

Risk and Return (part 2)

Economics 71a
Gitman/Madura Chapter 6
Malkiel Chapters 8 and 9
Lecture notes 6

Goals

- Return components and nondiversifiable risk
- Capital Asset Pricing Model (CAPM)
- How well does the CAPM work, and should you care about **beta**?

Nondiversifiable Risk

- Many equity returns are positively correlated
- What does that mean to our new thoughts on risk?
- How would this appear in an economic equilibrium?
- $R(m)$ is the return of an overall market index

Individual Equity Return Structure

- Assume the following framework for stock returns

$$R_j = \alpha_j + \beta_j R_m + e_j$$

- $R(j)$ is the return on some stock
- $R(m)$ is the return on the market (Something like S+P 500)
- $e(j)$ is random noise, special for stock j : Mean or expectation of $e(j) = 0$

Individual Equity Return Structure

- Assume the following framework for stock returns

$$R_j = \alpha_j + \beta_j R_m + e_j$$

- Three parts

Expected Return: α

Nondiversifiable (systematic): β

Diversifiable (unsystematic): e

What does a portfolio of 2 stocks look like?

- Call these two stock 1 and stock 2
- Hold 50/50 of each

$$R_{port} = 0.5R_1 + 0.5R_2$$

$$R_{port} = 0.5(\alpha_1 + \alpha_2) + 0.5(\beta_1 + \beta_2)R_m + 0.5(e_1 + e_2)$$

Portfolio of N stocks

- Sum with 1/N weight on each

$$R_{port} = \frac{1}{N} \sum_{j=1}^N \alpha_j + \frac{1}{N} \left(\sum_{j=1}^N \beta_j \right) R_m$$

- 3 parts

Expected return

nondiversifiable risk (systematic)

Diversifiable risk (unsystematic)

$$+ \frac{1}{N} \left(\sum_{j=1}^N e_j \right)$$

What about diversifiable risk?

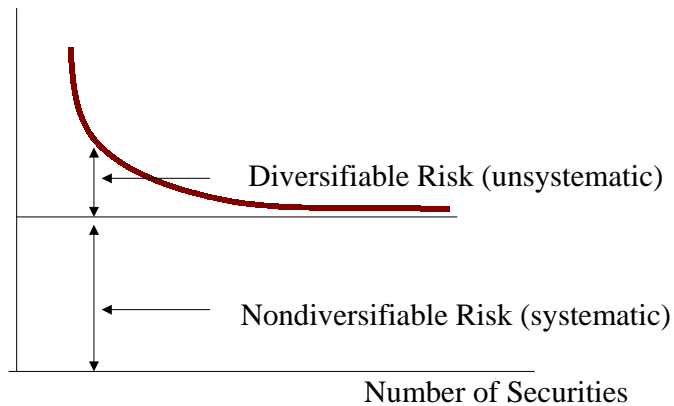
- The part of the portfolio related to diversifiable risk is

$$\frac{1}{N} \sum_{j=1}^N e_j$$

- The critical aspect of diversification is that as N gets big this random number gets close to zero
- “Law of large numbers”

Risk Reduction

Portfolio Risk
(Variance or standard deviation)



Why?

- This is a little like going to a casino, and playing roulette
- You bet on red many, many times
- Keep track of $W/(W+L)$
- As you play more and more this gets very close to 0.5

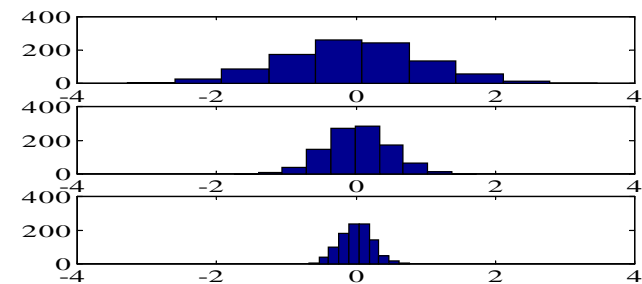
What About Beta?

- Beta (nondiversifiable risk) is the mean over all the individual beta's
- Alpha is also the mean over all the individuals

$$R_{port} = \frac{1}{N} \sum_{j=1}^N \alpha_j + \frac{1}{N} \left(\sum_{j=1}^N \beta_j \right) R_m + \frac{1}{N} \left(\sum_{j=1}^N e_j \right)$$

Diversification Histograms

Distribution of mean(e) for portfolios of sizes 1, 5, 20
(Sample = 1000, Distribution Normal, mean = 0, var = 1)



Key issue

- For equities the diversifiable part of risk can be eliminated
- All that remains is the part that moves with the market, or the nondiversifiable risk
- This depends on beta **ONLY**

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- Return components and nondiversifiable risk
- **Capital Asset Pricing Model (CAPM)**
- How well does the CAPM work, and should you care about beta?

Capital Asset Pricing Model (CAPM)

- Risk depends on beta alone
- If there is a payoff of higher return for higher risk,
then alpha, the expected return, depends on Beta only
- In the CAPM world
Beta is the key component of risk
and expected returns depend on Beta alone

What would happen in a non CAPM world?

Malkiel's experiment

- Assume the risk measure that people care about is related to the total (nondiversifiable+diversifiable) risk
- Stocks with higher $e(j)$ variance pay higher returns
- Build two stock portfolios
High $e(j)$ variance, Beta = 1
Low $e(j)$ variance, Beta = 1

More on Malkiel's experiment

- Since this is a nonCAPM world
The first portfolio pays a higher expected return
- However, the risk of the two portfolios is the same
They have the same beta
e(j) risk is diversified away
- Investors will load up on high e(j) risk stocks,
driving their prices up, and returns down, until they are
the same as the others

Beta is Key

- In the CAPM world:
No reward for holding stocks with lots of
diversifiable risk
Only beta matters as a measure of risk

Adjusting Beta Using a Risk Free Asset

- Market Portfolio
Expected return = 10%
Beta = 1
- Risk free (bank account)
Expected return = 4%
Beta = 0
- Combine these two

Combinations

- All risk free
beta = 0, expected return = 4%
- 50/50 Market/Risk Free
$$R_p = 0.5(4\%) + 0.5(R_m)$$

$$R_p = 2\% + 0.5R_m$$
- Beta = 0.5

More on 50/50

- Beta = 0.5
- Expected return =
 - $0.5 (4\%) + 0.5 (10\%) = 7\%$
- More Beta, more risk, more expected return

Fully invested

- Easy
 - Beta = 1
 - Expected return = 10%

More risk: Borrow

Like buying on credit and margins

- Start with \$1
- End with $\$(1+R_p)$
- Borrow \$0.50 at 4% risk free
- Invest \$1.50 in the market
- What does this portfolio look like at end?

$$1 + R_p = -0.5(1 + .04) + 1.5(1 + R_m)$$

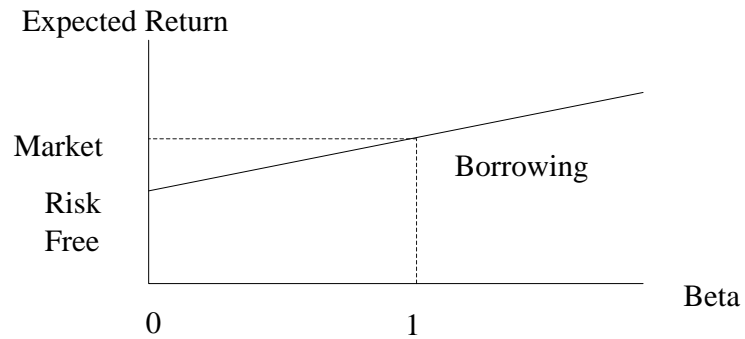
$$R_p = -0.5(0.04) + 1.5R_m$$

- Beta = 1.5, riskier than 1

What is the expected return?

- $-0.5(4\%) + 1.5(10\%) = 13\%$
- **Wow!** Greater than the expected return on the market. What's going on?
- Taking on greater risk

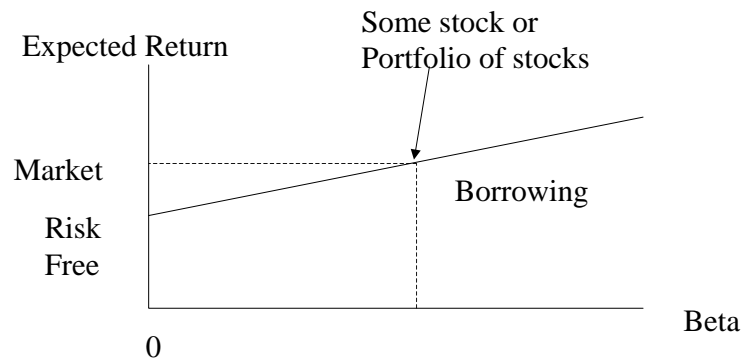
Risk Versus Return



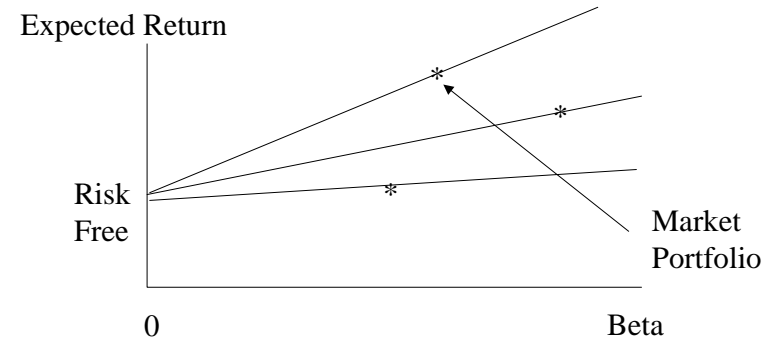
Advanced Risk Concept

- Using this relationship you can actually show that if the CAPM is working expected return and beta should be linearly related

Risk Versus Return Can Generate Entire Line (security/market line)



Risk Versus Return Different Stocks or Portfolios Combined with Risk Free: All choose highest



Market Portfolio Holdings

- All investors hold market portfolio
- Combine with the risk free to move on the security market line
- Depends on taste for risk
- Note: This prediction is strongly violated in the real world

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- **How well does the CAPM work, and should you care about beta?**

How well does the CAPM work?

- Results: Fama and French
- Construct portfolios of stocks
- Estimate betas
- Plot beta versus expected return
- No relationship
- Malkiel repeats this for mutual funds

Is Beta Dead?

- Older research showed a weak relationship between beta and expected return
- Recent evidence shows that there is probably no relationship
- Premier model of asset pricing
- Should or do we still care?

Reasons to Still think about Beta

- Diversification and portfolio theory is still important
 - Beta is informative about how a security moves with the market
- If the CAPM is not working, should try to “beat it”
 - Load up on low beta stocks
 - Should be lower risk, and higher return

Problems with CAPM

- Beta is very unstable over time
 - Hard to estimate
- Market inefficiency
- Diversification
- Attitudes toward risk
- Important side message
 - Look at other stuff

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