Module 2

Alternative Approaches to Valuation and Investment

Unsystematic versus Systematic Risk (Getting rid of unrewarded risk)

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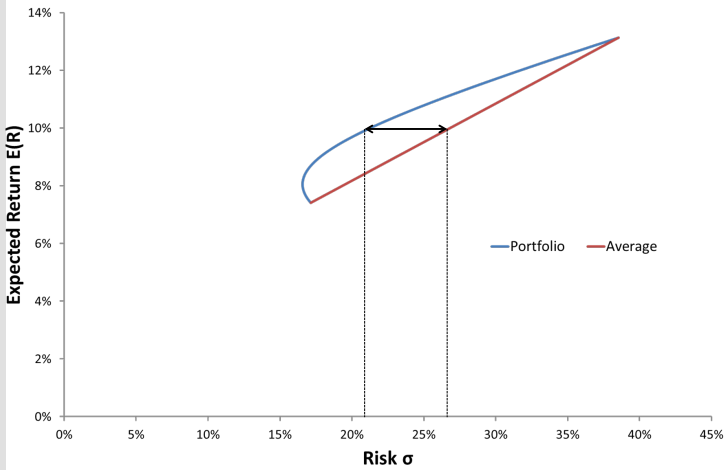
A brief recap…

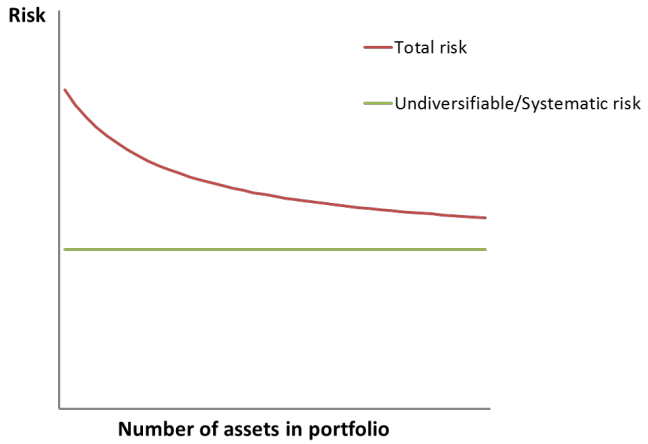


A brief recap…

Recall also that…

Number of assets	Number of σ_i terms	Number of $\sigma_{i,j}$ ($\sigma_i\sigma_j\rho_{i,j}$) terms
2	2	2
3	3	6
4	4	12
5	5	20
10	10	90
50	50	2450

Diversifiable risk



*But let's say you **fully diversify** your portfolio, does that mean you have eliminated all risk?*

Some definitions

Total risk: Total variability in returns of an asset – commonly measured using **standard deviation** (σ).

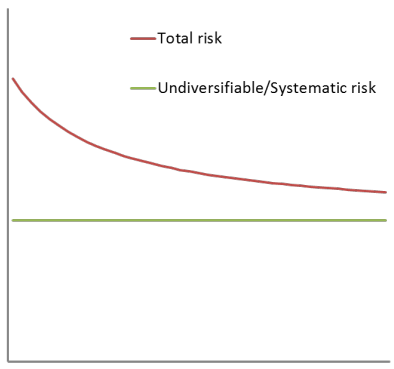
Diversifiable risk: The risk that can be diversified away by combining the asset into a well-diversified portfolio. Also known as **unsystematic, firm-specific** or **idiosyncratic** risk**.**

Undiversifiable risk: The risk that cannot be eliminated by diversification. Also known as **systematic, market** or **covariance** risk.

Which of these risks will the market compensate you for taking on?

Undiversifiable/Systematic risk: An illustration

- Start with the assumption that the only assets in the world are shares that are included in the S&P500 index.
- Let's assume that you own a very-well diversified portfolio – that is – its returns mimic the returns on the S&P500 index.
- You are now considering adding another asset to the portfolio.
- As you can only be compensated for **systematic** risk – the only measure that you are really interested in is the way in which the new asset's returns behave relative to all the other assets in the portfolio (which we call the **market portfolio**).
- We measure covariance as $\sigma_{iM} = \sigma_i \times \sigma_M \times \rho_{i,M}$



Beta (β): A measure of systematic risk

- It will be useful to have a standardized measure of risk that will ultimately be able to be linked to expected return.
- The standardized measure of risk we use is known as **beta** (as in Greek letter β) risk.
- It measures risk – relative to the risk of the **market portfolio.**

$$\beta_i = \frac{Cov(R_i, R_M)}{Var(R_M)} = \frac{\sigma_{i,M}}{\sigma_M^2} = \frac{\sigma_i \sigma_M \rho_{i,M}}{\sigma_M^2}$$

Beta (β): A measure of systematic risk

Key points about β:

- Almost all assets will have positive β
- Assets with β > 1 are more risky than the market – and will tend to be characterised by a greater sensitivity to market returns
- Assets with β < 1 are **less** risky than the market, showing lower sensitivity to market-wide changes in returns
- A company's strategic choices will impact upon the value of β (e.g. leverage, hedging, investment).

Measuring Beta (β)

- To measure β we would need to be able to observe the returns on a portfolio consisting of **all** risky assets (across countries, asset classes… everything).

$$\beta_i = \frac{\sigma_i \sigma_M \rho_{i,M}}{\sigma_M^2}$$

- This isn't practicable – so instead we use a **proxy** for the market portfolio – commonly a share price index – such as S&P500 index.
- A common approach to estimating the beta of a company is:
  1. Gather stock price data for company and market proxy
     e.g. 1 year of daily prices [can use sources such as Yahoo Finance].
  2. Convert prices to returns for both the stock and the market proxy
  3. Using these two return series calculate the following:
     a) Standard deviation of stock returns (σ_i) using Excel "=STDEV(..)" function
     b) Standard deviation of stock returns (σ_M) using Excel "=STDEV(..)" function
     c) Correlation between (a) and (b) ($\rho_{i,M}$) using Excel "=CORREL(..)" function.

Measuring Beta (β)

Let's do this for a sample of companies from the U.S. using the S&P500 index as a market proxy and using daily returns from 1 Jan to 31 Dec 2014:

$$\beta_{Kellogg's} = \frac{\sigma_K \sigma_M \rho_{K,M}}{\sigma_M^2} = \frac{(0.1714)(0.1133)(0.511)}{(0.1133)^2} = 0.773$$

Company	σ_i	$\rho_{i,M}$	β_i
Kellogg's	17.14%	0.511	0.773
Kraft	15.58%	0.606	0.833
Microsoft	19.00%	0.573	0.962
S&P 500	11.33%	1	1
American Airlines	38.53%	0.468	1.590
Facebook	35.69%	0.556	1.750

Portfolio Betas

Recall that we could eliminate some risk by combining assets into a portfolio. But this was only – by definition – diversifiable risk!

When you combine assets into a portfolio – systematic risk is **not** diversified away – it is simply **averaged:**

The beta for a portfolio is simply the weighted average beta of the assets in the portfolio.

e.g. Let's assume we invest 40% of our wealth in Kellogg's, 30% in American Airlines and 30% in Facebook. *What is the beta of our portfolio?*

$$\beta_{Portfolio} = (0.40)(0.773) + (0.3)(1.59) + (0.3)(1.75)$$

$$\beta_{Portfolio} = 1.311$$

WARNING: Issues in beta estimation

Recall that $\beta_{Kellogg's} = 0.773$, now consider these questions:

1. *How do we choose between different proxies for the market portfolio?*
   - Use NYSE 100, $\beta_{Kellogg's} = 0.330$
2. *What is the appropriate amount of time over which to calculate returns so as to estimate beta?*
   - 5 years daily data $\beta_{Kellogg's} = 0.469$
3. *Should I use daily, weekly, monthly returns or something else (e.g. second-by-second returns)?*
   - 5 years weekly data $\beta_{Kellogg's} = 0.384$

Summary

We have defined the concepts of:

- Diversifiable/Firm-specific/Idiosyncratic risk
- Undiversifiable/Systematic/Covariance risk.

We defined our measure of systematic risk as:

$$\beta_i = \frac{Cov(R_i, R_M)}{Var(R_M)} = \frac{\sigma_{i,M}}{\sigma_M^2} = \frac{\sigma_i \sigma_M \rho_{i,M}}{\sigma_M^2}$$

We highlighted some of the issues associated with trying to measure β.

How are we going to use β to help assist in corporate financial decision making?

Source list

Slides 3, 4 and 6:

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Slides 2, 10, 11 and 12:

All figures created by Sean Pinder using data downloaded from Yahoo Finance in June 2015 at https://au.finance.yahoo.com. © The University of Melbourne.