Financial Markets

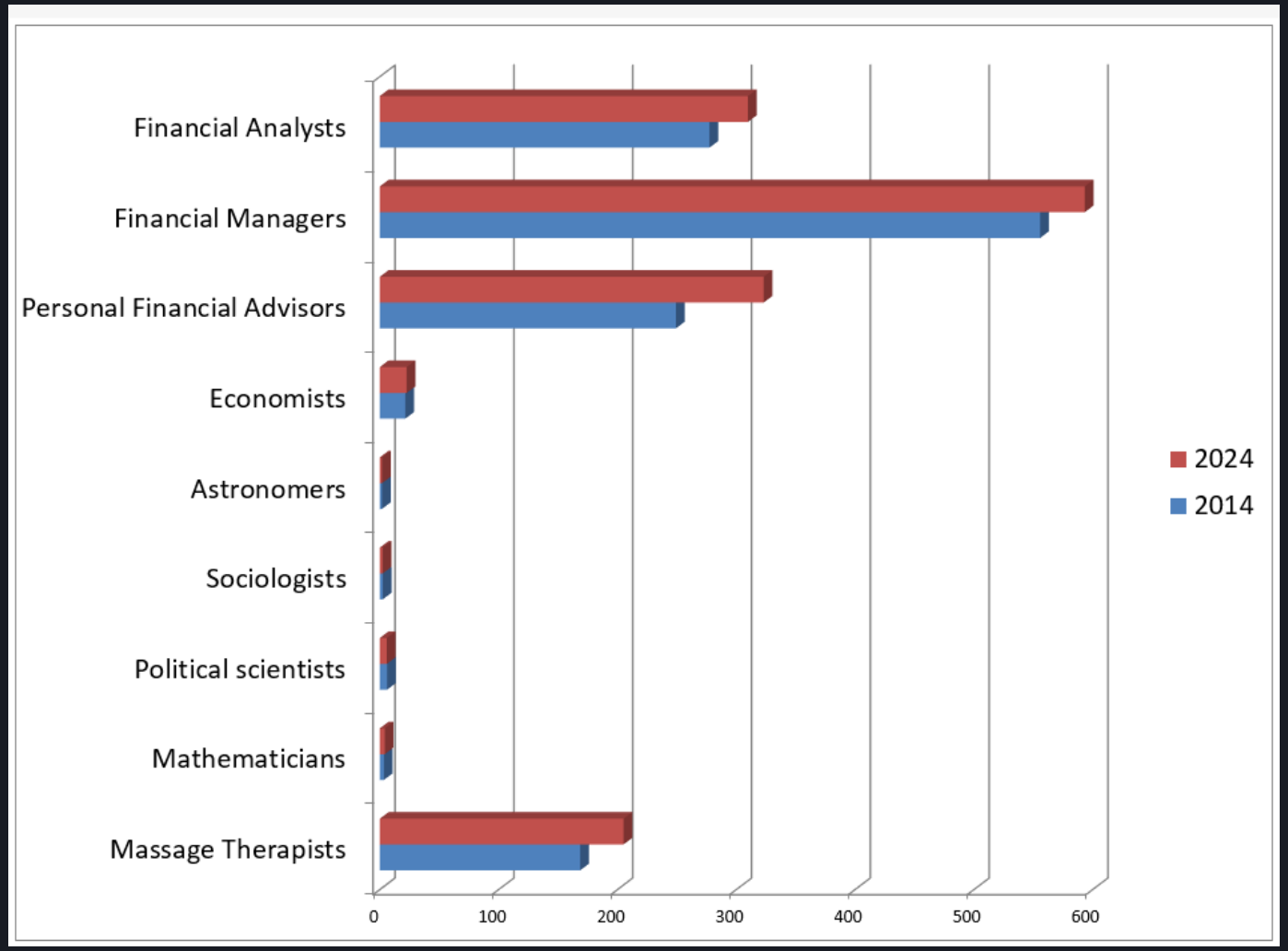
Prof. Robert Shiller, Yale University

Financial institutions are a pillar of civilized society, directing resources across space and time to their best uses, supporting and incentivizing people in their productive ventures, and managing the economic risks they take on. The workings of these institutions are important to comprehend if we are to predict their actions today and their evolution in the coming information age.

Topics Covered in this Course

- Risk
- Insurance
- Diversification
- History of finance
- Innovation
- Efficient markets
- Behavioral finance
- Debt
- Stocks
- Real Estate
- Regulation
- Banking
- Futures
- Monetary policy
- Endowment management
- Investment banking
- Options
- Money managers
- Exchanges
- Public finance
- Nonprofits
- Purpose

Finance Among Occupations, Thousands of People, US Bureau of Labor Statistics



Finance is a Technology, for Good or Evil

- All technologies can be used or misused
- Developing world is more interested in our finance technology than in our paltry foreign aid or empty sympathies
- This is not a course on how to make yourself rich to lead a self-indulgent life
- The most successful people in finance end their lives as philanthropists

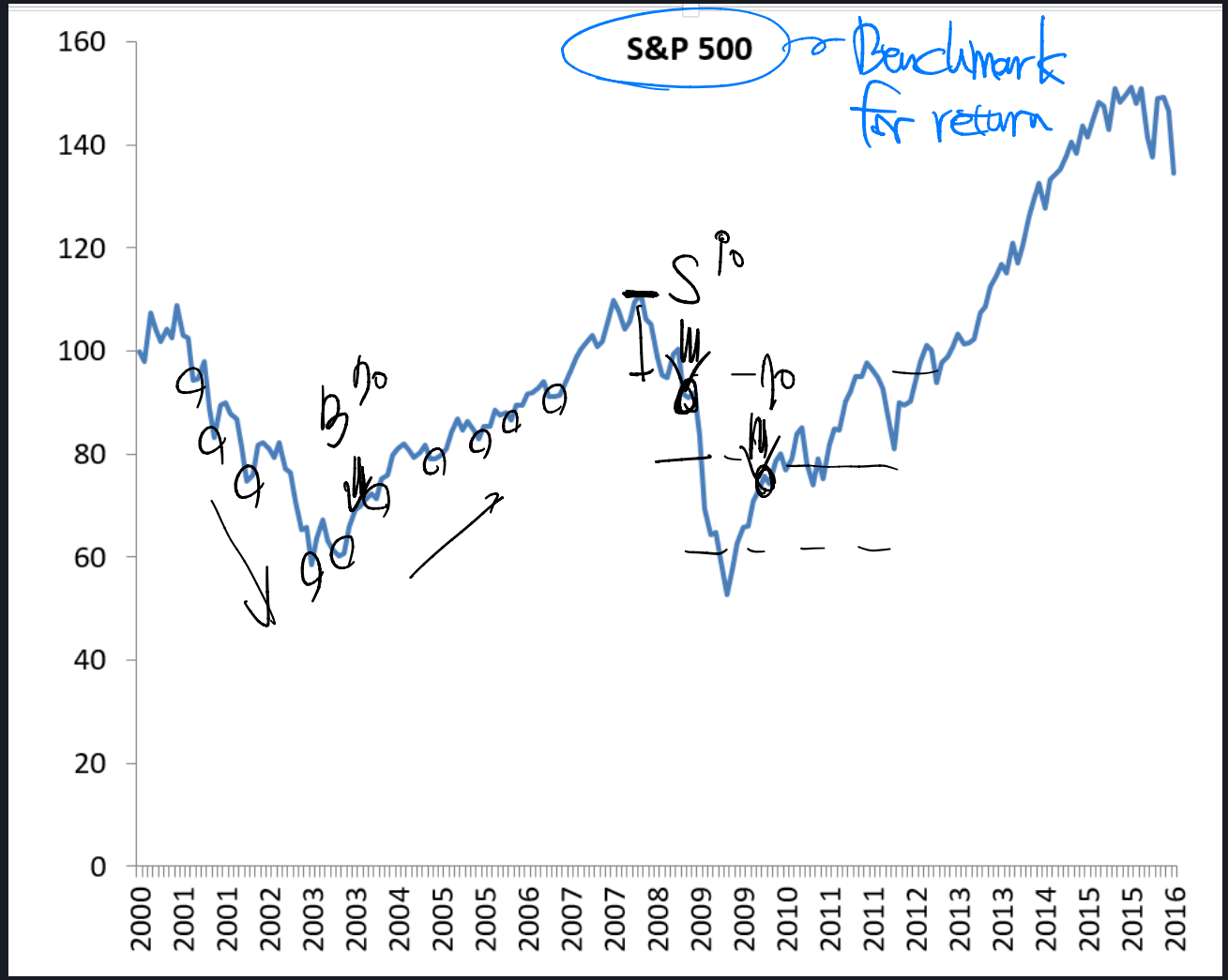
VaR

- VAR in finance means two things, variance and “value at risk” but when the A isn’t capitalized, it means value at risk
- Invented after stock market crash of 1987
- Value at risk is usually quoted in units of $ for a given probability and time horizon
- 1% one-year VaR of $10 million means 1% chance that a portfolio will lose $10 million in a year

Stress Tests

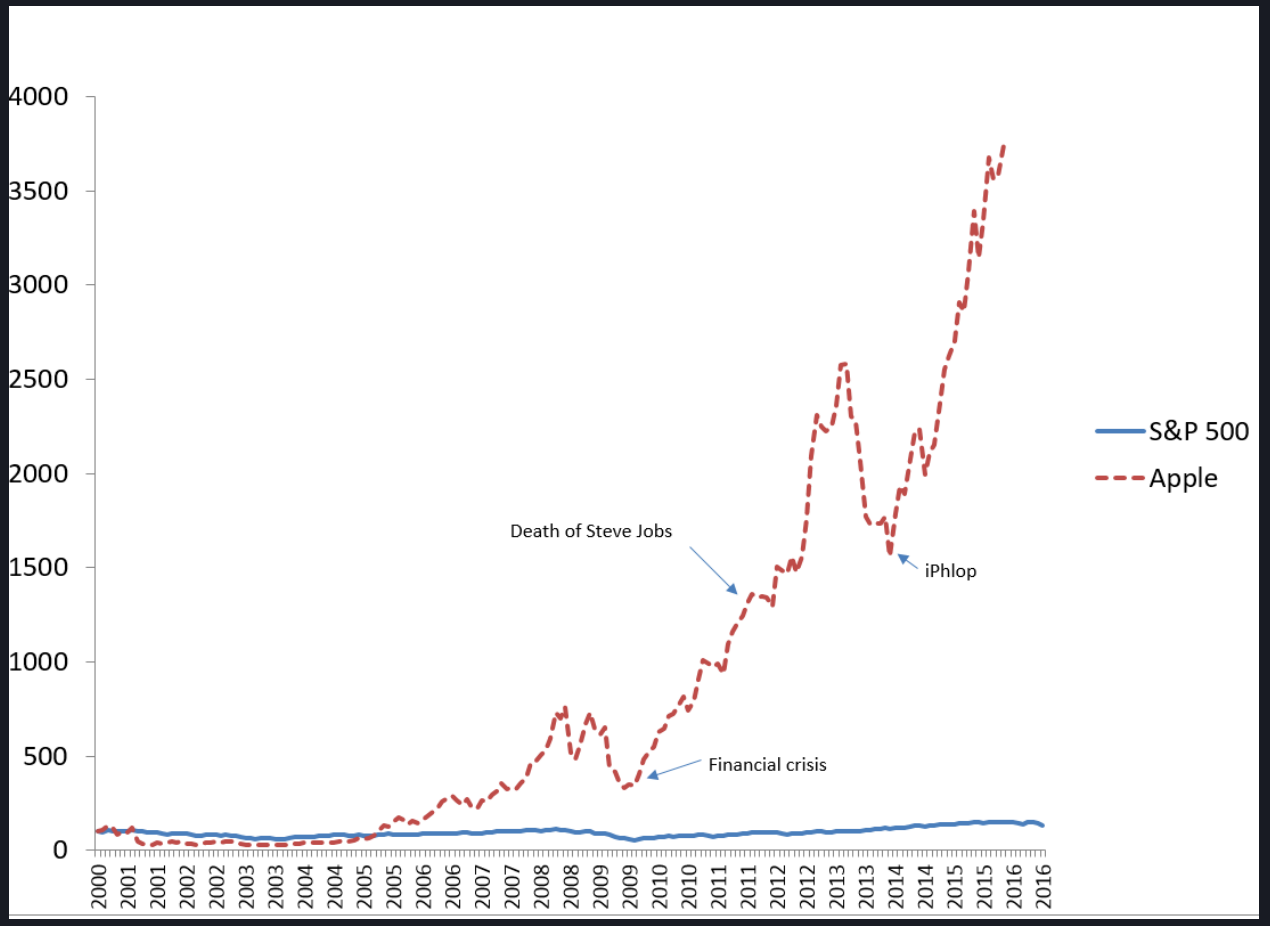
- Originally, term referred to a medical procedure to test for cardiovascular fitness
- OFHEO started testing firms' ability to withstand economic crisis before the 2008 crisis, failed.
- Dodd Frank Act 2010 requires the Federal Reserve to do annual stress tests for nonbank financial institutions it supervises for at least three different economic scenarios
- European Banking Authority, created 2011
- UK, China, etc.
- Critics of stress tests such as Anat Admati find them inadequate.

Stock Market Level, 2000-2016, 2000=100

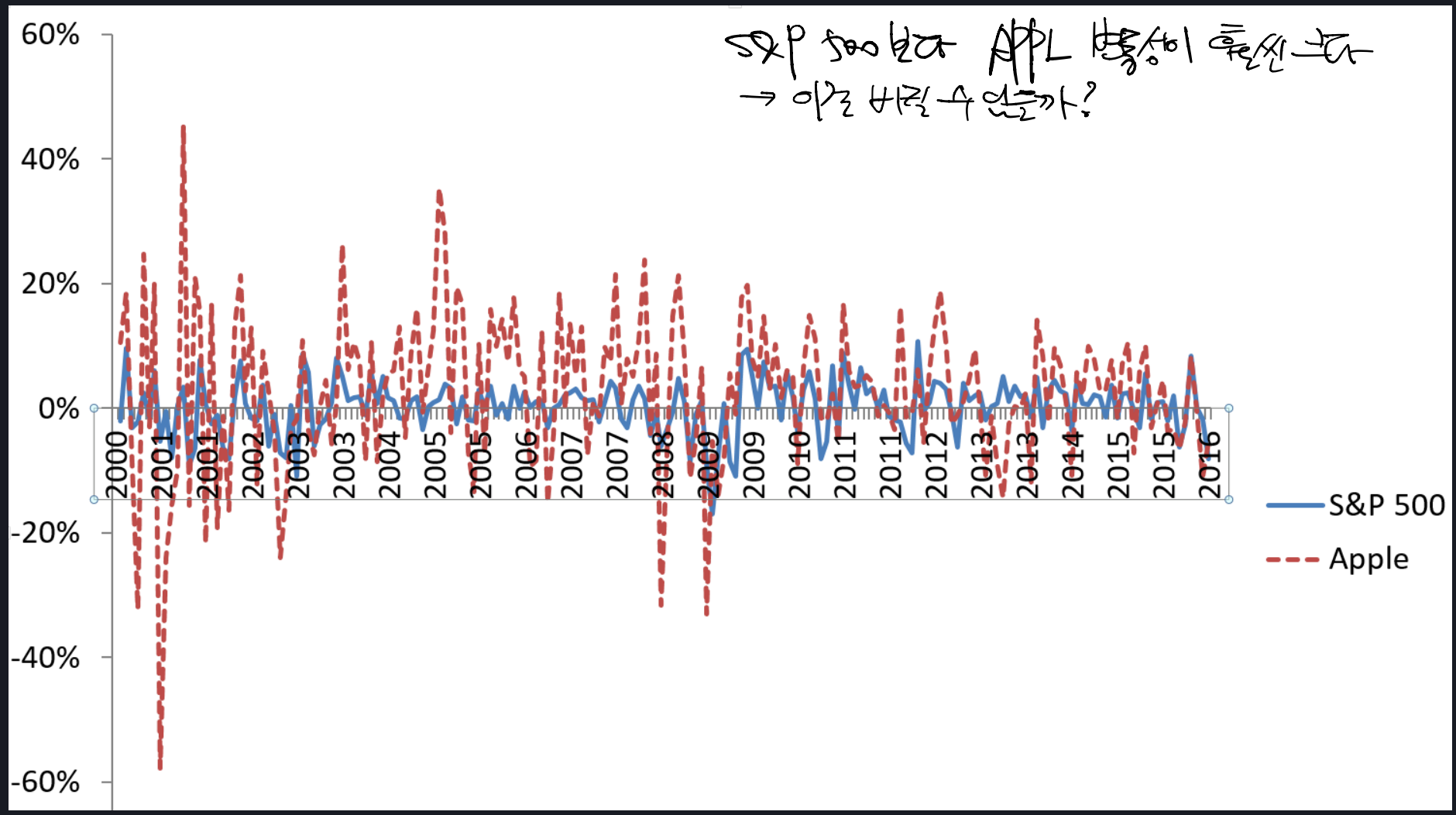


- Very unstable
  - Law of Large Number ⇒ X
    - → Stock market is not independent
    - → 시장은 강한 관성이 있음

Apple, Inc. and S&P 500 Monthly Adjusted Price 2000-2016, 2000=100



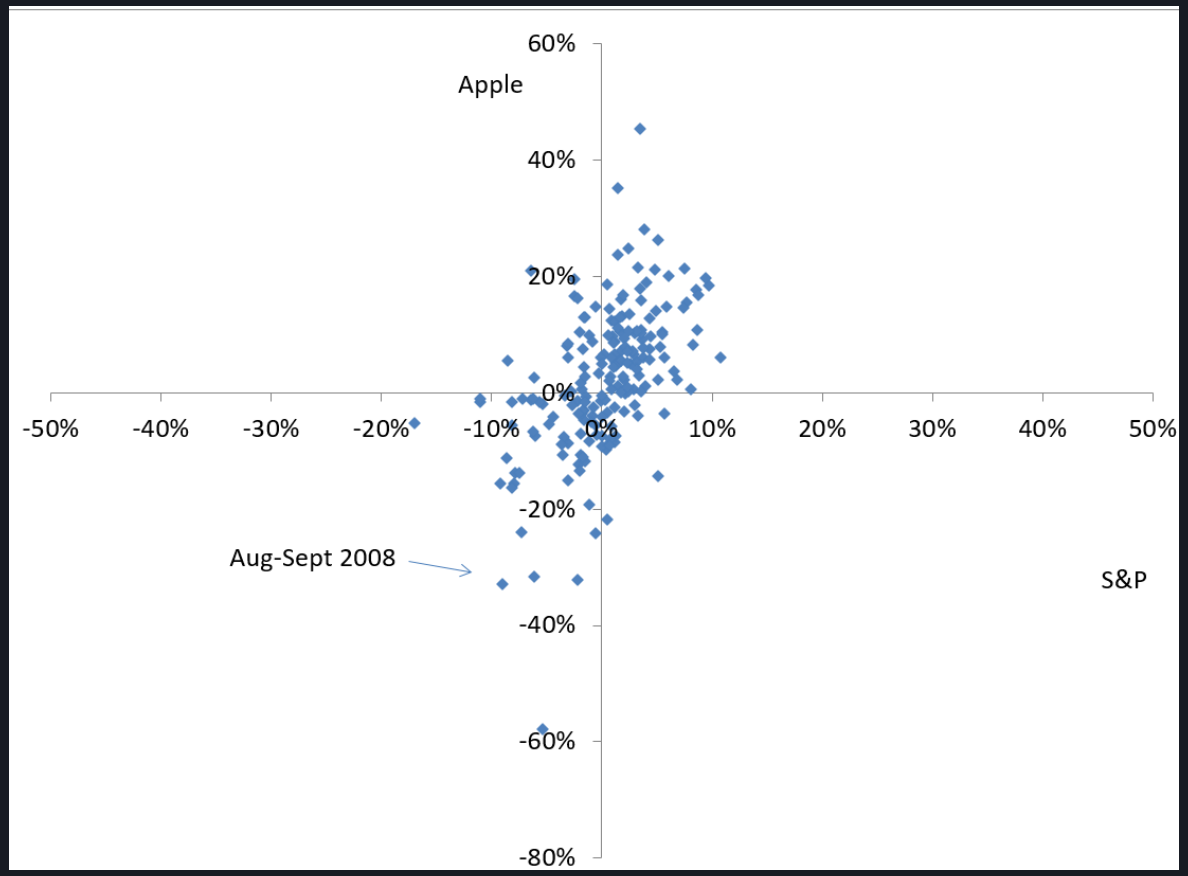
Apple, Inc. and S&P 500 Monthly Returns, 2000-2016



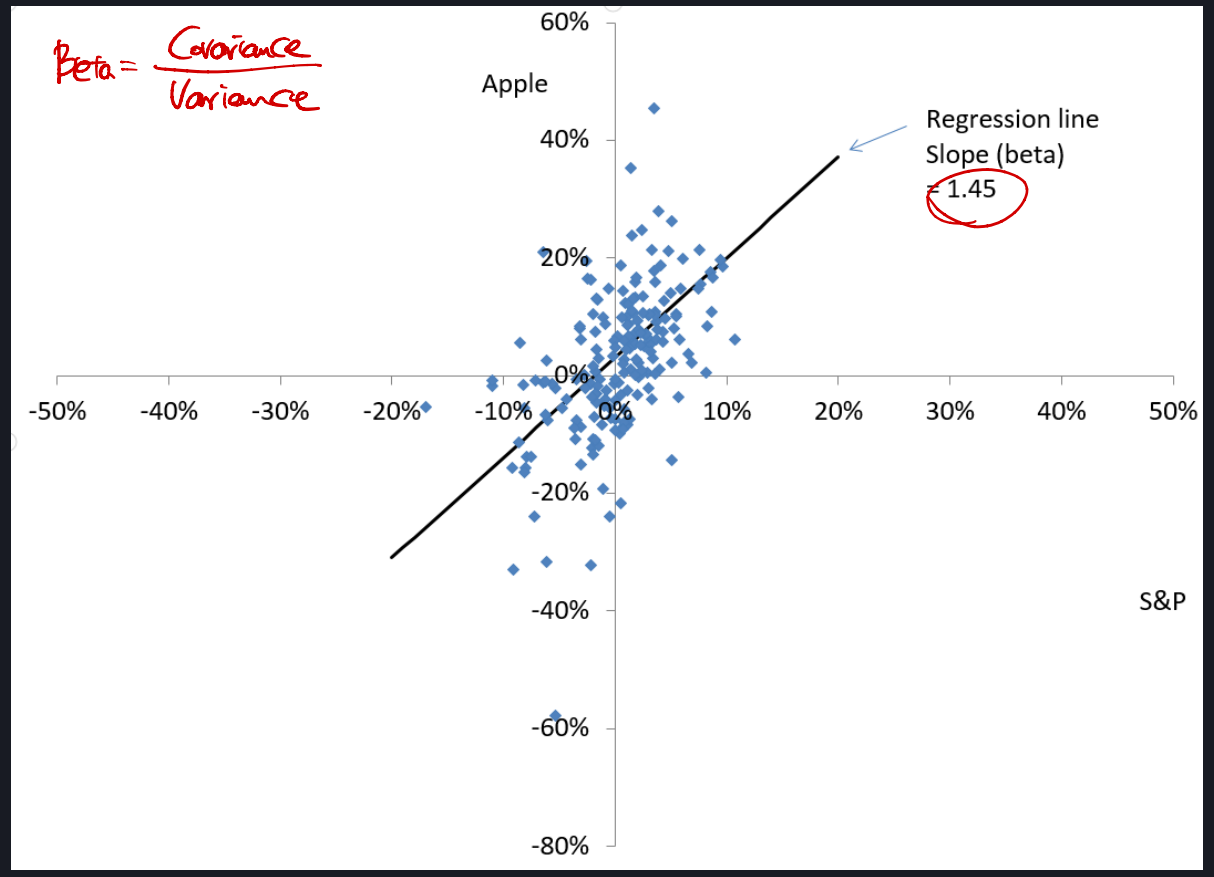
Variance of Apple vs Variance of S&P500

- Standard deviation of Apple capital gain in decade shown is 12.8% a month (not annualized) (arithmetic mean 3.47% a month, geometric mean 2.65% a month)
- 1.0347^123=65, 1.0265^123=25
- Standard deviation of S&P 500 return in decade shown is 4.7% (arithmetic mean capital gain mean 0.01%, geometric mean -0.16% a month, meaning we've lost money)

Scatter, Apple vs S&P 500 Returns Monthly Feb 2000-Jan 2016



Same Scatter with Regression Line



Beta

1 = Stock market 변화와 동일한 움직임

1.45 → S&P500보다 변동폭이 더 큰

$$\beta = \frac{Cov(r_i, r_{market})}{Var(r_{market})}$$

r : return
Cov 공분산
Var 분산

Beta

⇒ 자산 간의 분산 vs 시장과 자산 간의 공분산 ⇒ 즉, 시장대비 변화율을 의미
공분산의 비율

- The CAPM implies that the expected return on the ith asset is determined from its beta
- Beta (β_i) is the regression slope coefficient when the return on the ith asset is regressed on the return on the market
- Fundamental equation of the CAPM:

$$r_i = r_f + \beta_i (r_m - r_f)$$

Investment Return 투자대비수익

Risk-free rate

Risk

Risk premium

expected market return

ex) 국채수익률 $r_f = 3\%$
시장수익률 S&P500 $= 11\%$
$\beta = 3$ 일경우,

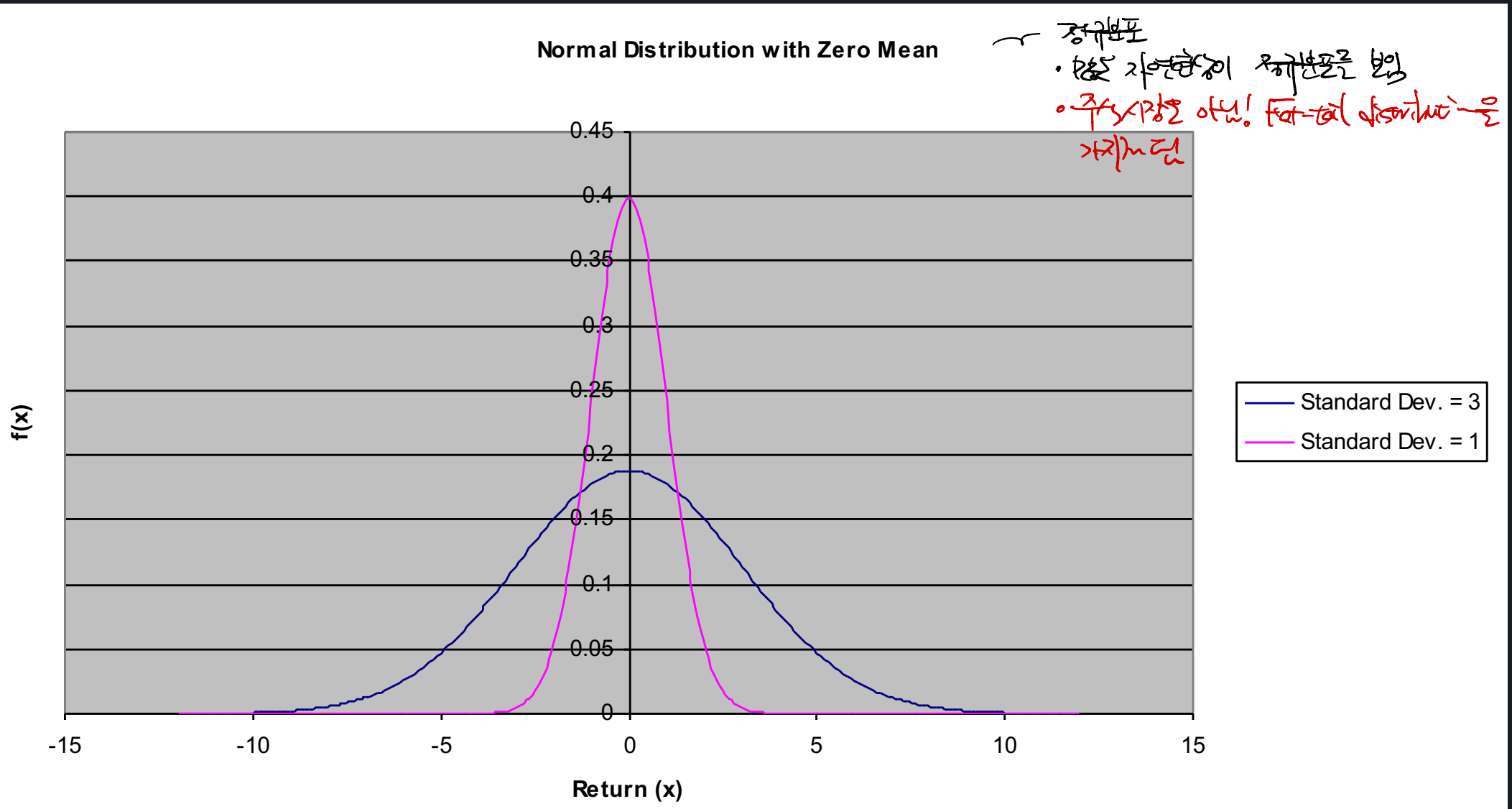
$\Rightarrow r_i = 27\%$

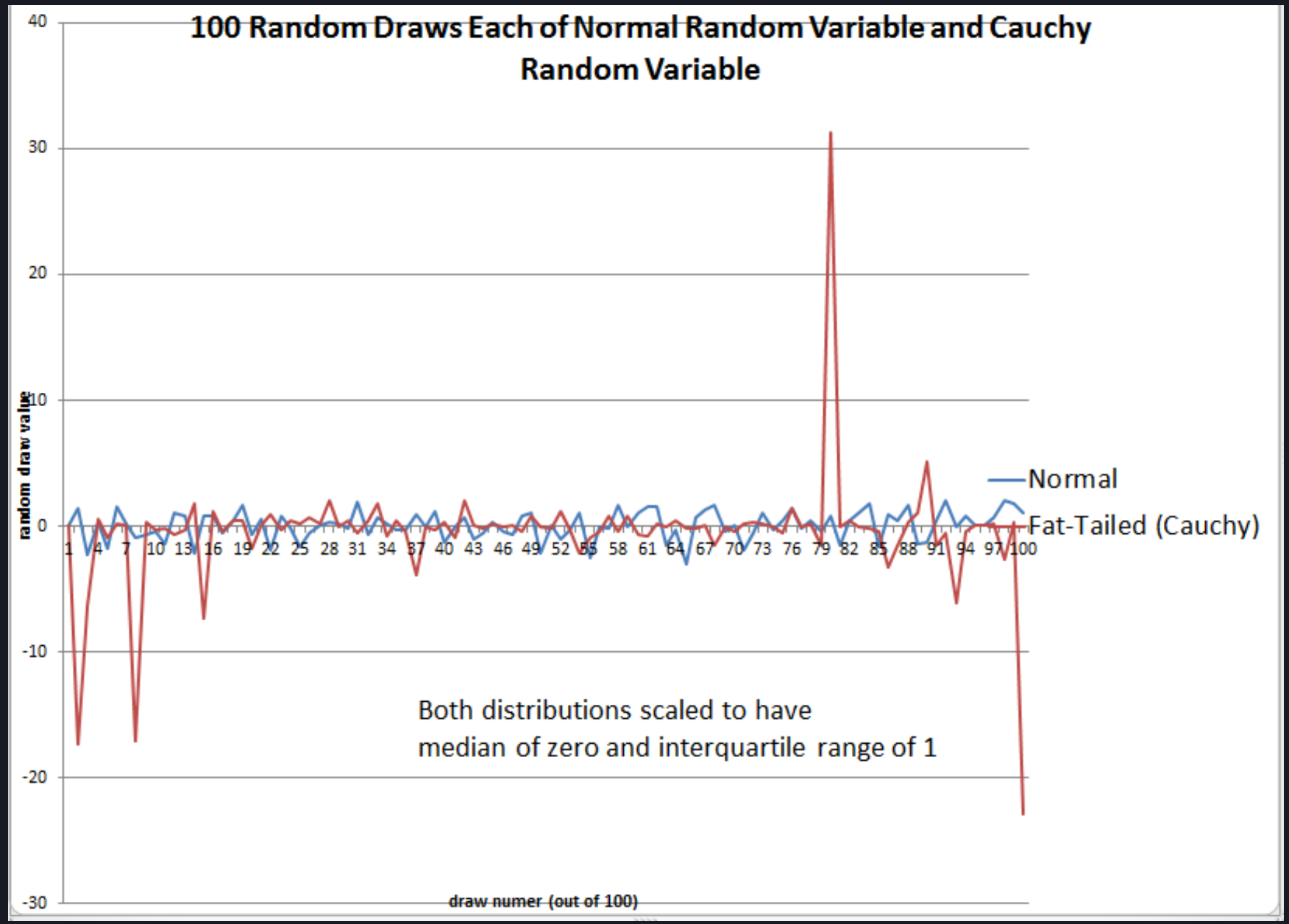
Market Risk versus Idiosyncratic Risk

- By construction, the residuals of error terms in a regression are uncorrelated with the fitted or predicted value
- So, the variance of the return of a stock is equal to its beta squared times the variance of the market return (systematic risk) plus the variance of the residual in the regression (idiosyncratic risk)

Joe McNay

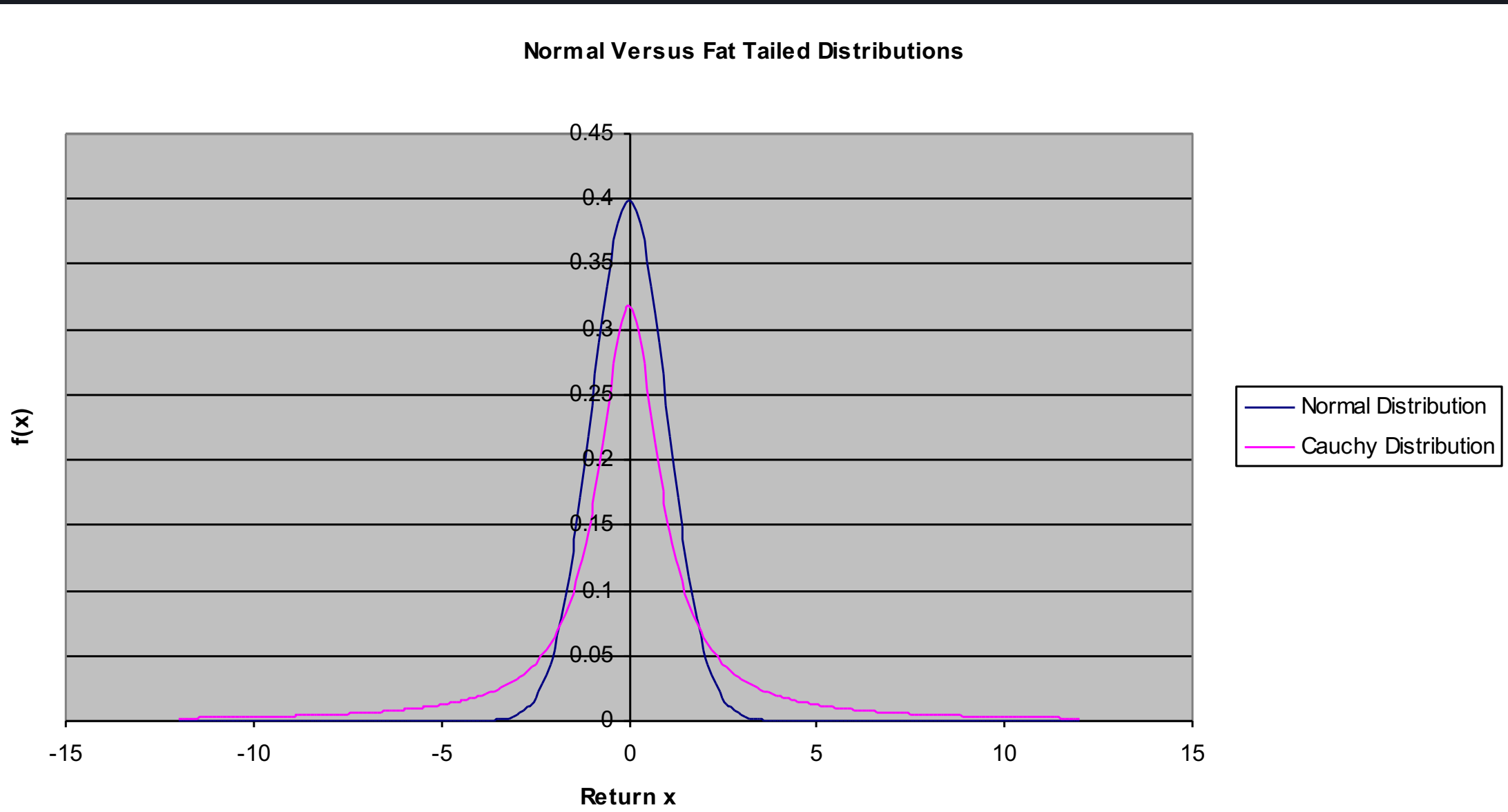
- The Class of 1954 gave $370,000 for Yale at its 25th anniversary (in 1979) but asked Joe McNay of Essex Investment Management to invest it for 25 years. They refused to let Yale investments handle it (pre-Swensen)
- In 2004, they presented it to Yale, now worth $90 million, 24.6% a year return geometric
- He invested in Walmart and Home Depot and Internet
- They got special dispensation from the federal government so that this trust did not need to give away 5% a year
- 1.8% a month geometric

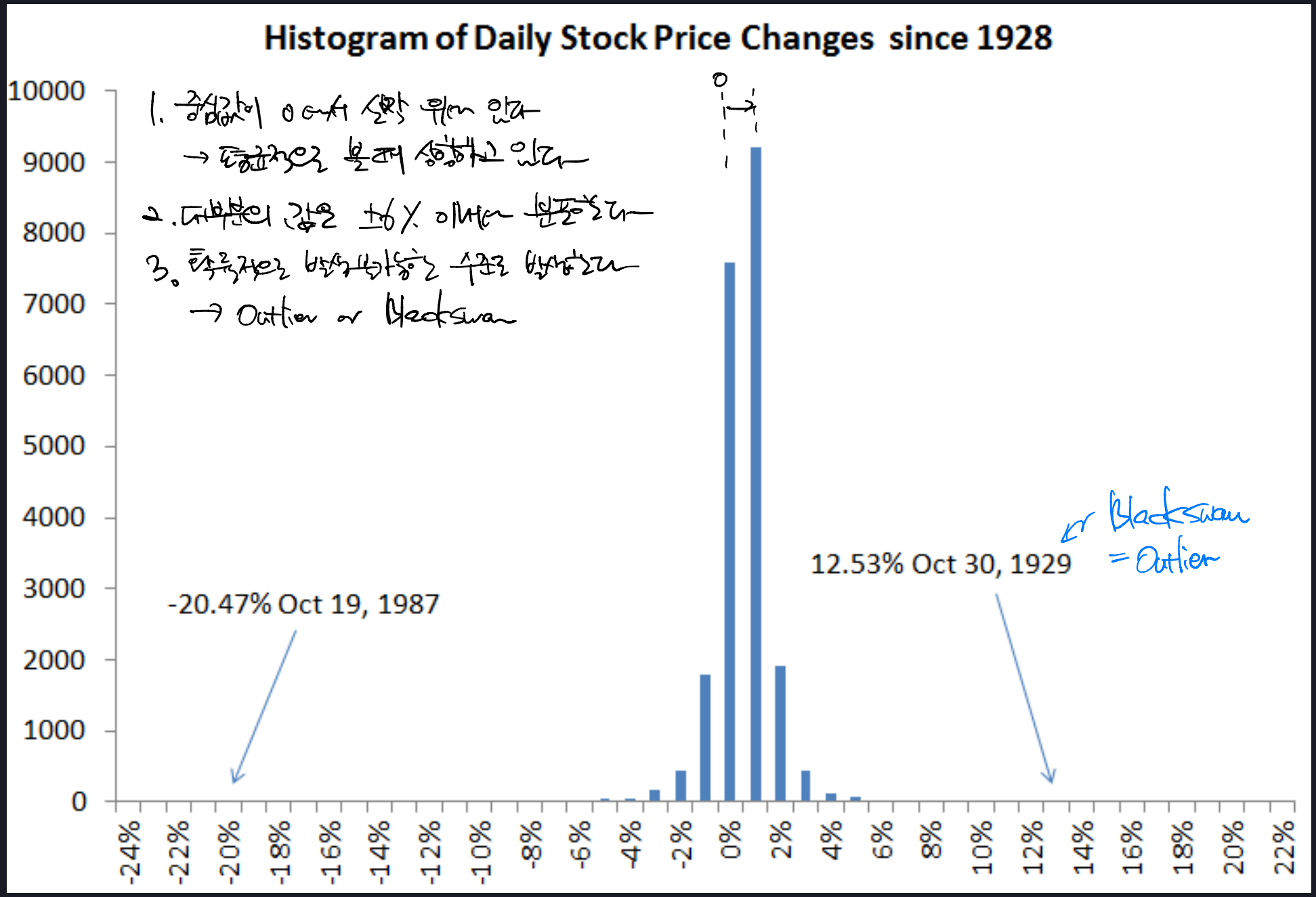

Normal Distribution with Zero Mean
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
f(x)
-15
-10
-5
0
5
10
15
Return (x)
Standard Dev. = 3
Standard Dev. = 1


100 Random Draws Each of Normal Random Variable and Cauchy Random Variable
40
30
20
10
0
-10
-20
-30
random draw value
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64 67 70 73 76 79 82 85 88 91 94 97 100
draw numer (out of 100)
Normal
Fat-Tailed (Cauchy)
Both distributions scaled to have
median of zero and interquartile range of 1

Central Limit Theorem

- Averages of a large number of independent identically distributed shocks (whose variance is finite) are approximately normally distributed
- Can fail if the underlying shocks are fat tailed
- Can fail if the underlying shocks lose their independence


Normal Versus Fat Tailed Distributions
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
f(x)
-15
-10
-5
0
5
10
15
Return x
Normal Distribution
Cauchy Distribution


Histogram of Daily Stock Price Changes since 1928
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-24%
-22%
-20%
-18%
-16%
-14%
-12%
-10%
-8%
-6%
-4%
-2%
0%
2%
4%
6%
8%
10%
12%
14%
16%
18%
20%
22%
-20.47% Oct 19, 1987
12.53% Oct 30, 1929
Blackswan
= Outlier

Outliers

- Normal distribution with same mean and standard deviation as the histogram shown has a probability of a drop greater than 20% equal to 3*10^-71

→ 1987年 발생할 일
확률적으로 불가능하지만 실제 일어났다!

Fundamental Insurance Principles and Issues

- ***Risk Pooling*** is the source of all value in insurance
- ***Moral Hazard*** dealt with partially by deductions and co-insurance
- ***Selection Bias*** dealt with by group policies, by testing and referrals, and by mandatory government insurance

Risk Pooling

- If n policies, each has independent probability p of a claim, then the number of claims follows the binomial distribution. The standard deviation of the fraction of policies that result in a claim is

$$\sqrt{p(1-p)/n}$$

ex. 10000개의 계약으로 이루어진 보험이 개별로 10%의 지급확률이 있을 때, 전체 표준편차는?

← n이 커질수록 0에 가까워짐

Sol. $\sqrt{0.1 \times (1-0.1) / 10000} = 0.003$ ⇒ 수가 많아질 수록 편차는↓

- *Law of large numbers*: as n gets large, standard deviation approaches zero

Radical Financial Innovation
Example I: Insurance

- Burial societies ancient Rome, true insurance policies appeared in Italy in 14th century
- Rapid development of actuarial theory starting in1600s with notion of probability
- Morris Robinson Mutual Life of NY 1840: highly-paid salesmen (agency theory)
- Henry Hyde Equitable Life Assurance Society 1880s: large cash value (psychological framing)
- Viviana Zelizer: challenging God, tempting fate (psychological framing)
- Inventions copied around the world
- Life insurance is a relic, of a day when people died young

Federal Insurance Office (Dodd Frank)

- Monitors insurance companies, looking for systemic risk. (Still no national insurance charter)

"(A) to monitor all aspects of the insurance industry, including identifying issues or gaps in the regulation of insurers that could contribute to a systemic crisis in the insurance industry or the United States financial system;

"(B) to monitor the extent to which traditionally underserved communities and consumers, minorities (as such term is defined in section 1204(c) of the Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (12 U.S.C. 1811 note)), and low- and moderate-income persons have access to affordable insurance products regarding all lines of insurance, except health insurance;

"(C) to recommend to the Financial Stability Oversight Council that it designate an insurer, including the affiliates of such insurer, as an entity subject to regulation as a nonbank financial company supervised by the Board of Governors pursuant to title I of the Dodd-Frank Wall Street Reform and Consumer Protection Act;

State Insurance Guarantee Funds

- Most U.S. states have guarantee funds protecting insurance against failure of the insurance company
- The first state to set up such a fund was New York, in 1941
- Protects individuals, not businesses or group insurance

Connecticut Life and Health Insurance Guaranty Association

- Founded 1972 by Connecticut legislature
- Maximum death benefit $500,000 and maximum cash value insurance $500,000. Connecticut's (along with NY and NJ) is generous. (benefits not taxable)
- Even so, not big enough. If you were buying life insurance for your family, $1 million minimum
- You can't increase coverage by buying multiple policies (as you can with FDIC)
- CT disallows mentioning the guaranty in insurance company advertising (opposite FDIC)

China

- In September 2008, CIRC set up a nonprofit state-owned corporation with a registered capital of 100 million yuan to manage its insurance protection fund, amounting to at least 7 billion yuan (about US$1 billion). [1]

China Insurance Protection Fund

- Policyholders' losses that are no more than 50,000 yuan (US$7,500) will be fully covered by the fund
- For losses in excess of that number, the fund covers 90 percent of the extra for individual policyholders and 80 percent for corporate policyholders

US Government Regulation of Insurance

- McCarran Ferguson Act 1945 delegated insurance regulation to the states. Fifty different state regulators
- National Association of Insurance Commissioners (NAIC) creates standardized suggested laws
- In 1993 the NAIC adopted risk-based capital requirements.
- Gramm-Leach-Bliley Financial Modernization Act of 1999 allowed banks to affiliate with insurance companies

Health Insurance

- Proposed in 1694 by Hugh the Elder Chamberlen
- First U.S. health insurance: Franklin Health Assurance Company of Massachusetts, 1850

The Health Maintenance Organization Act of 1973

- Required employers with 25 or more employees to offer federally certified HMO options
- Designed to overcome moral hazard problem, doctors earning fees for procedures make more money if people are sick
- HMO doctors are salaried, each patient has a “primary” who serves as gatekeeper
- Yale Health Plan is an HMO, Yale employees can also choose Blue Cross, which is not

U.S. Emergency Medical Treatment and Active Labor Act (EMTALA) 1986

- Requires hospitals and ambulance services to provide care to anyone needing emergency treatment
- An “unfunded mandate”

U.S. Patient Protection and Affordable Care Act 2010 (Obamacare)

- Penalty for individuals not buying insurance
- Penalty for companies not buying insurance for their employees
- New insurance exchanges A health insurance exchange is a set of state-regulated and standardized health care plans, from which individuals may purchase health insurance that is eligible for Federal subsidies
- Insurance companies may not disallow for preexisting conditions, or drop people who get sick

Haitian Earthquake 2010

Casualty Insurance in Haiti

- Since 2007, Haiti has participated in the Caribbean Catastrophe Risk Insurance Facility, funded by donors and member countries
- But that covered only $8 million of losses
- Coverage from private insurers similarly small (premiums about 0.3% of GDP)
- Losses from the Haitian earthquake reached into many billions

Hurricane Katrina twenty-foot high Storm Surge, August 29, 2005

Assessment of Insurance Performance in U.S. after Katrina

- The total insured property loss of Katrina, $34.4 billion
- 70% of claims were settled by January 2006, $7.5 billion paid out by insurers (Insurance Information Institute)
- Roughly 200,000 homes severely damaged, so payment was about $40,000 per home
- Insurance companies argued homes were damaged by flood, not wind
- Many homeowners did not have flood insurance (60% of homeowners in Orleans parish)
- insurance premiums in Louisiana had already gone up by 70% between 1997 and 2005, causing many people to cancel their insurance

Terrorism Risks

TRIA, 2002

- Before 9/11/2001, insurers generally did not exclude terrorism risk, which they then saw as inconsequential
- After 2001, insurers wanted these exclusions
- US Terrorism Risk Insurance Act of 2002 (TRIA) required insurers to offer terrorism insurance for three years
- Government agreed to pay 90% of insurance industry losses above a deductible of $100 billion
- December 2005 TRIA renewed for two more years, and in 2007 for 7 more years. In 2015, the act was renewed again to 2020

An Alternative to Insurance: Portfolio Management

- Diversification of ownership

From Crump 1874 book p. 94

There is an old saying that it is unadvisable to have all your eggs in one basket, a saw that is constantly quoted among both *bonâ fide* investors, as well as among speculators. A broker is not desirous that his clients who speculate should be interested very largely in one stock. He prefers to have the liability spread over the market, for obvious reasons. If a client fancies a particular stock, or has good reasons for believing it is about to improve, and he goes to his broker with a view to increase his stake, he will not receive the same encouragement as if he selected something else. The influence thus brought to bear arises from selfish motives, and proves again that the client should keep his own counsel. If he have no decided views himself, it is certain he had better do nothing, for speculation thus entered upon is doubly and childishly haphazard.

ALL THE EGGS IN ONE BASKET.

The more organized methods of speculation which prevail in these times, cause the public to be mulcted of their money in a much more wholesale manner than was the case formerly. They are now driven like sheep, or rather enticed into a pen,

TRAPS FOR THE PUBLIC.

A Later Insight

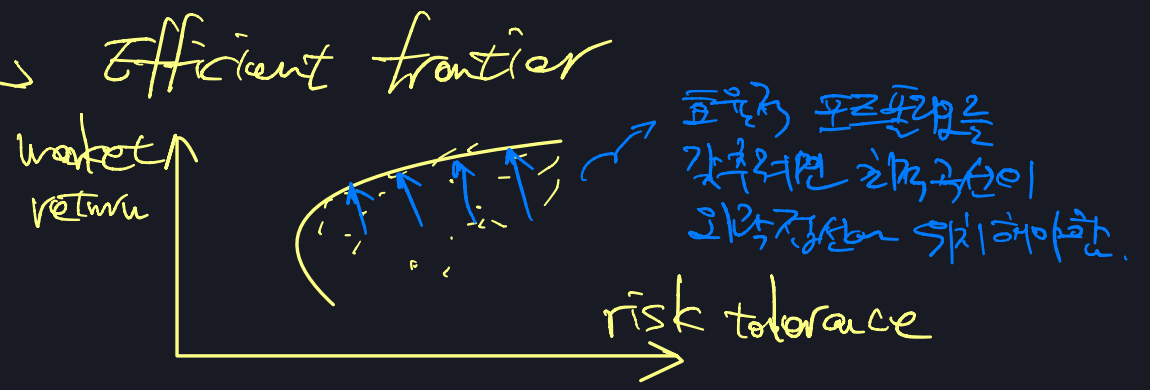
- If people are all like me, all calculating with the same data, all wanting to hold portfolios on the frontier, then then they all want to hold the same portfolio (and cash)
- So **THAT HAS TO BE THE MARKET PORTFOLIO**

Portfolio Diversification

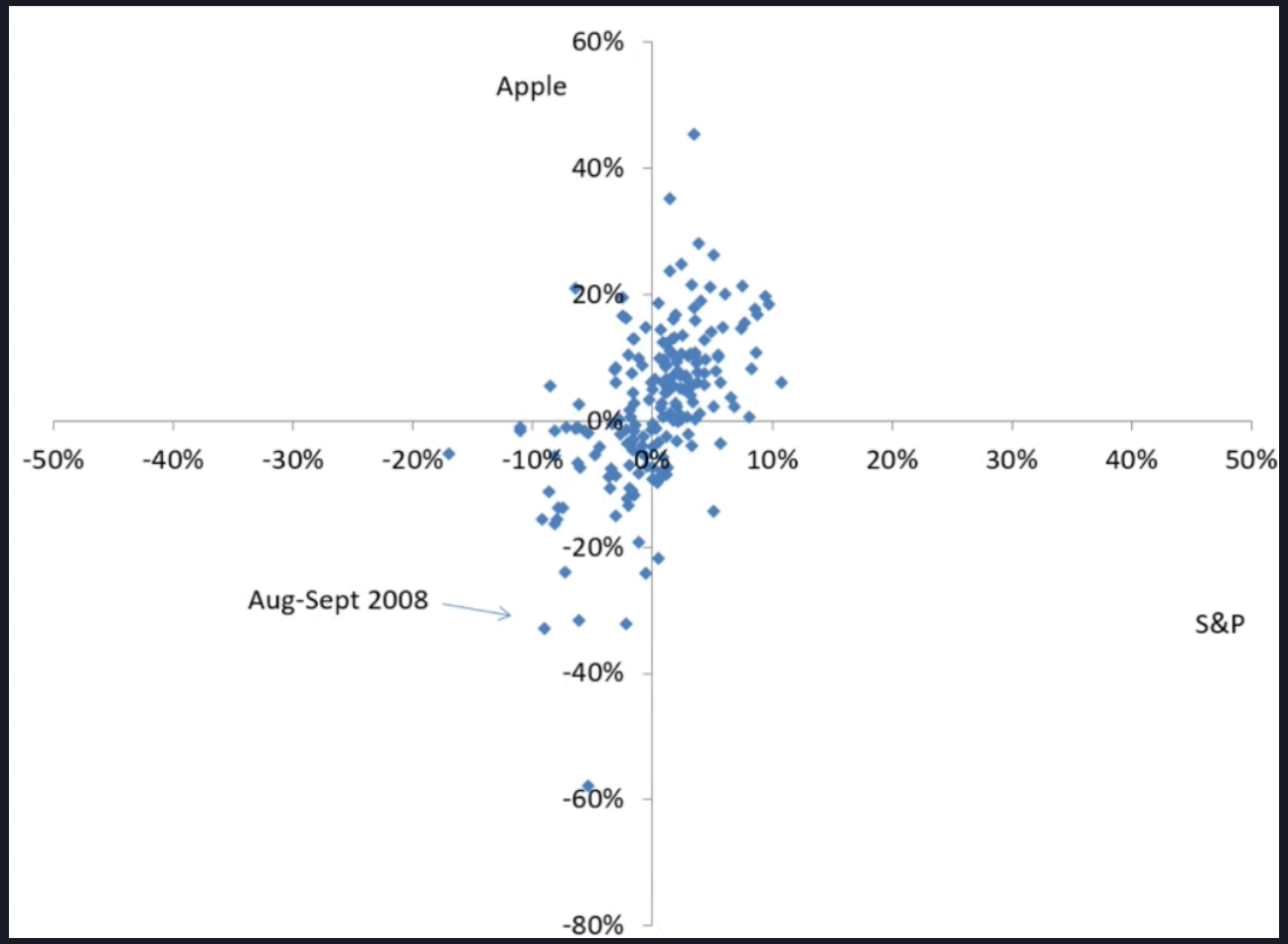
- All that should matter to an investor is the performance of the entire portfolio
- Mean and variance of portfolio matter
- Law of large numbers means that spreading over many independent assets reduces risk, has no effect on expected return

Capital Asset Pricing Model (CAPM)

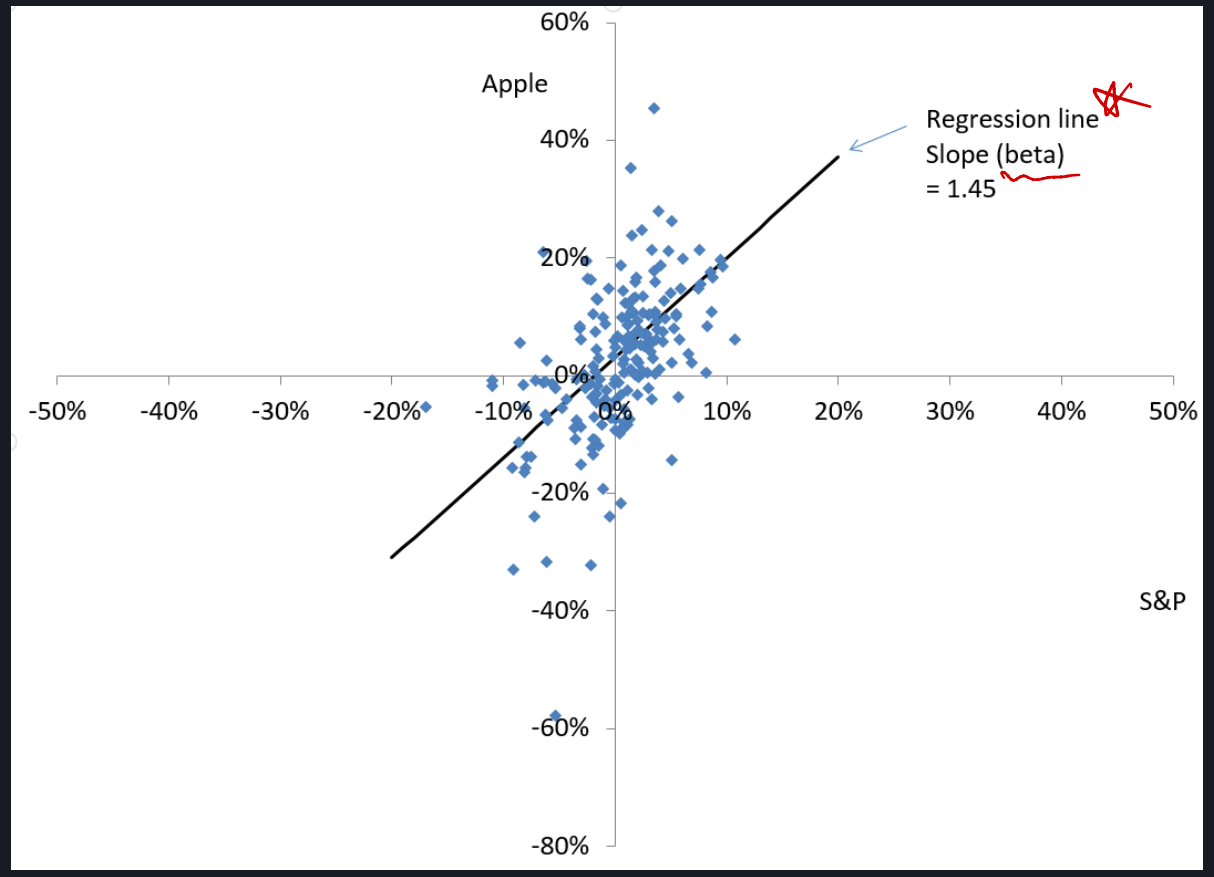
- CAPM Asserts that all investors hold their optimal portfolio
- Consequence of the mutual fund theorem: all investors hold the same portfolio of risky assets, the tangency portfolio
- Therefore the CAPM says that the tangency portfolio equals the market portfolio



Scatter, Apple vs S&P 500 Returns Monthly Feb 2000-Jan 2016



Scatter, Apple vs S&P 500 Returns Monthly Feb 2000-Jan 2016



Beta

- The CAPM implies that the expected return on the ith asset is determined from its beta
- Beta (β_i) is the regression slope coefficient when the return on the ith asset is regressed on the return on the market

Investment Companies as Providers of Diversification

- Investment trusts (before 1940s)
- Mutual funds (especially index funds)
- Closed end investment companies
- Unit investment trusts
  - All these institutions can enable small investors to overcome transactions cost and lumpiness problems in achieving diversified portfolios

Doubts about Diversification

- Complete diversification would imply holding much in fixed incomes, real estate, etc. But hasn't stock market outperformed these?

The (in a Sense Fallacious) Risk/Return Pyramid

$r_i = r_f + \beta(r_m - r_i)$

Equity Premium Puzzle

- US Geometric average real stock market return 1802-2012: 6.6% (Siegel *Stocks for the Long Run* 5th Edition 2014 Figure 1-1)
- US Geometric average real short-term governments return 1802-2012: 2.7% (Siegel Figure 1-1)
- Equity premium = 6.6%-2.7%=3.9%
- Puzzle: Why has equity premium been so high?

International Evidence

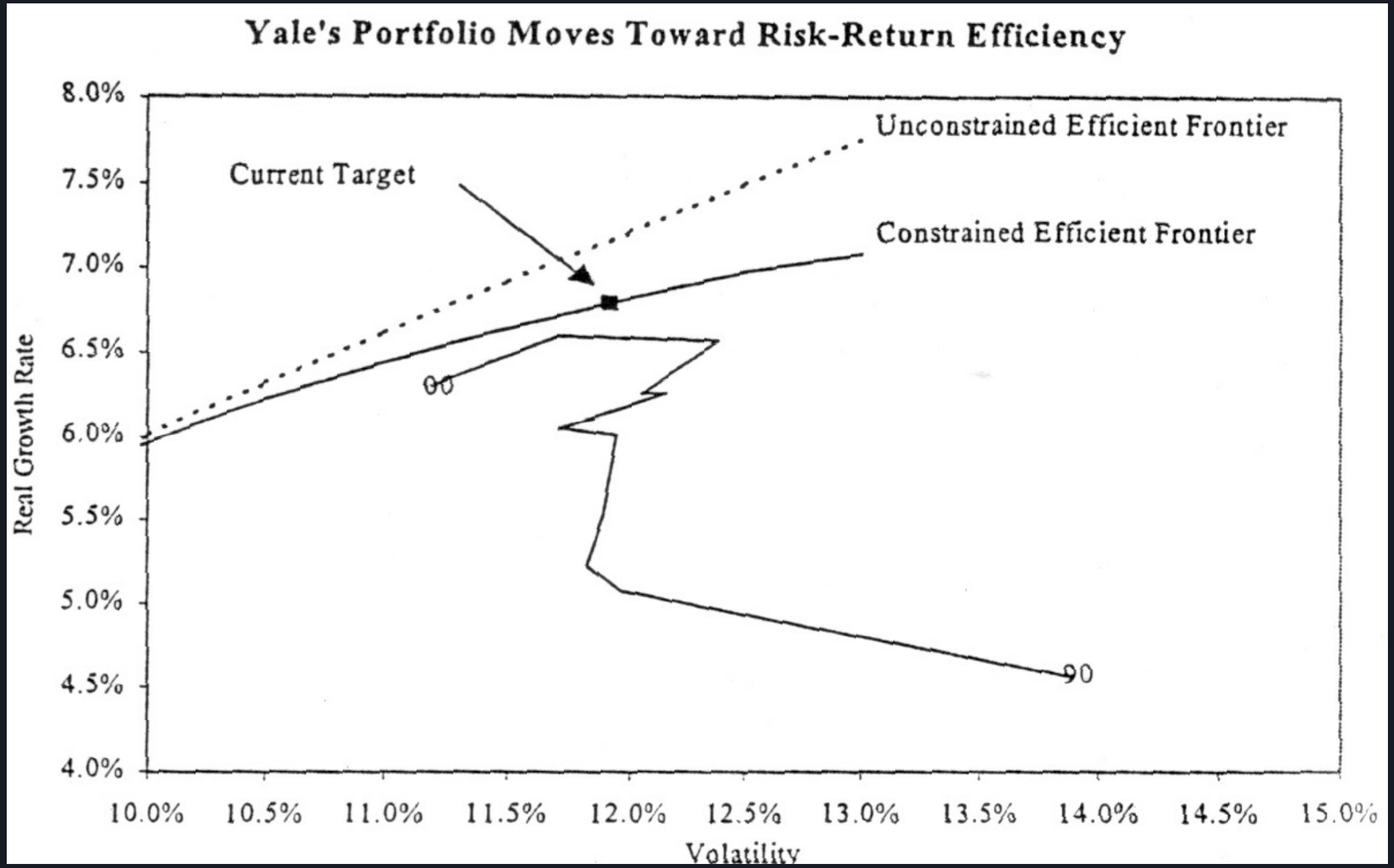
- Median real stock market appreciation rate for 39 countries 1926-96: 0.8% per year
- Real stock market appreciation rate for US 1926-96: 4.3% per year

  (Philippe Jorion and William Goetzmann, *Journal of Finance* 54:953-80, 1999.)
- So, US equity premium may reflect a selection bias

⇒ 다른 자본시장이 많이 존재한다는!

Short Sales

- Brokers can enable you to hold a negative quantity of a tradable asset: they borrow the security and sell it, escrow the proceeds, you receive the proceeds, owe the security
- Short sales in the United States were briefly abolished in September 2008 For a list of 799 stocks https://www.sec.gov/news/press/2008/2008-211.htm


Yale's Portfolio Moves Toward Risk-Return Efficiency
Unconstrained Efficient Frontier
Current Target
Constrained Efficient Frontier
00
90
Real Growth Rate
8.0%
7.5%
7.0%
6.5%
6.0%
5.5%
5.0%
4.5%
4.0%
10.0%
10.5%
11.0%
11.5%
12.0%
12.5%
13.0%
13.5%
14.0%
14.5%
15.0%
Volatility

* Shiller 수업 예제 - 위험자산 / 안전자산
r_1 20% / r_f 10%
σ_1 5% / σ_f 0

A Portfolio of a Risky and Riskless Asset

① $0.5, $0.5 투자시
r = 20×0.5 + 10×0.5
= 15% (기대수익)
σ = 5×0.5 + 0
= 2.5%

② $9, -$8 투자시
($8:1 레버리지)
r = 20×9 + 10×-8 = 100%
σ = 5×9 = 45%

PORTFOLIO

RISKY ASSET	RISKLESS ASSET
x dollars	$1-x$ dollars
return r_1	return r_f

레버리지를 일으켜 기대수익률을 획기적으로 높일 수 있으나 하지만, 기대만큼의 수익을 올리지 못할 경우, 파산 노출 위험이 커진다.

PORTFOLIO EXPECTED VALUE

$$r = xr_1 + (1-x)r_f$$

PORTFOLIO VARIANCE

$$x^2 \operatorname{var}(return_1)$$

Riskless asset의 분산은 0으로 가정하므로 제외된다.

PORTFOLIO STANDARD DEVIATION

$$\sigma = \left|\frac{r-r_f}{r_1-r_f}\right| \sigma(return_1)$$

A Portfolio of 2 Risky Assets

PORTFOLIO

RISKY ASSET 1	RISKY ASSET 2
x dollars	$1\text{-}x$ dollars
return r_1	return r_2

포트폴리오 구성시, 금등의 안전자산을 편입하는 이유

Asset 1과 2의 연관관계로 공분산을 고려해야

① (+) 연관관계라면 전체포트폴리오 변동은 악화

② (-) 연관이라면 Good! 전체 변동은 개선

③ 0 연관이라면 Cov항은 0 (무시)

PORTFOLIO EXPECTED VALUE

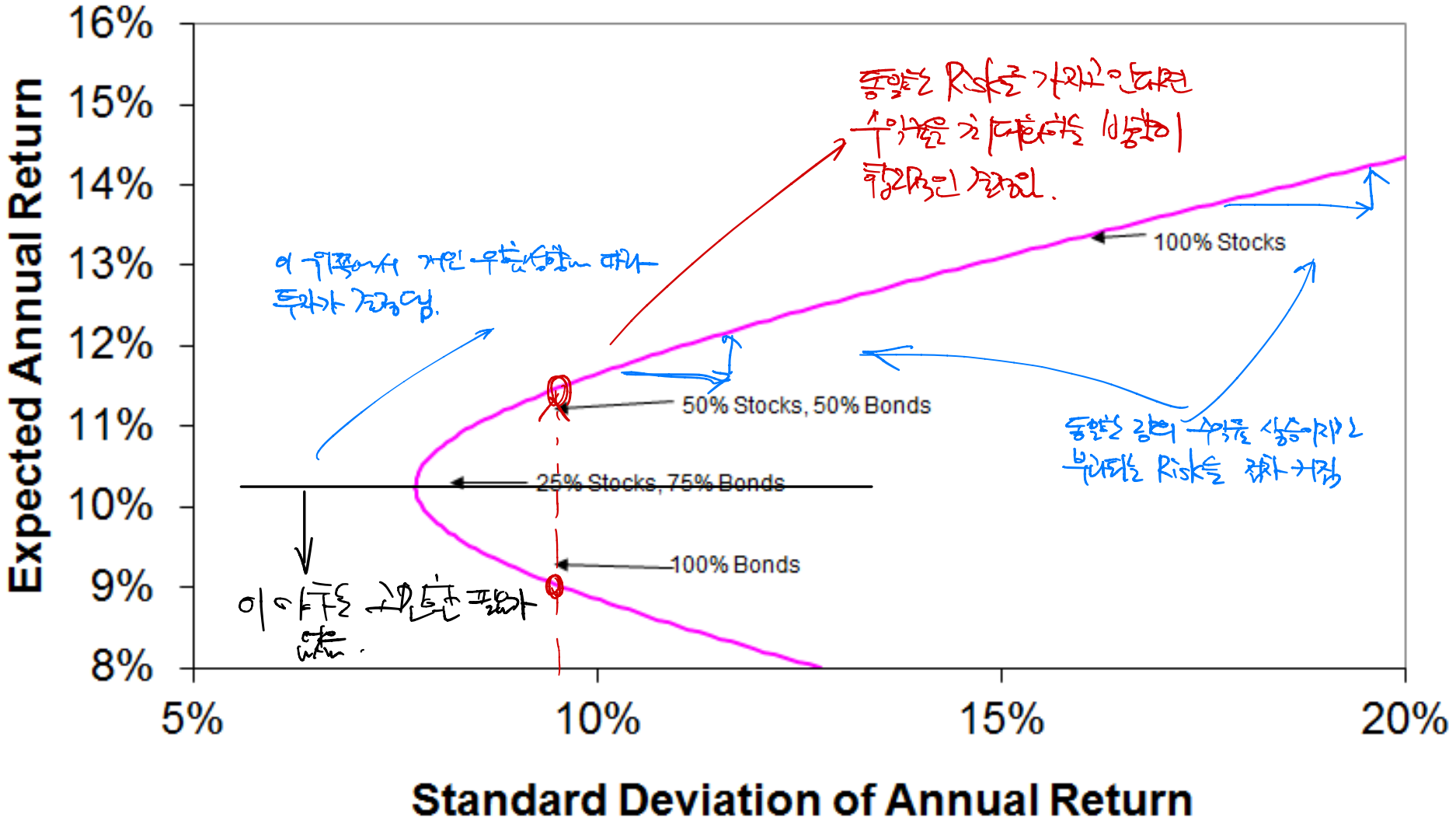
$$r = x_1 r_1 + (1\text{-}x_1) r_2$$

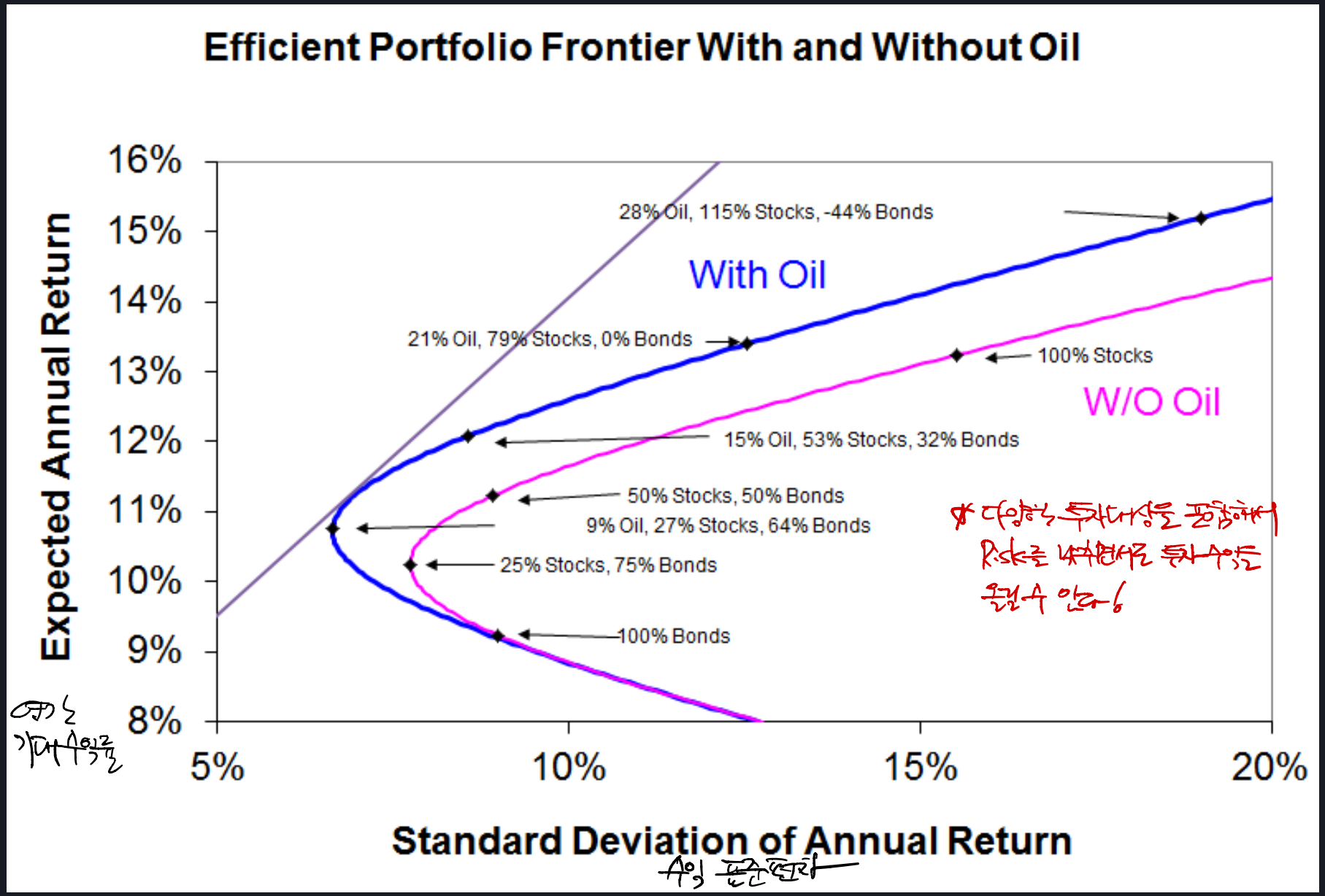
위험자산이 아니므로 Asset2의 분산도 필요

PORTFOLIO VARIANCE

$$x_1^2 \operatorname{var}(return_1) + (1-x_1)^2 \operatorname{var}(return_2) + 2x_1(1-x_1)\operatorname{cov}(return_1, return_2)$$

Efficient Portfolio Frontier Stocks and Bonds




Efficient Portfolio Frontier With and Without Oil
Expected Annual Return
16%
15%
14%
13%
12%
11%
10%
9%
8%
5%
10%
15%
20%
Standard Deviation of Annual Return
28% Oil, 115% Stocks, -44% Bonds
With Oil
21% Oil, 79% Stocks, 0% Bonds
100% Stocks
W/O Oil
15% Oil, 53% Stocks, 32% Bonds
50% Stocks, 50% Bonds
9% Oil, 27% Stocks, 64% Bonds
25% Stocks, 75% Bonds
100% Bonds

Gordon Growth Model

- 일정한 성장률을 갖는 자산에 대한 현재 가치 산출
- 매년 g% 씩 가격이 오르는 것을 고려하면,

year	0	1	2	···	n
price	X	X(1+g)	X(1+g)^2	···	X(1+g)^n

$$\Rightarrow PV = \frac{X}{r-g}$$

present value

X 현재가
r 할인율 discount rate, g 성장률

risk 팩터
위험이 없는 자산일 경우, r = 무위험수익률
위험이 있는 경우, 베타값을 통해 r값 상승 → 현재 가치 ⇓

- g가 (−)라도 투자할 가치가 있다.
  현재가격이 PV보다 더 낮다면...
  → 2000年 닷컴버블 당시 적자회사 주식 등