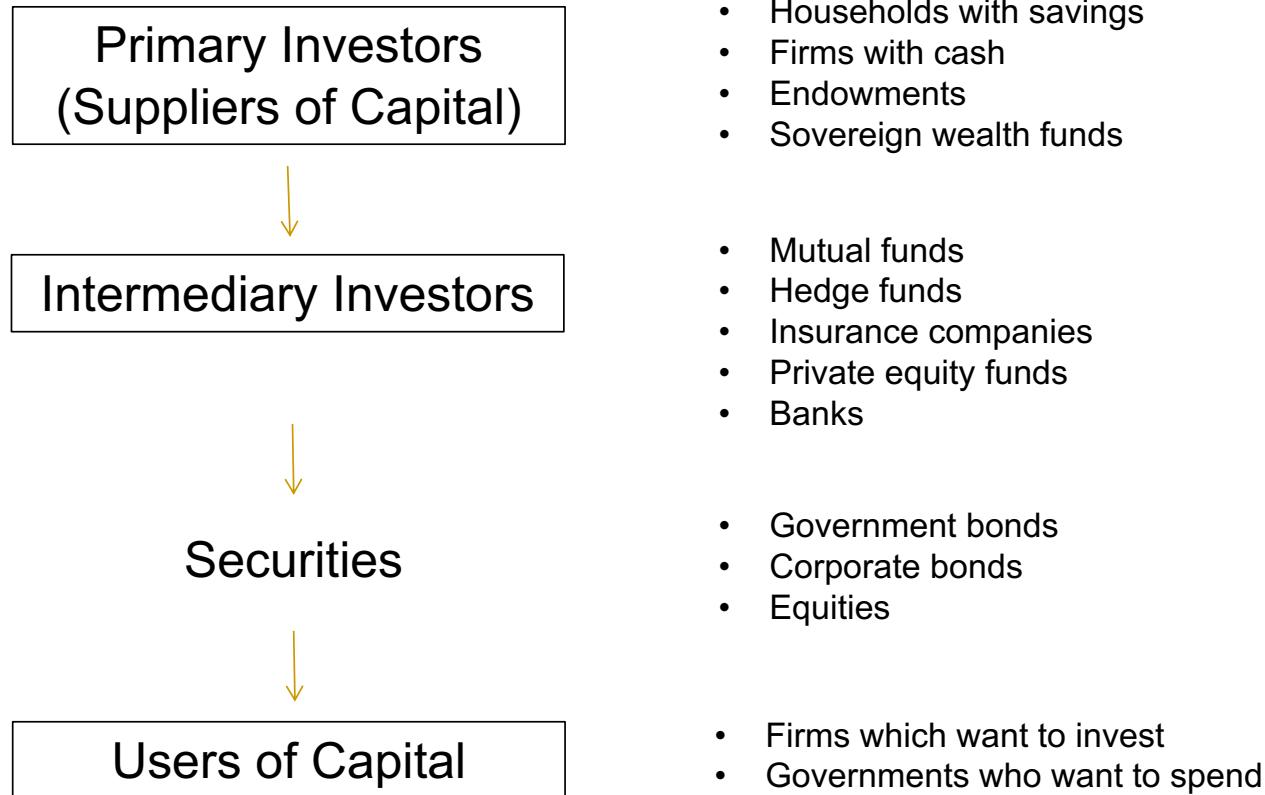


N=1000

结论：连续多年基金收益率都很高的manager可能只是运气好



The Financial System



Review various types of
intermediary investors

Mutual Funds 公募

- Pool money from many investors and invest that money in stocks, bonds, or other securities
 - cater to individual investors
满足
- Charge a fee equal to some fraction of assets under management (AUM) 被管理的资产规模
 - e.g. Fidelity; Vanguard

Hedge Funds 私募

- Pool money from investors and invest that money in stocks, bonds, or other securities
- Differ from mutual funds in that they use more aggressive investment techniques
 - short-selling, leverage, derivatives 衍生品相关
做空 加杠杆 → 有钱的、投资量大的投资者
- Limited to “sophisticated” primary investors (pension plans, endowments, or wealthy individuals)
- Charge a fee that is some fraction of AUM, and also collect some fraction of the fund's profits
 - e.g. Citadel, SAC Capital, LTCM

Private Equity Funds (many different types)

私募股权投资基金：投资后直接控制该公司

■ Venture capital funds 风险投资基金

- Pool money from primary investors and use it to invest in early-stage firms
- exit the investment a few years later, typically in an IPO
- Charge a fee that is some fraction of AUM, and also collect some fraction of the fund's profits

Private Equity Funds (many different types)

加杠杆投资公司

■ Leveraged buyout funds (LBO funds)

结合

- Pool money from primary investors and use it, in conjunction with significant borrowing, to buy entire companies
- exit from the investment a few years later
- Charge a fee that is some fraction of AUM, and also collect some fraction of the fund's profits
- e.g. KKR, TPG Capital, Bain Capital, Blackstone

Average Performance

How to measure?

- Look at their average returns, both before and after fees
- Look at whether they beat benchmarks
 - index benchmarks: S&P 500, Wilshire 5000
 - CAPM benchmark

The CAPM benchmark

- Run a regression of excess fund returns on excess market returns:

$$r_{P,t} - r_{f,t} = \alpha_P + \beta_P(r_{M,t} - r_{f,t}) + \epsilon_{P,t}$$

- If $\underline{\alpha_P > 0}$, this is interpreted as evidence that the manager has skill

- The fund's "alpha"

$$\alpha_P = \underbrace{\bar{r}_p}_{\text{Skill}} - \underbrace{\left(\bar{r}_f + \beta_P(\bar{r}_M - \bar{r}_f) \right)}_{\text{How the fund should have done, given the risk}}$$

How the fund did

Institutional Fund Managers

没人能持续打败市场

- Poor record. Studies have found underperformance, relative to benchmarks, even before fees!

Table 2. Annual Return of Equity Funds and Percentage Underperforming S&P 500, 1983–89^a

Percent

Year	Equally-weighted return across funds	Value-weighted return across funds	S&P 500 return	Funds underperforming S&P 500
1983	17.8	18.1	22.5	59
1984	3.8	3.2	6.3	63
1985	33.3	30.5	32.2	38
1986	18.1	16.8	18.5	50
1987	4.0	4.4	5.2	61
1988	17.9	15.7	16.8	47
1989	29.2	25.9	31.5	61
Mean across years	17.7	16.4	19.0	54

a. Performance database excluding cash portfolio.

Source: Lakonishok, Shleifer, and Vishny (1992)

Institutional Fund Managers

- In more recent studies
 - In US stock market, during the period of 1971-2009, the average annual return of actively managed stock mutual funds is 1% lower than the return of Wilshire 5000 Index. The average returns lose to the index returns in 23 years out of 29 years.

Mutual Funds and Hedge Funds

■ Mutual Funds

- ❑ On average, beat their benchmarks slightly before fees but underperform after fees

■ Hedge Funds:

- ❑ Outperform benchmarks slightly, before fees, but underperform, after fees

Private Equity Funds

■ Private equity funds:

- On average, both LBO funds and venture capital funds outperform the S&P 500 slightly, before fees, but underperform, after fees
跑赢大盘
- Particularly unimpressive, given the illiquidity of the investments, and the use of leverage
不引人注意 *流动性小*
- Different types of investors have different returns

Are some funds persistently
better than others?

Consistency of performance of pension funds

Table 9. Equity Fund Performance over Time Using Quartile Rankings of One-Year Past Performance to Predict Future One-Year Performance^a

<i>Investment style</i>	<i>1^b</i>	<i>2^b</i>	<i>3^b</i>	<i>4^b</i>	<i>Return over past one-year period^c</i>	<i>Return over future one-year period^c</i>
All						
(Top)	1	26	24	23	27	25.5
	2	20	26	29	25	18.4
	3	22	28	26	24	13.7
	4	32	22	22	24	5.5
(Bottom)						17.6
						17.3
						17.4
						18.5

Source: Lakonishok, Shleifer, and Vishny (1992)

Consistency of performance of others

- Institutional fund managers
 - Very little persistence in performance from year to year
持续的
- Mutual funds
 - Some limited persistence from year to year
- Hedge funds
 - Some limited persistence from year to year
- Private equity funds
 - Quite strong persistence from year to year

Implications on market efficiency

个人投资者太菜了

- Overall, intermediary investors do not seem particularly skilled at exploiting mispricing
 - before fees, intermediary investors do not significantly outperform benchmarks
 - little persistence in fund returns 纯靠运气
 - even existence of people like Peter Lynch does not prove that stock-picking ability exists (e.g., coin-flip example) 选股能力

Implications on market efficiency

- But the weak performance of intermediary investors before fees *can* still be consistent with inefficient markets
- Even if prices are wrong, it's not easy to beat the market
- Intermediary investors may be swamped with more money than they can usefully invest, lowering their average returns 资金量过大 \Rightarrow 回报率为市场回报率

Implications for primary investors

■ Individual investors

- even though markets probably contain inefficiencies, index funds are still best for individuals
- active money managers don't beat benchmarks, after fees
- it's puzzling why actively managed mutual funds remain so popular

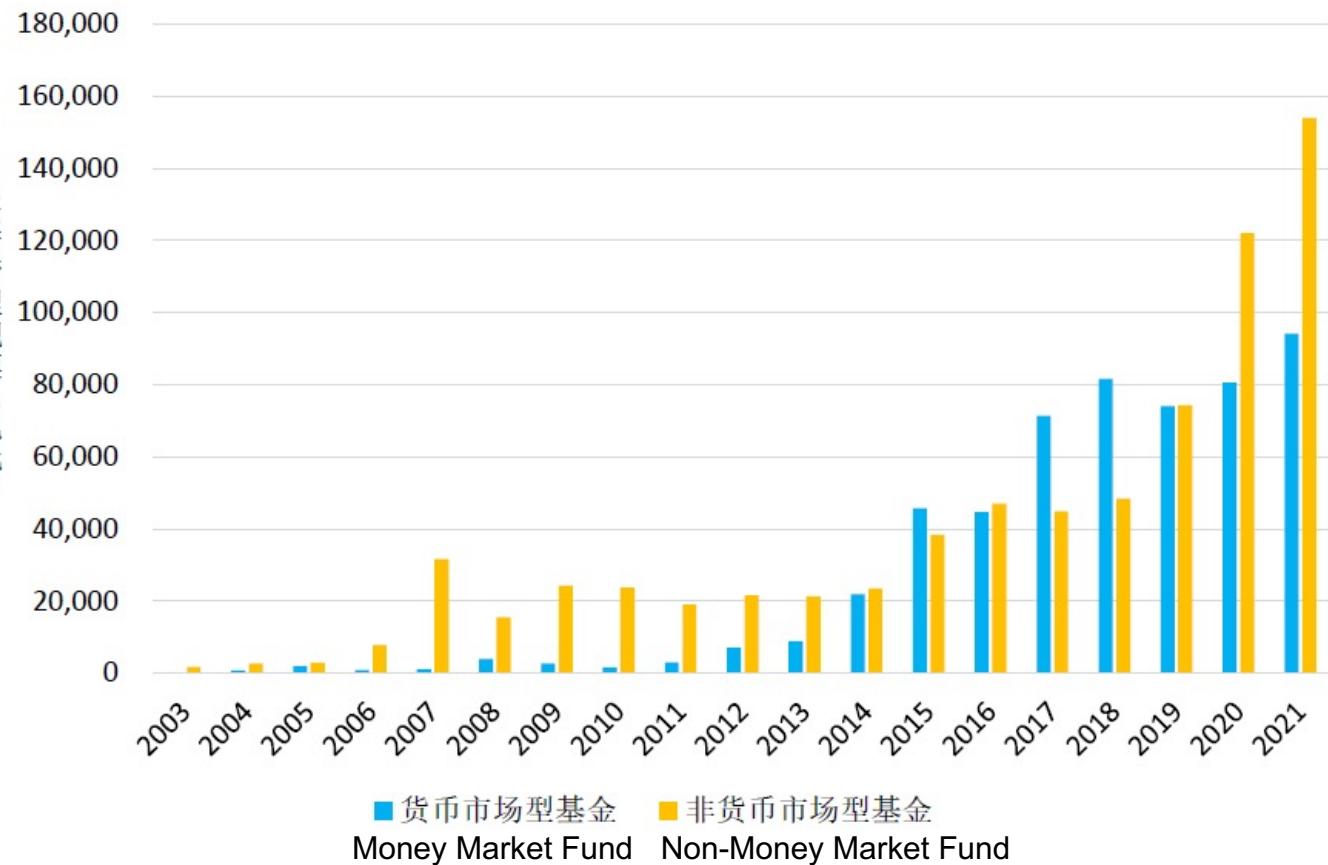
■ Other primary investors

- beware of the poor returns, after fees, of many investors

如果所有人都投ETF，没有公又私募基金经理，则市场消息不会使价格发生变动。

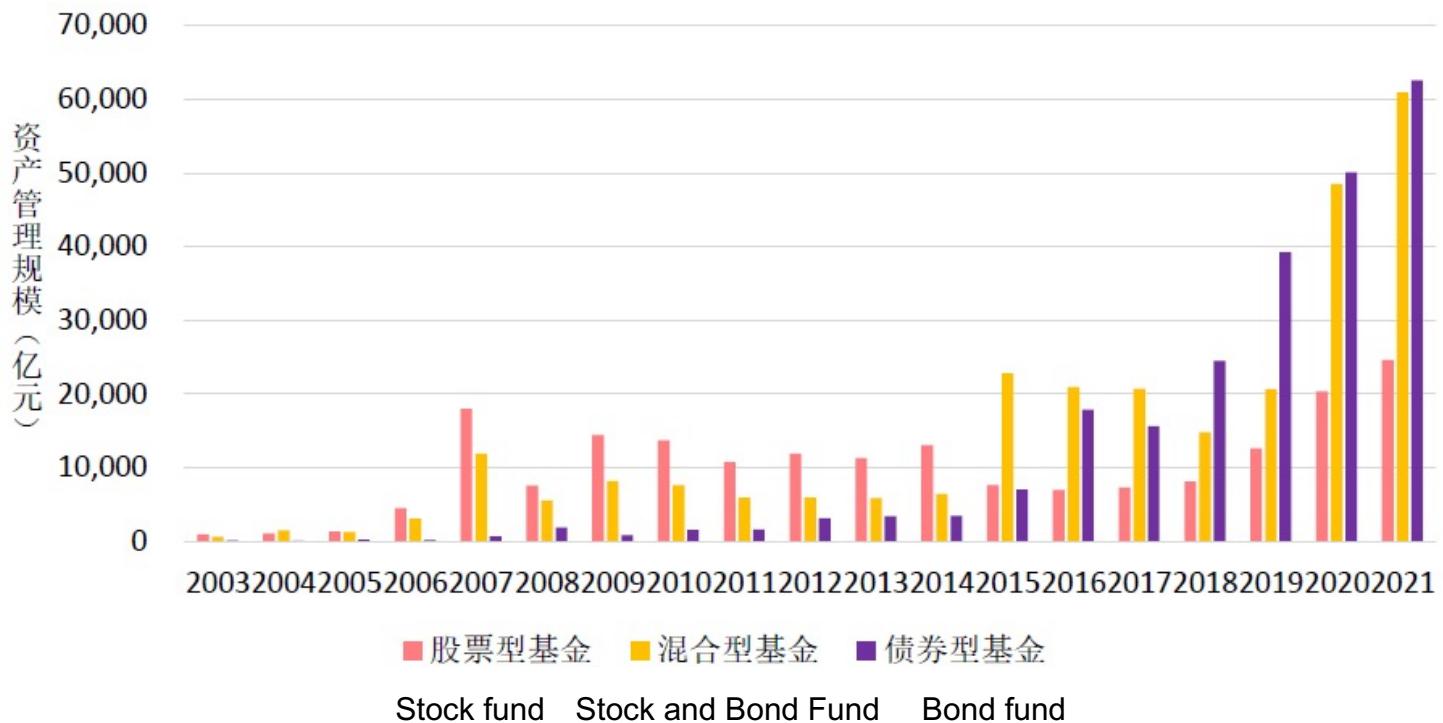
Can mutual fund manager beat market (China)

AUM (100 millions)



Can mutual fund manager beat market (China)

AUM (100 millions)

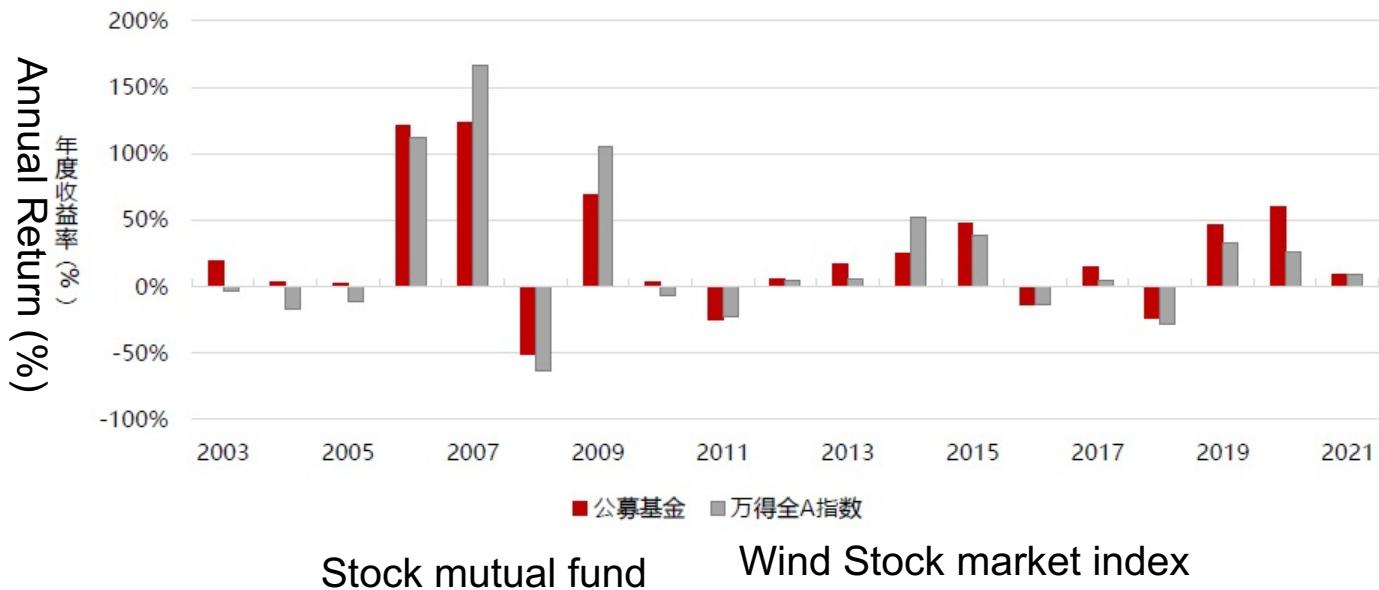


How to evaluate the performance of China's mutual funds? *General principles*

- Total return perspectives
- Risk adjusted return
 - Sharpe ratio
 - Risk adjusted returns (APT model)
- Performance persistency

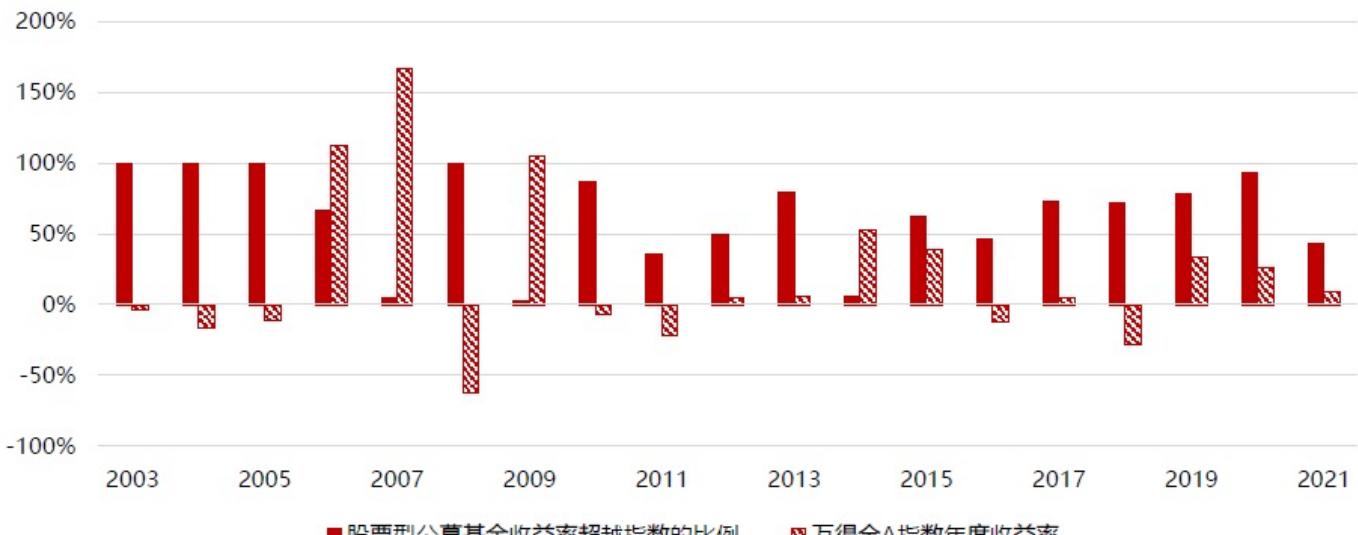
Can mutual fund managers beat the market (China)?

- Mutual fund return is equal weighted



Can mutual fund managers beat the market (China)?

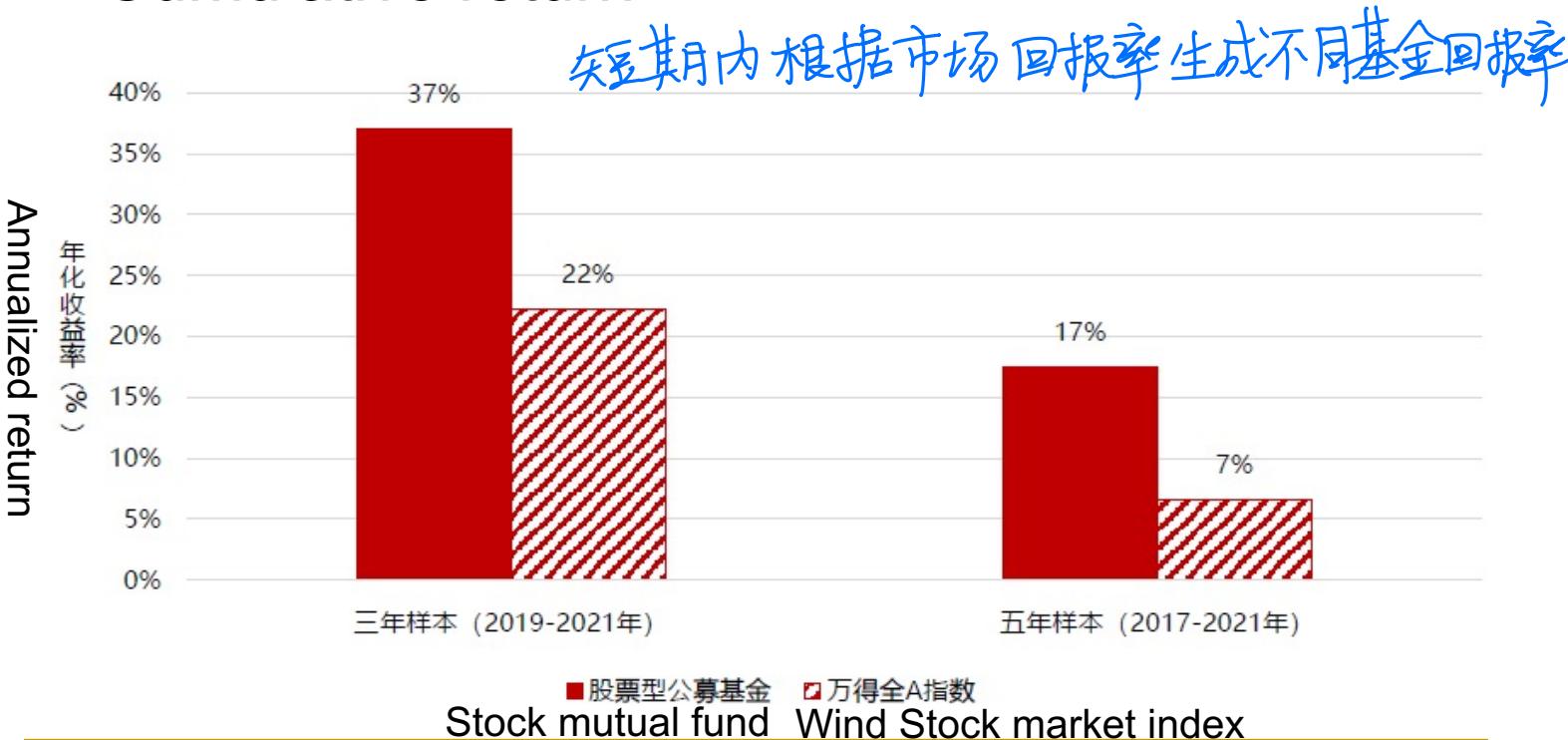
- The percentage of mutual funds to beat the market



The percentage of funds to beat the market Market index return

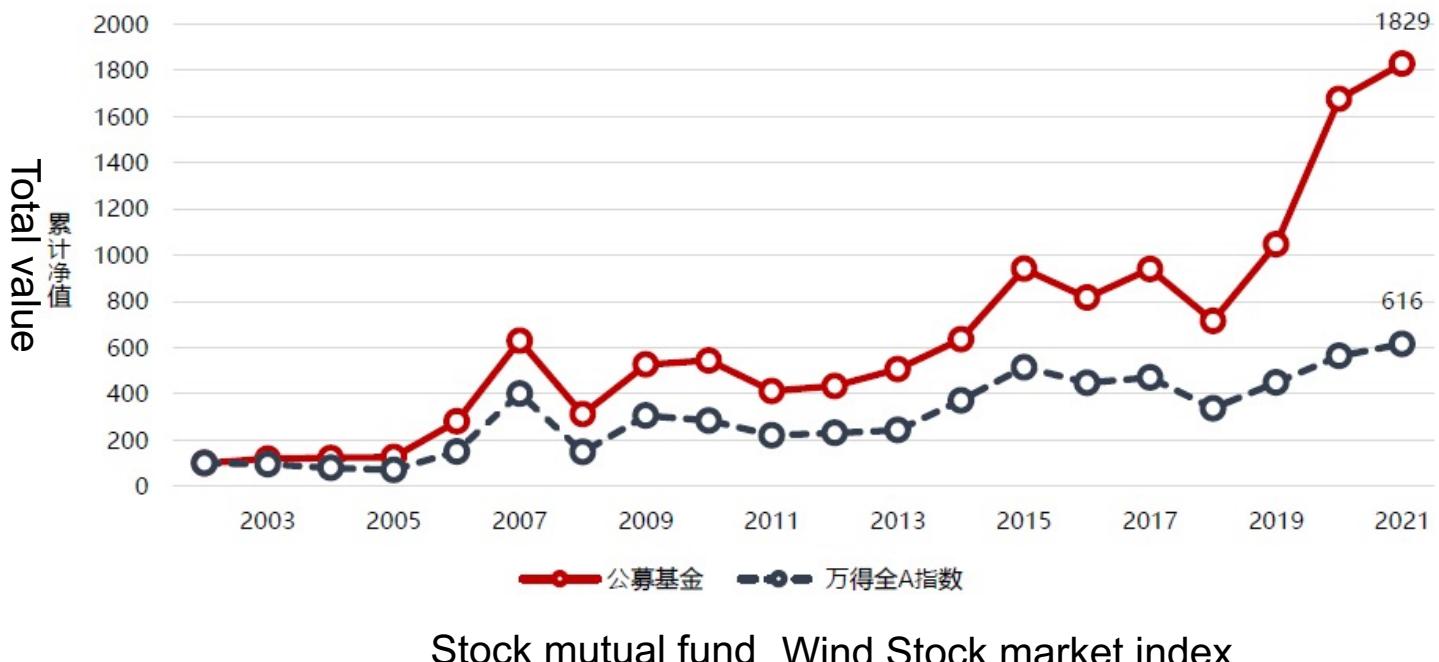
Can mutual fund managers beat the market (China)?

■ Cumulative return



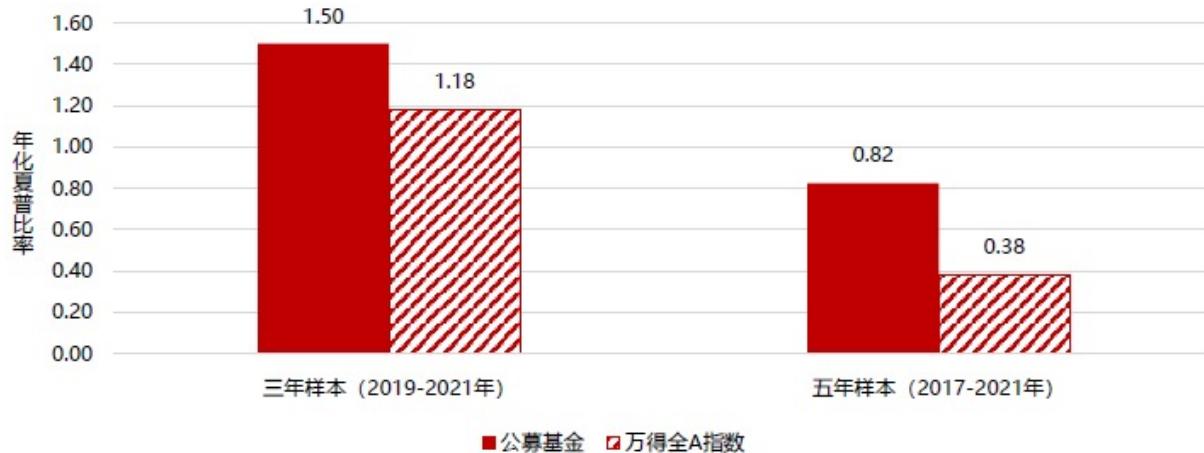
Can mutual fund manager beat market (China)?

- Cumulative return (Index 10% vs fund 17%)



Can mutual fund manager beat market (China)?

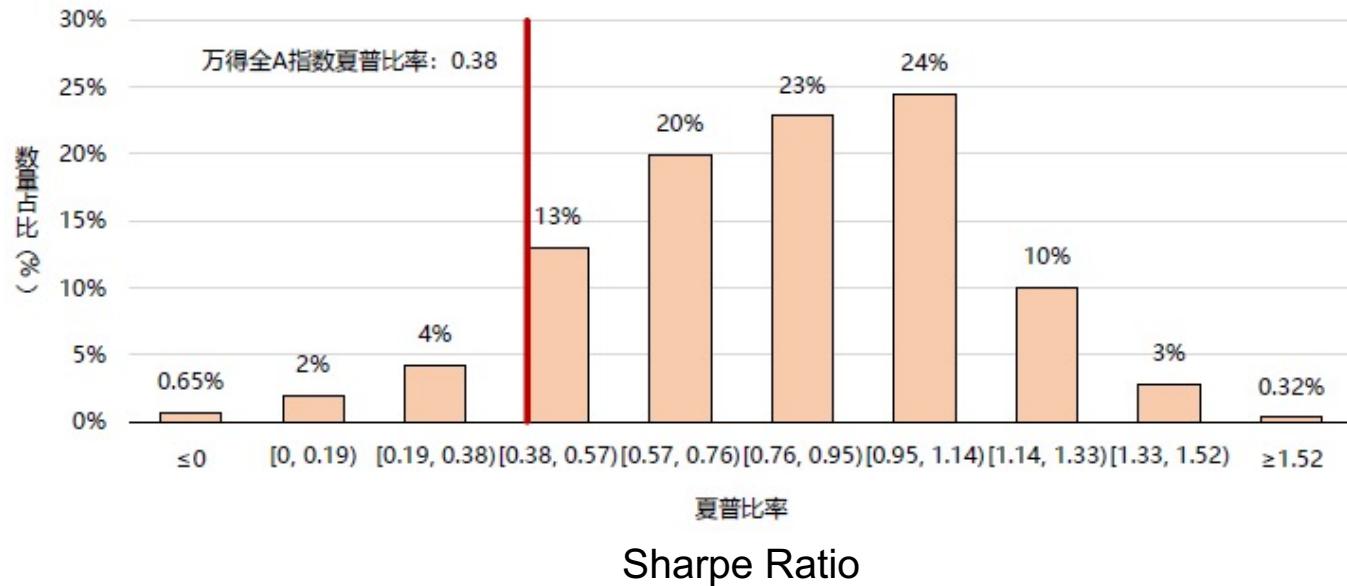
- Sharpe ratio $\text{月} \rightarrow \text{年} : \frac{\sqrt{12}(\bar{r} - r_f)}{\sqrt{12}\sigma_r} = \frac{\sqrt{12}(\bar{r} - r_f)}{\sigma_{\bar{r}}}$



Stock mutual fund Wind Stock market index

Can mutual fund manager beat market (China)

■ The distribution of Sharpe ratio



Can mutual fund managers beat market (China)?

- Fama-French four factors model
 - The distribution of alphas

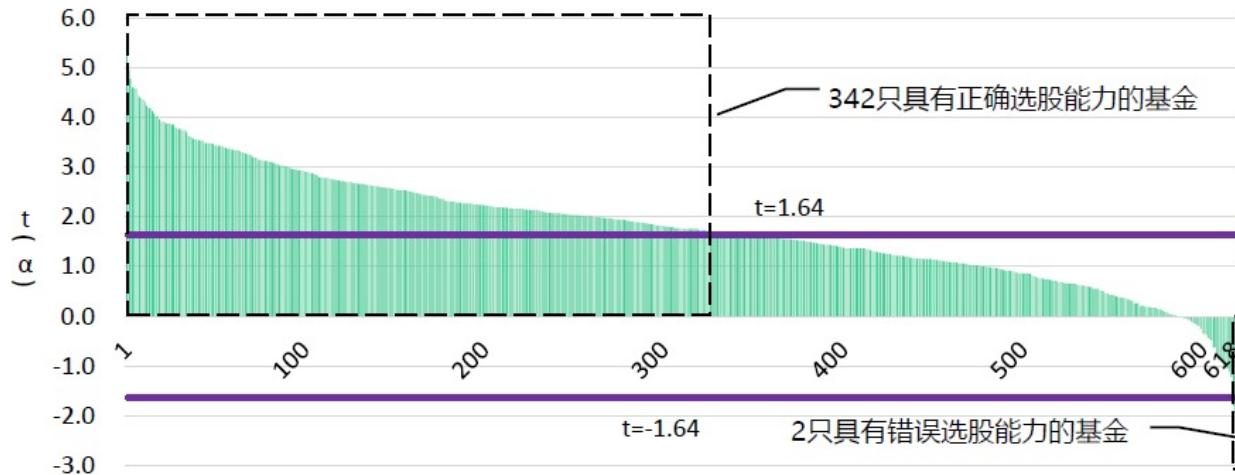


图 3-1 股票型基金的选股能力 α 的 t 值 (显著性) 排列: 2017~2021 年

注: 正确选股能力代表 $t(\alpha) > 1.64$; 错误选股能力代表 $t(\alpha) < -1.64$; 未表现出选股能力代表 $-1.64 \leq t(\alpha) \leq 1.64$ 。基金具有选股能力是指基金表现出正确的选股能力, 基金不具有选股能力代表基金表现出错误的或未表现出选股能力。

Can mutual fund manager beat market

- Market timing can be profitable theoretically

The Allure of Market Timing: Missing the Worst Days

20 Years (1/1/1995 - 12/31/2014)

\$10,000 Invested in the S&P 500 Index	S&P 500 Annualized Return	Value of \$10,000 at the end of the period	Gain/Loss	Impact of Missing Days
All 5,036 trading days	9.85%	\$65,475	\$55,475	--
Less the 5 days with the biggest losses	12.24%	\$100,688	\$90,688	63.48%
Less the 10 days with the biggest losses	14.13%	\$140,670	\$130,670	135.55%
Less the 20 days with the biggest losses	17.19%	\$238,681	\$228,681	312.22%
Less the 40 days with the biggest losses	22.19%	\$550,011	\$540,011	873.43%

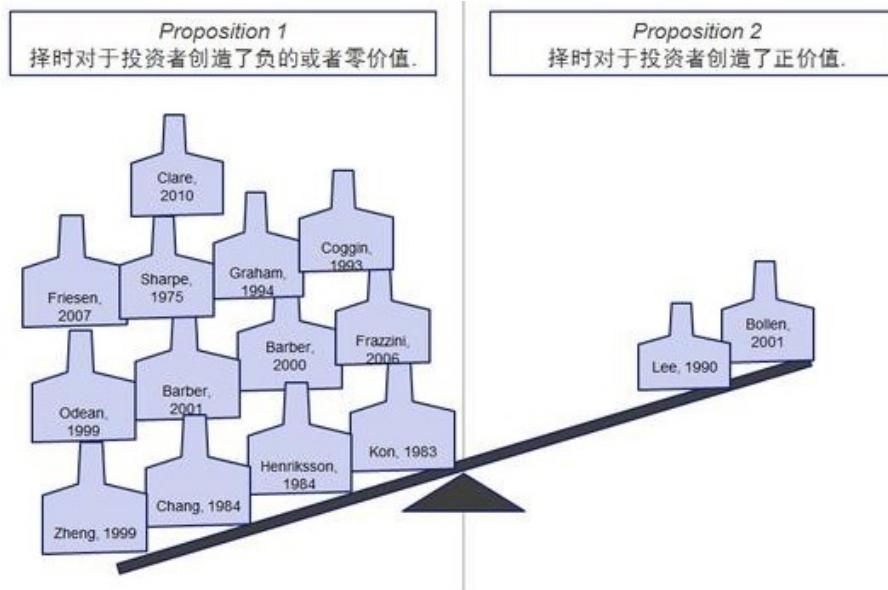
Can mutual fund manager beat market

- But, if the market pricing is wrong....

The Problem with Market Timing: Missing the Best Days 20 Years (1/1/1996 - 12/31/2015)				
\$10,000 Invested in the S&P 500 Index	S&P 500 Annualized Return	Value of \$10,000 at the end of the period	Gain/ Loss	Impact of Missing Days
All 5,036 trading days	8.19%	\$48,249.94	\$38,249.94	--
Less the 5 days with the biggest gains	5.99%	\$32,008.68	\$22,008.68	-42.46%
Less the 10 days with the biggest gains	4.49%	\$24,079.67	\$14,079.67	-63.19%
Less the 20 days with the biggest gains	2.05%	\$15,004.35	\$5,004.35	-86.92%
Less the 40 days with the biggest gains	-1.96%	\$6,734.45	-\$3,265.55	-108.54%

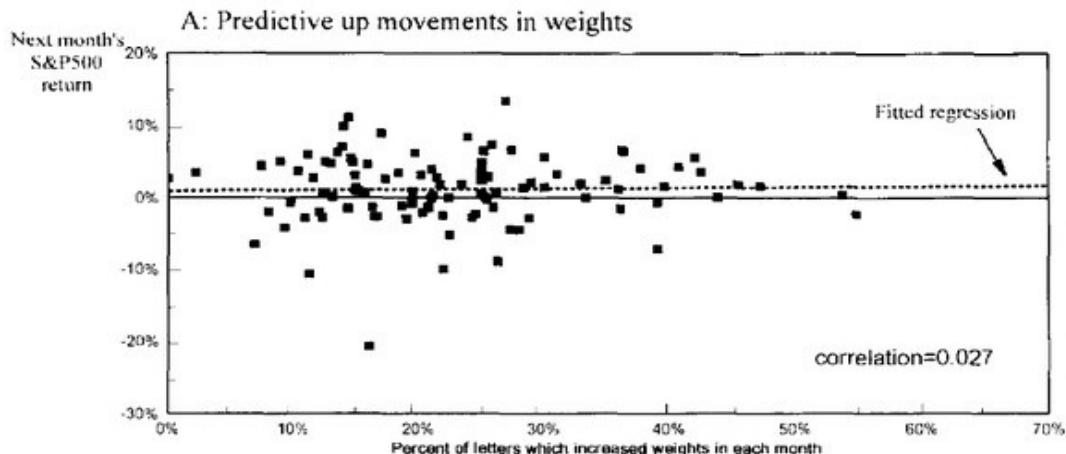
Can mutual fund manager beat market

- Most academic research find no evidence of successful market timing



Can mutual fund managers beat market?

- The recommendations of Investment magazine can not predict the stock market movement
 - When they recommend buying stocks



Source: Graham, John R., and Campbell R. Harvey. "Market timing ability and volatility implied in investment newsletters" asset allocation recommendations. Journal of Financial Economics 42.3 (1996): 397-421.

Can mutual fund managers beat market? (China)

- Is past winner still the winner in the future

%	G1 (Lowest)	G2	G3	G4	G5 (Highest)	Last year return	Next year return
G1 (Lowest)	23. 6	18. 8	18. 3	20. 1	19. 1	5. 01%	24. 15%
G2	16. 9	22. 7	20. 4	20. 6	19. 1	15. 6%	25. 34%
G3	16. 8	17. 0	20. 8	25. 8	19. 7	22. 25%	26. 82%
G4	20. 8	22. 2	20. 9	18. 4	17. 4	29. 26%	24. 28%
G5 (Highest)	22. 9	19. 4	18. 9	15. 1	23. 6	42. 85%	26. 02%

Overall

- Mutual fund can beat the market in China
 - Larger average return (on average beat the market by 4%-5% each year)
 - Larger cumulative return
 - In terms of lower Sharpe ratio
 - Then, how?

■ Market timing? ① $\alpha_P > 0$

纯赚, 选股精准 Stock Picking

■ Stock picking? ② β_i 较大

冒险

③ Smart β

动态调整 β 大小, 调市场杠杆
(通过预测市场) Market Timing

How to test fund managers' market timing capacity?

■ Treynor-Mazuy Model

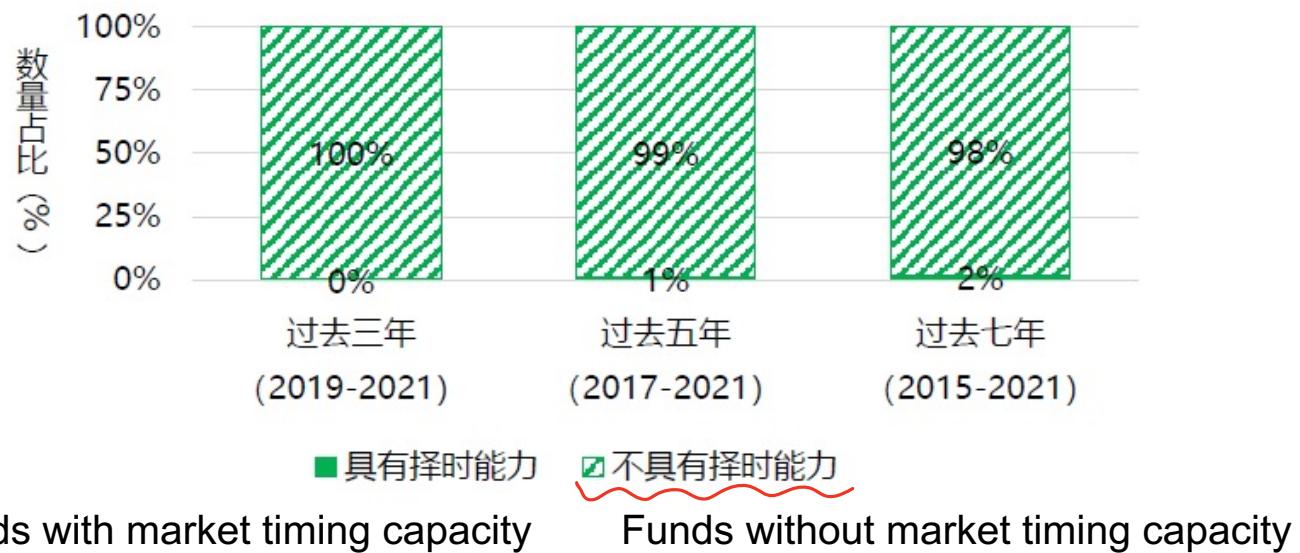
- If the coefficient of the square term is positive and significant, it indicates the existence of market timing

$$R_{it} - R_{ft} = \alpha_i + \beta_{im} * (R_{mt} - R_{ft}) + \gamma_i * (R_{mt} - R_{ft})^2 + \beta_{ismb} * SMB_t + \beta_{ihml} * HML_t + \beta_{imom} * MOM_t + \varepsilon_{it}$$

若显著，证明不管大盘涨跌，都能赚，
此投资者具有择时能力

The Market Timing capacity

- The proposition of mutual funds having market timing capacity



Can mutual fund manager beat the stock market?

- There is evidence in support of fund managers' stock picking capacity
- There is no evidence in support of fund managers' market timing capacity

Investor Behavior

Jinfan Zhang
CUHK(Shenzhen)

Overview

- We want to understand investor behavior
 - the decisions investors make about their assets and liabilities
 - the portfolios they hold and how they trade
- This is an important topic:
 - There is a real danger that many investors are making poor financial decisions
 - Financial markets are complex and sometimes counter-intuitive
 - Many decision-makers are unsophisticated, and all the more so in recent years
单纯^的
 - If some people **are** making poor decisions, we need to find ways to help them do better

Overview

- We divide investors into individuals and institutions
 - focus more on individuals
 - they are more likely to be making poor decisions
- The field that studies the financial decisions of individuals is called “household finance”
 - It has grown rapidly in recent years

Financial decisions of individuals

- Assets (pre-retirement)
 - under-saving
 - non-participation
 - buying high, selling low
 - preference for active management
 - under-diversification
 - stock-picking performance
 - the selling decision
 - the buying decision
- Assets (post-retirement)
 - under-annuitization
- Liabilities

Under-saving

- Survey evidence suggests that many Americans are not saving as much as they should for retirement
- E.g., in a survey of hundreds of employees at a large U.S. company
 - two-thirds said that their saving rate was below the ideal
 - one-third said that it was about right
 - no one said they were saving too much
- Of those who said their saving rate was too low, 35% planned to raise it in the future
 - However, hardly any of them actually did

Behavioral approach: present bias

- Our heavy focus on the present leads us to consume too much today
 - and to save too little for the future
- Present bias also explains why people fail to follow through on their plans

Implications of present bias

- Insufficient saving for pensions. We discount value of future pension payments and save insufficiently
低质货物
- Consumption of demerit goods. We ignore future health costs for short-run utility of enjoying the drug.
- Delaying decisions. Given a choice between doing a project now, when we have time, we may put off until last moment, when we are tired and can't do as well.

Responses to present bias

"四两拔千斤"

- Nudges. Governments/pension companies may give us incentives to nudge us into taking out pension commitments.
- Highlight of costs. Government campaigns to highlight costs of consuming demerit goods or taxes to make them less palatable.

Non-participation 不参与投资

- A sensible investment portfolio should contain at least some exposure to the stock market
- For many decades, however, most U.S. households had no exposure at all to the stock market
 - e.g. in 1984, only 28% had any exposure
 - even among people with more than \$100,000 in liquid assets, only 50% held any equity
- Even in more recent years, many households do not participate in the stock market

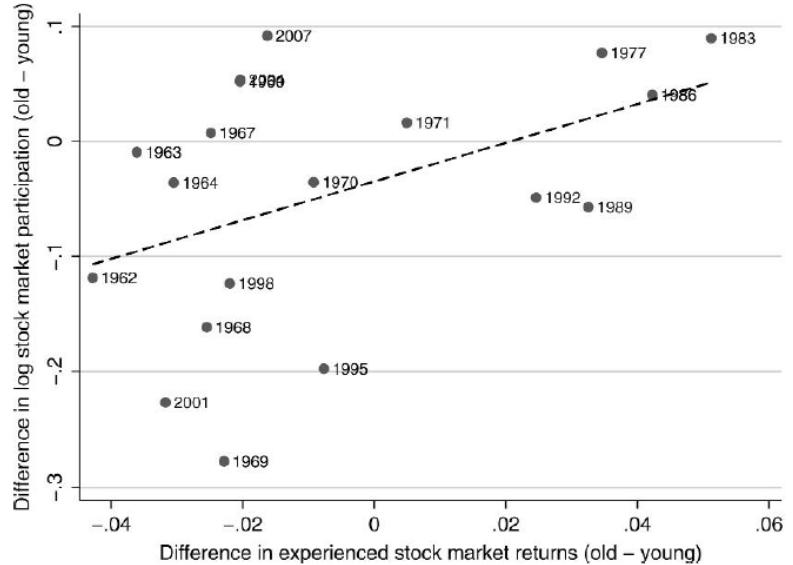
Non-participation

- Rational approaches? 前景
- Behavioral approach: prospect theory
 - Over the next year, the stock market may go up in value, but it may also go down
 - Investors who are loss averse find this prospect unappealing 没吸引力
 - Probability weighting makes the stock market even less appealing: (overweight small probability of crash)
 - Market return is negatively skewed

Non-participation

- Behavioral approach: **experience effects**
- When making a decision, we should take into account of **all** available data
- However, people appear to pay too much attention to the data that they have **personally experienced**
 - predicts that whether people participate in the stock market will depend on the stock returns they have experienced during their lifetime
- The data confirm this prediction
 - Malmendier and Nagel (2012)

Non-participation



Source: Malmendier and Nagel (2011)

Non-participation

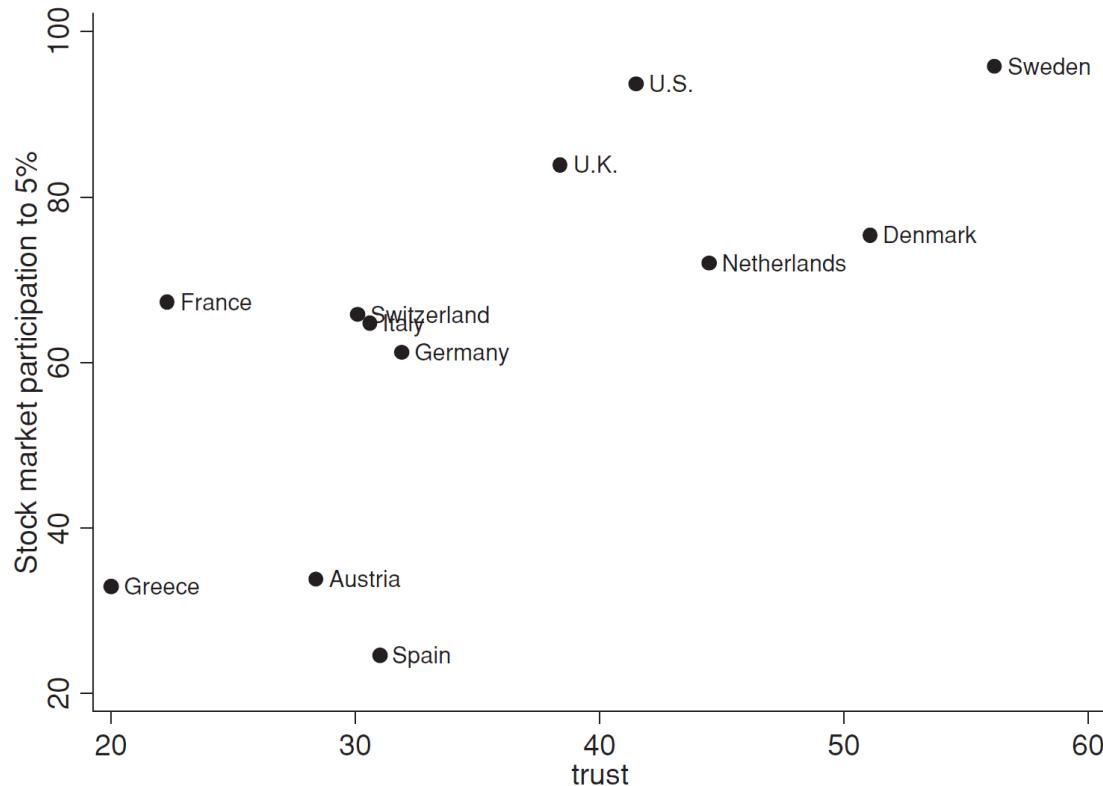
- Behavioral approach: **Trust**
- An investment in financial markets requires trust
- Trust can be measured through questions like:
 - “Generally speaking, would you say that most people can be trusted, or that you have to be careful in dealing with people?”
- In a study of 2,000 Dutch households, less trusting households were less likely to participate in the stock market
 - Guiso, Sapienza, Zingales (2006)

Non-participation

- Trust may also explain another puzzle: the difference across countries
- Trust explains the differences in participation rates across different countries
- More trusting countries have more participation

Non-participation

不说谁影响谁，可能两个因素互相影响



More on Trust

- Trust may also affect the composition of investors' portfolios
- Less trusting households tilt their portfolios more toward *dividend-paying stocks* (Kelly, 2014)

risk 较小

Correlation vs. causality

Correlation ≠ Causality

- Observation: when A happens, B is likely to happen
 - Conclusion:
 - A caused B
 - B caused A
 - C caused both A and B.
 - Trust and participation
 - Giannetti and Wang (2016) suggest that trust causes participation
 - Exogenous shock: The collapse of Arthur Andersen
 - Personal experience
- Instrumental Variable 工具变量 influence trust

Non-participation

→ 不知道 probability distribution

- Behavioral approach: ambiguity aversion
- The stock market is more “ambiguous” than a bank deposit or T-Bill
- Investors who are ambiguity-averse therefore find the stock market unappealing

Buying high, selling low

- Many investors appear to have poor market timing
 - They increase their exposure to the stock market when it is highly valued, in advance of poor returns
 - and reduce their exposure when its valuation is low, in advance of high returns
- Key evidence: the **dollar**-weighted average return on mutual funds is lower than the **time**-weighted average return
 - by 1.5% per year
 - Investors chase past returns of mutual funds

散户

return × AUM (资产管理规模)

Buying high, selling low

过度推断

- Behavioral approach: **over-extrapolation**
- Some investors overweight past returns when forming beliefs about future returns “追涨杀跌” typical evidence

Preference for actively-managed funds

- Mutual funds come in two types: index funds and actively-managed funds
- A large body of research indicates that, after fees, actively-managed funds underperform index funds, on average
 - It is therefore puzzling that actively-managed funds are as popular as they are
- Rational approaches?
- Behavioral approaches?
 - Over confidence
 - Extrapolation “我觉得我行”

Under-diversification

- Traditional advice tells people to diversify their holdings of financial assets
- Many households appear to ignore this advice,
- Four types of under-diversification
 - home bias
 - local bias
 - concentrated stock holdings
 - large holdings of own-company stock

Home bias

本国股票

- Individuals often invest heavily in **domestic** stocks, apparently ignoring the benefits of international diversification
- Rational approaches?
 - Information advantage
- Behavioral approach: Preference for the familiar/mere exposure effect 心理效应
 - Mere exposure to something makes us like it more than justified based on informational considerations alone
 - We are exposed, every day, to our home country

Local bias

- Within their domestic equity holdings, individuals tilt toward locally-headquartered stocks
 - The average distance to a stock in the typical investor's portfolio is 917 miles 喜欢买自己家乡的股票.
 - But the average distance to a stock, across all stocks, is 1225 miles
- Investors appear to be forgoing the diversification benefits of a more geographically-dispersed portfolio 放弃 地理位置分散

Local bias (cont'd)

- Rational approaches?
- Behavioral approach: Preference for the familiar / mere exposure effect
 - We are exposed, every day, to our local region

Concentrated stock holdings

- Some households hold concentrated positions in relatively few stocks
- Rational approaches?
- Behavioral approach: **Overconfidence**
 - Investors may be overconfident about the validity of their analysis

Concentrated stock holdings (cont'd)

- Behavioral approach: **Prospect theory (probability weighting)**

赌一把

- People may want to have large positions in “lottery-type” stocks so as to give themselves a chance of becoming wealthy
 - There is empirical evidence to support this idea (Boyer, Mitton, Vorkink, 2010)

Large holdings of own-company stock

- People invest a surprisingly large fraction of their retirement savings in the stock of their own company (Benartzi, 2001)
 - 23% of their discretionary contributions
 - Worst under-diversification 工资、股票高度相关
- Rational approaches?
- Behavioral approaches?
 - Familiarity
 - Overconfidence
 - Loyalty
 - Inertia 惯性（跟风）

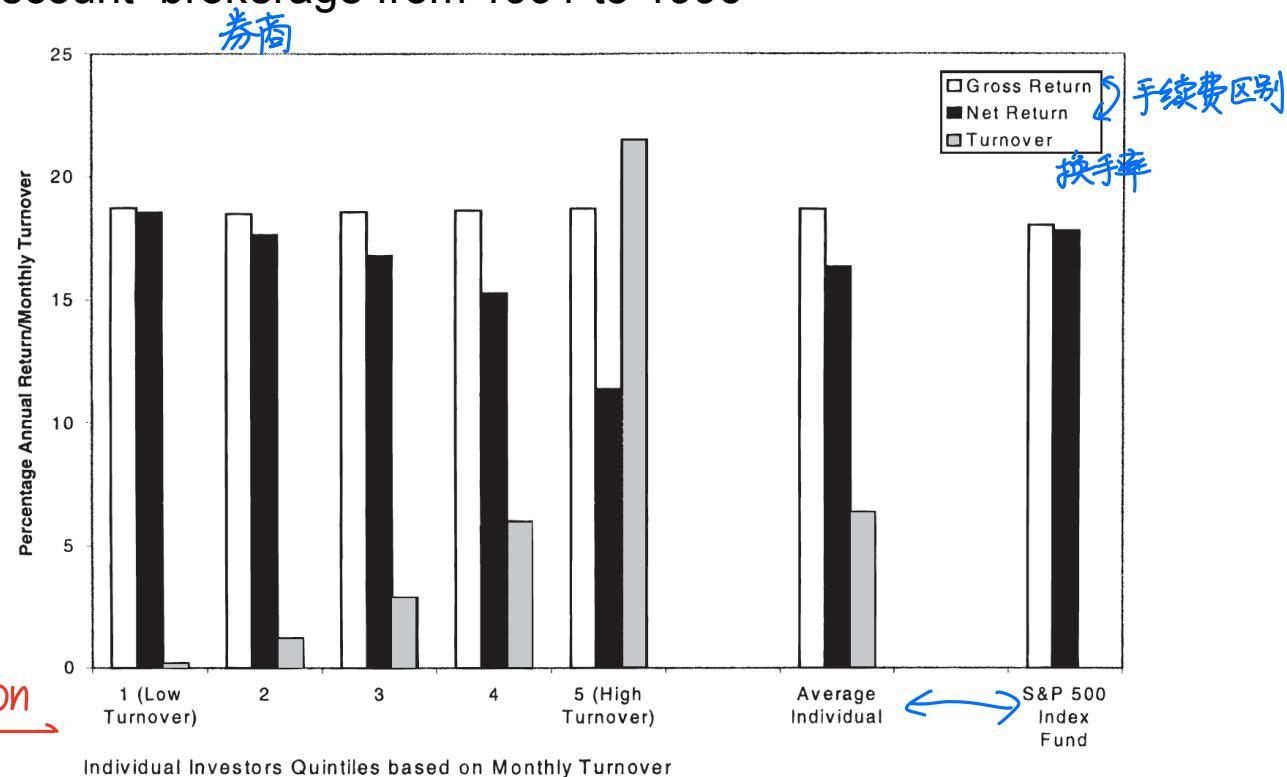
Stock-picking performance

- Most studies find that individuals do a poor job trading stocks
- They underperform a range of benchmarks
 - their beginning-of-the-year portfolio
 - the return of the overall market
 - a CAPM benchmark

Example: Barber and Odean (2000)

- Looked at the trading of 70,000 households through a large discount brokerage from 1991 to 1996

→ 不明样本数据来源



Stock-picking performance (cont'd)

- Rational approaches?
- Behavioral approach: **overconfidence**
 - Most investors believe that they are “above average” traders, and therefore trade stocks actively
 - Many are over-estimating their ability, however, and end up under-performing
- More Evidence?

Stock-picking performance (cont'd)

■ More evidence:

- This view predicts that more overconfident people will trade more
- One study tests this using data from Finland
 - measures overconfidence as self-reported confidence minus an objective measure of confidence
 - finds that more overconfident people indeed trade more *Net Return 更低*
- The psychology literature suggests that men are more overconfident than women
 - this predicts that men will trade more, and perform worse
 - the evidence is consistent with this (Barber and Odean, 2002)

More on Overconfidence

- Overconfidence has also been applied to understanding the puzzlingly high level of trading volume in many financial markets
- In an economy where all investors are fully rational, there will be relatively little trading
 - Each investor will infer a negative signal from others' willingness to trade with them
- Trading volume will be much higher, however, when investors are overconfident
 - They disregard the signal in others' willingness to trade

Selling behavior: The disposition effect

处置效应

- Individual investors have a greater propensity to sell a stock at a gain relative to purchase price, rather than at a loss (Odean, 1998) 卖赚钱的股，留赔钱的股
- A similar effect has been documented in the real estate market 房地产市场
 - People appear reluctant to sell their homes below purchase price (Genesove and Mayer, 2001)

Selling behavior: The disposition effect

- (Potential) rational approach: **information**
 - Perhaps individuals sell past winners because they have good information that these stocks will subsequently do poorly
 - and hold on to their past losers because of information that these stocks will do well
- It turns out, however, that the past winners people sell subsequently do **better** than the past losers they hold on to
- Other rational approaches?

Selling behavior: The disposition effect

- Other evidence also suggests that the disposition effect is a mistake
 - Among individual investors, it is more pronounced for the “less sophisticated” 散户：“别想得太复杂”
 - It is also more pronounced for individuals than for mutual fund managers

Selling behavior: The disposition effect

- Behavioral approach: **realization utility**
 - The idea that people feel pleasure when they sell an asset at a gain and pain when they sell an asset at a loss
- This simple idea was not taken seriously until recently
- Realization utility may stem from the way people think about their investing history
 - as a series of investing **episodes**, each one defined by the name of the asset, the purchase price, and the sale price

Selling behavior: The disposition effect

- Selling at a gain brings pleasure because it creates a positive investing episode
- Selling at a loss brings pain because it creates a negative investing episode
- Realization utility can explain the disposition effect, although an additional ingredient is needed
 - e.g. impatience (time discounting)
 - Barberis and Xiong (2012)

Selling behavior: The disposition effect

- Broad theme: when making selling decisions, we should focus on an asset's **future** performance
 - Allowing yourself to be influenced by realization utility is a mistake because it is based on the **past**
 - It leads investors to exhibit a disposition effect, which is costly, because of momentum 动量因子
- Professional traders recognize this
 - basic advice is to ignore realization utility
 - part of being a disciplined trader
训练有素

Selling behavior: The disposition effect

- Recent work has used techniques from neuroscience to provide evidence for realization utility
 - Frydman, Barberis, Camerer, Bossaerts, Rangel (2014)
- 28 participants traded stocks in an experimental market while we monitored their brain activity using fMRI

Selling behavior: The disposition effect

- The experiment was designed so that there was momentum in stocks' returns
 - and participants had enough information to figure this out
- Given this, participants should have exhibited the opposite of the disposition effect
 - but they actually exhibited a disposition effect
 - a mistake, in this context

Selling behavior: The disposition effect

- We can test the hypothesis that realization utility is driving the trading mistake
 - A part of the brain called the ventral striatum (vSt) tracks feelings of pleasure and pain
 - Under realization utility, people should feel a burst of pleasure when they sell at a gain, as compared to when they hold a stock with a similar gain.
 - When participants sell at a gain, we should see a spike in activity in the vSt, as compared to when holding a gain.
 - That is exactly what we find.

Selling behavior: The disposition effect

- The disposition effect can be used to extract information from the sales of corporate insiders
- One might have thought that sales of stock by insiders would be followed by poor returns
 - but the evidence for this is weak
- However, a sale of stock *at a loss* by an insider *is* followed by poor returns (Kelly, 2014)
 - intuition? 在亏了的情况下还要卖 (违背处置效应)
↳ 表示股票前景较差

Buying behavior

倾向

- The propensity to **buy** a stock is positively related to the stock's past returns, going back at least three years
 - Such buying behavior may not be fully rational
 - Long-term prior winners subsequently underperform (De Bondt and Thaler, 1985)
- Behavioral approach: *over-extrapolation*
- Note:
 - Both buying **and** selling propensities are positively related to past returns