W1 - ASSETS & INVESTMENTS

Overview of Investment Process

1. Allocation decision
- Identify different investment options
- Identify investor preferences:
  - Risk appetite; and investment horizon
- Decide on the combination of investment assets and rebalancing frequency
  - Active vs. Passive investment management

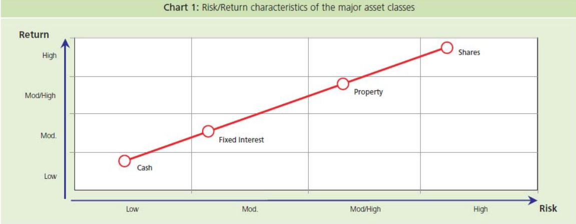
2. Performance measurement
- Returns and Risks

3. Review stage
- Actual vs. Expectations
- Any amendment needed?

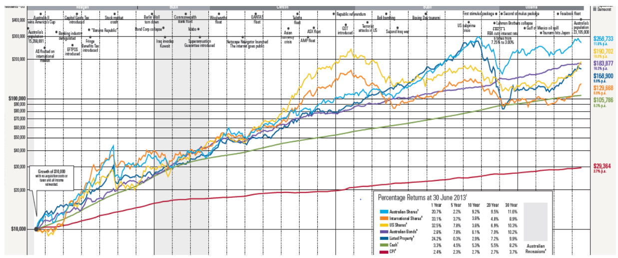
1. Allocation decision

Asset Classes
- Defensive assets
  - Money market instruments (e.g. Bank CDs, 30-day T bill)
    - (No risk / low risk. Steady income)
  - Fixed interest instruments (e.g. T-bonds, corporate bonds)
    - (High risk aversion. Low risk preference)
- Growth assets
  - Property (through indirect and direct channels)
  - Equity (e.g. Domestic and International shares)
    - (Low risk aversion. High risk preference)
- Derivatives
  - Options, Futures and other derivatives

Chart 1: Risk/Return characteristics of the major asset classes

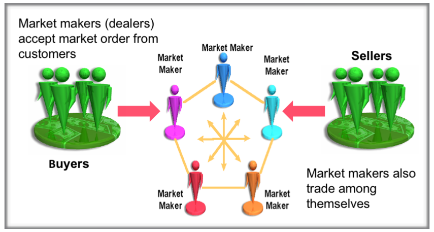


Source: Zurich

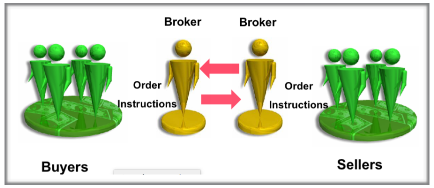


Trading in the Securities Markets

Types of markets
- Dealer markets
  - markets in which traders specialising in particular assets, buy and sell for their own accounts
  - 3rd party acts as intermediate buyer/seller
  - market makers help with time efficiency however they have a higher fee
  - Example: OTC market like money market



- Auction markets
  - a market where all traders meet at one place to buy or sell an asset
  - Brokers and dealers trade in one location
  - Trading is more or less continuous
  - E.g. **ASX**, NZX



Types of orders
(instructions to the brokers on how to complete the order)
- Market order - execute immediately at the best price
- Limit order - order to buy or sell at a specified price or better
  - On the exchange the limit order is placed in a limit order book kept by an exchange official or computer
  - Ex. A share is trading at $50. Could place a buy limit at $49.90 or a sell limit order at $50.25.
  - Table: The limit order book for Rio Tinto on the ASX, 2012. ($0.01 cost to buyers - difference between $57.23 and $57.24)

Rio Tinto (RIO)			
Bid		Offer	
Size	Price	Price	Size
294	57.23	57.24	319
652	57.22	57.25	22
1,452	57.21	57.26	1042
152	57.2	57.27	644
262	57.19	57.28	1208
214	57.16	57.30	1976
159	57.15	57.32	1719
151	57.14	57.39	715
79	57.12	57.40	500
1100	57.10	57.45	950

- Stop loss order - becomes a market sell order when the trigger price is encountered
  - Ex. You own a share trading at $40. You could play a stop loss at $38. The stop loss would become a market order to sell if the price of the share hits $38.
- Stop buy order - becomes a market buy order when the trigger price is encountered
  - Ex. You shorted a share trading at $40. You could place a stop buy at $42. The stop buy would become a market order to buy if the price of the share hits $42.

- Transaction costs
  - Commission - fee paid to broker for making the transaction
  - Spread - cost of trading with dealer
    - **Bid** - price at which dealer will buyer from you
    - **Ask** - price at which dealer will sell to you
    - **Spread** - ask **minus** bid
    - (between highest bid price and lowest offer price)
  - Market impact - for large transactions
    - What would happen if you submit a market order to buy 1000 Rio Tinto shares?

Margin Trading
(Buying on a margin - borrowing money to purchase shares)
- Initial Margin Requirement - is the difference between investment value and loan value. I.e. the minimum % initial investor equity
  - Margin changes daily with change in investment value and margin call is initiated if stare price drops
- Maintenance Margin Requirement (MMR) - minimum amount borrower's equity can be before additional funds must be put into the account
- Margin call - notification from broker that you must put up additional funds or have your position liquidated

- Example. Margin trading - initial conditions
  - X Corp — Share price = $70
  - 50% — Initial margin
  - 40% — Maintenance margin
  - 1000 — Shares purchased

Initial position			
Share	$70 000	Borrowed	$35 000
		Equity	$35 000

- Share price falls to $60 per share (1000 shares)
- Margin% = $25000/$60000 = 41.67%
- How far can the stock price fall before a margin call? (MMR = 40%)

New Position			
Share	$60 000	Borrowed	$35 000
		Equity	$25 000

- Market value = Borrowed / (1 - MMR) = $35000 / (1 - 0.40) = $58333
- With 1000 shares, the stock price at which we receive a margin call is $58333/1000 = $58.33

New position			
Stock	$60 000	Borrowed	$35 000
		Equity	**$23 333**

- Margin% = $23333/$58333 = 40%
- How much cash must you put up? To restore the IMR you will need?
  - Equity = ½ x $58333 = $29167
  - Have equity of $23333 so an additional $5834 is required

Short Sell
(Borrow shares from a broker/dealer, must post margin)
- Broker sells share and deposits proceeds and margin in a margin account (you are not allowed to withdraw the sale proceeds until you "cover")
- Cover or close out the position - buy the share and the broker returns the share title to the party from whom it was borrowed
- Bullish (rising) or bearish (falling) view?
- ASX daily gross short sale: https://www.asx.com.au/data/shortsell.txt

2. Performance Measurement

(How to calculate returns and risks associated with different investments?)

Measuring ex-post (past) returns
- One period investment - regardless of the length of the period
  - Holding Period Return (HPR)
  - Why use percentage returns?
    - To compare with different shares
  - What are we assuming about the cash flows in the HPR calc?
    - Assuming CF comes in at Ps due to TVM so it's assumed to be received at the selling of the investment
  - Why would you want to annualise returns?
    - Annualising HPRs for holding periods of greater than one year
    - Without compounding (simple or Annual Percentage Rate APR)
    - With compounding: Effective Annual Rate EAR where n = number of years held

$HPR = [P_S - P_B + CF] / P_B$ where
P_S = Sale price (or P_1)
P_B = Buy price *($ you put up)* *(or P_0)*
CF = Cash flow during holding period

$$HPR_{ann} = HPR/n$$

$$HPR_{ann} = [(1+HPR)^{1/n}] - 1$$

Example. Measuring ex-post (past) returns Suppose you buy one share of a stock today for $45 and you hold it for two years and sell it for $52. You also received $8 in dividends at the end of the two years.

PB = $45, PS = $52, CF = $8

HPR = (52 - 45 + 8) / 45 = 33.33%

HPR_{ann} = 33.33% / 2 years = 16.66%

(*Annualised without compounding*)

HPR_{ann} = $(1 + 0.3333)^{½}$ - 1 = 15.47%

(*Annualised HPR with annual compounding*, n = 2)

- Annualising HPRs for holding periods of less than one year
  - Without compounding (simple) $HPR_{ann} = HPR \times n$
  - With compounding $HPR_{ann} = [(1+HPR)^n] - 1$

    where n = number of compounding periods per year

Example. When the HP is < 1 year Suppose you have a 5% HPR on a 3-month investment. What is the annual rate of return with and without compounding?

- Without: n=12/3=4 so HPR_{ann} = HPR x n = 0.05 x 4 = 20%
- With: $HPR_{ann} = (1.05^4) - 1 = 21.55\%$
- Why is the compound return greater than the simple return? Accumulated on interest on interest basis

Arithmetic Average

(Finding the average HPR for a *time series* of returns)

- Without compounding (arithmetic average return AAR)
- n = number of time periods

$$HPR_{avg} = \sum_{T=1}^{n} \frac{HPR_T}{n}$$

Example. You have the following rates of returns on a stock

2000: -21.56%
2001: 44.63%
2002: 23.35%
2003: 20.98%
2004: 3.11%
2005: 34.46%
2006: 17.62%

$$HPR_{avg} = \sum_{T=1}^{n} \frac{HPR_T}{n}$$

$$HPR_{avg} = \frac{(-.2156+.4463+.2335+.2098+.0311+.3446+.1762)}{7} = 17.51\%$$

AAR = 17.51%

Geometric Average

(Finding the average HPR for a portfolio of assets for a given time period)

- With compounding (geometric average return GAR)

Where:

VI = amount invested in asset I

J = total # of securities

TV = total amount invested

$$HPR_{avg} = \sum_{I=1}^{J}\left[HPR_I \times \frac{V_I}{TV}\right]$$

Thus VI/TV = % of total investment invested in asset I

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2006: 17.62%

$$HPR_{avg} = \left[\prod_{T=1}^{n}(1+HPR_T)\right]^{1/n} - 1$$

$$HPR_{avg} = (0.7844 \cdot 1.4463 \cdot 1.2335 \cdot 1.2098 \cdot 1.0311 \cdot 1.3446 \cdot 1.1762)^{1/7} - 1 = 15.61\%$$

GAR = 15.61%

Example. Suppose you have $1000 invested in a stock portfolio in September. You have $200 invested in Share A, $300 in Share B and $500 in Share C. The HPR for the month of September for Share A was 2%, for Share B 4% and for Share C -5%

The average HPR for the month of September for this portfolio is:

$$HPR_{avg} = \sum_{I=1}^{J} HPR_I \cdot \frac{V_I}{TV}$$

$$HPR_{avg} = (.02 \cdot (200/1000)) + (.04 \cdot (300/1000)) + (-.05 \cdot (500/1000)) = -0.9\%$$

Risk and Risk Premium (recommendations)

- Measuring mean - scenario or subjective returns
- Subjective expected **returns** & Subjective expected **variance**

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

E(r) = expected return
p(s) = probability of a state
r(s) = return if a state occurs (1 to s states)

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

E(r) = expected return
p(s) = probability of a state
r(s) = return if a state occurs (1 to s states)
$\sigma = [\sigma^2]^{1/2}$

Example.

State	Prob. of state	Return
1	.2	–.05
2	.5	.05
3	.3	.15

E(r) = (.2)(–0.05) + (.5)(0.05) + (.3)(0.15) = 6%

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

$\sigma^2 = [(.2)(-0.05 - 0.06)^2 + (.5)(0.05 - 0.06)^2 + (.3)(0.15 - 0.06)^2]$

$\sigma^2 = 0.0049\%^2$

$\sigma = [0.0049]^{1/2} = .07$ or 7%

Ex-post expected return and σ

$$\bar{r} = \sum_{T=1}^{n} \frac{HPR_T}{n}$$

$\bar{r}$ = average HPR
n = # observations

$$\text{Ex-post variance: } \sigma^2 = \frac{1}{n-1}\sum_{i=1}^{n}(r_i - \bar{r})^2$$

$$\text{Ex-post standard deviation: } \sigma = \sqrt{\sigma^2}$$

Annualising the statistics

$$\bar{r}_{annual} = \bar{r}_{period} \times \#\text{periods}$$

$$\sigma_{annual} = \sigma_{period} \times \sqrt{\#\text{periods}}$$

Using ex-post returns to estimate HPR

(Estimating expected HPR (E[r]) from ex-post data

Use the arithmetic average of past returns as a forecast of expected future returns as we did, and perhaps apply some (usually ad-hoc) adjustment to past returns

Problems??

- Which historical time period?
- Have to adjust for current economic situation
- Unstable averages
- Time-varying risk

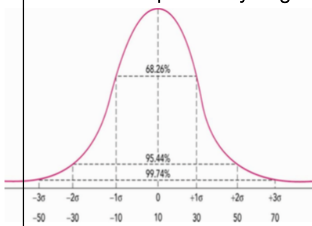
Characteristics of a probability distribution

1. Mean - Arithmetic average & usually most likely
2. Median - Middle observation
3. Variance or standard dev - Dispersion of returns about the mean
4. Skewness - Long tailed distribution, either side
5. Leptokurtosis - Too many observations in the tails

- If a distribution is approximately normal, the distribution is fully described by Characteristics 1 and 3

Normal Distribution

Risk is the possibility of getting returns different from expected.



- σ measures deviations above the mean as well as below the mean
- Returns > E[r] may not be considered as risk, but with symmetric distribution it is okay to use σ to measure risk
- That is, ranking securities by σ will give same results as ranking by asymmetric measures such as lower partial standard deviation

E[r] = 10%

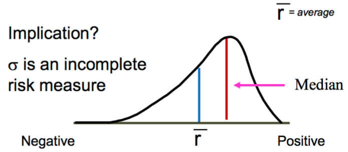
σ = 20%

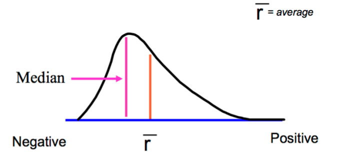
Average = Median

Skewed Distribution -

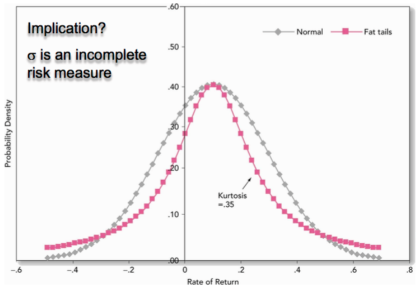
large negative returns possible (left skewed)

large positive returns possible (right skewed)





Leptokurtosis



Value at Risk (VaR)

Value at risk attempts to answer the following question:

- How many dollars can I expect to lose on my portfolio in a given time period at a given level of probability?
- The typical probability used is 5%
- We need to know what HPR corresponds to a 5% probability
- If returns are normally distributed then we can use a standard normal table or Excel to determine how many standard deviations below the mean represents a 5% prob:
  - From Excel: =NORMINV(0.05,0,1) = -1.64485 standard deviations
  - =NORMINV(%,mean,variance SD) shows a standard normal dist
  - market doesn't follow a normal diet hence why we lose money all the time

From the standard deviation we can find the corresponding level of the portfolio return:

VaR = E[r] + -1.64485σ

Example. A $500,000 stock portfolio has an annual expected return of 12% and a standard deviation of 35%.

- What is the portfolio VaR at a 5% probability level?
  - VaR = 0.12 + (-1.64485 x 0.35)
  - VaR = -45.57% (rounded slightly)
  - VaR$ = $500,000 x -0.4557 = - $227,850
- What does this number mean?
  - The greatest annual expected loss 95% of the time is $227,850

- **Expected utility** from a risky asset

$$\text{Expected Utility} = p_1 . U(W_1) + \ldots + p_s U(W_s) = \sum_{s=1}^{s} p_s U(W_s)$$

where: **s** is a state of the world, $\mathbf{p_s}$ is the probability of state **s** occurring, and $U(\mathbf{W_s})$ is the utility of total wealth in state **s**.

- **An example of utility function:** Quadratic form

$$U = E(r_P) - 0.5 \times A \times \sigma_p^2$$

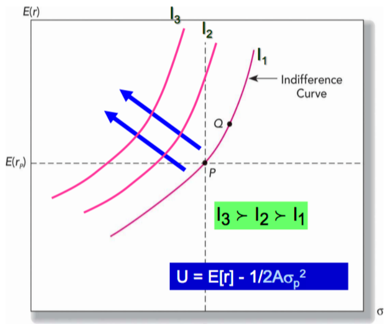
where:
U is the utility level (benefit, profitability level)
$\mathbf{E(r_p)}$ is the expected return on portfolio **p**
A is an index of the investor's risk aversion (larger values of A penalise risky investments more severely)
0.5 is a scaling convention that enables the expected return and standard deviation to be expressed as a percentage rather than a decimal
$\mathbf{\sigma_p^2}$ is the variance - larger variance (higher risk) lowers the utility. Higher E(**r**) increases utility

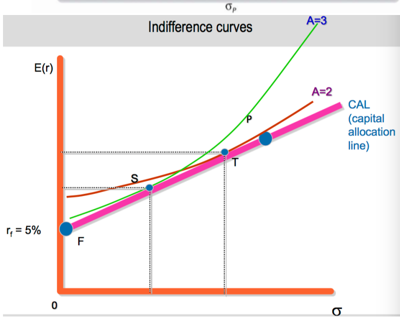
"A" and Indifference Curve

- The A term can be used to create indifference curves
- Indifference curves describe different combinations of return and risk that provide equal utility (U) or satisfaction
- Indifference curves are curvilinear because they exhibit diminishing marginal utility of wealth
  - The greater the A the steeper the indifference curve and, all else equal, such investors will invest less in risky assets
  - The smaller the A the flatter the indifference curve and, all else equal, such investors will invest more in risky assets

Indifference curves

- Investors want the most return for the least risk
- Hence indifference curves higher and to the left preferred





Passive Strategies and the Capital Market Line

- Investing in a broad stock index and a risk-free investment is an example of a passive strategy
  - The investor makes no attempt to actively find undervalued stocks nor to actively switch their asset allocations
  - The **CAL** that employs the market (or an index that mimics overall market performance) is called the capital market line or **CML**

	Excess return or risk premium		
Period	Average	σ	Sharpe ratio
1926–2008	7.86	20.88	0.37
1926–1955	11.67	25.40	0.46
1956–1984	5.01	17.58	0.28
1985–2008	5.95	18.23	0.33

Active (more risk) vs. Passive (less risk) Strategies

- Active strategies entail more trading costs than passive strategies
- Passive investor 'free-rides' in a competitive investment environment
- Passive involves investment in two passive portfolios
  - short-term Treasury notes
  - fund of ordinary shares that mimics a broad market index like the All Ordinaries
  - Varying combinations according to investor's risk aversion

2. Asset allocation with two or more risky assets

- Two-security portfolio return

$$E(\bar{r}_p) = W_1\bar{r}_1 + W_2\bar{r}_2$$

Example W1 = 0.6 $\bar{r}_1$ = 9.28%
W2 = 0.4 $\bar{r}_2$ = 11.97%
$E(r_p)$ = 0.6(9.28%) + 0.4(11.97%) = 10.36%

W_1 = Proportion of funds in security 1
W_2 = Proportion of funds in security 2
$\bar{r}_1$ = Expected return on security 1
$\bar{r}_2$ = Expected return on security 2

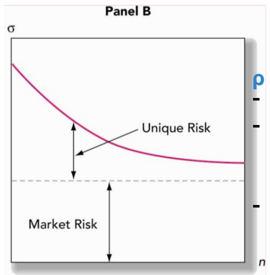
- Portfolio return - general case

$$E(\bar{r}_p) = \sum_{i=1}^{n} W_i\bar{r}_i; \quad n = \#\text{ securities in the portfolio} \quad \sum_{i=1}^{n} \mathbf{W_i = 1}$$

Combinations of risky assets

When we put shares in a portfolio, $\sigma_p < \Sigma(W_i\sigma_i)$
Why? 'Averaging principle'
When share 1 has a return < $E(r_1)$ it is likely that share 2 has a return > $E(r_1)$ so that r_p that contains shares 1 and 2 remains close to $E(r_p)$
What statistics measure the tendency for r_1 to be above expected when r_2 is below expected?
Covariance & correlation

- Asset pricing models - you need to price assets on market risk but in practice it is impossible to measure market risk.
- Invest in more than 1 shares to eliminate this unique risk



n = # securities in the portfolio

Portfolio Variance and Standard Deviation

$\mathbf{W_I, W_J}$ = Percentage of the total portfolio invested in stock I and J respectively
Q = The total number of stocks in the portfolio
$\mathbf{Cov(r_I,r_J)}$ = Covariance of the returns of stock I and stock J
If **I = J** then $\mathbf{Cov(r_I,r_J) = \sigma_I^2}$ & $\mathbf{Cov(r_I,r_J) = Cov(r_J,r_I)}$

$$\sigma_p^2 = \sum_{I=1}^{Q}\sum_{J=1}^{Q}[W_I\, W_J\, Cov(r_I, r_J)]$$

Variance of a two-stock portfolio:

$$\sigma_p^2 = W_1^2\sigma_1^2 + 2W_1W_2Cov(r_1, r_2) + W_2^2\sigma_2^2$$

Ex-post Covariance Calculations

$$Cov(r_1, r_2) = \frac{n}{n-1}\sum_{T=1}^{N}\frac{(r_{1,T} - \bar{r}_1)\times(r_{2,T} - \bar{r}_2)}{n}$$

$\bar{r}_1$ = average or expected return for stock 1
$\bar{r}_2$ = average or expected return for stock 2
n = # of observations

when $r_1 > E[r_1]$, $r_2 > E[r_2]$, and when $r_1 < E[r_1]$, $r_2 < E[r_2]$, COV will be positive.

when $r_1 > E[r_1]$, $r_2 < E[r_2]$, and when $r_1 < E[r_1]$, $r_2 > E[r_2]$, COV will be negative.

Ex-ante covariance measure: Using scenario analysis with probabilities the covariance can be calculated with the following formula:

$$Cov(r_S, r_B) = \sum_{i=1}^{S} p(i)\left[r_S(i) - \bar{r}_S\right]\left[r_B(i) - \bar{r}_B\right]$$

Covariance and Correlation

- The problem with covariance:
  - Covariance does not tell us the intensity of the co-movement of the share returns, only the direction - how likely it will move with the market
  - We can standardise the covariance however and calculate the correlation coefficient which will tell us not only the direction but provides a scale to estimate the degree to which the shares move together
  - You want shares with a **negative covariance** because you eliminate and reduce your unique risk. Do you want to diversify?
  - I.e. eliminate this risk or not?
  - You want to find shares that have negative covariance when they move in opposite directions the reason is in that way you will eliminate this unique risk
  - The theory says if you spread your investment over a lot of shares you will reduce the unique risk and what's remaining is the market risk in practice if you know a share or a firm really well and sure that you can price that firm accurately you wouldn't need to diversify, Diversify = Reduce unique risk
- Standardised covariance is called the correlation coefficient or ρ

$$\rho_{(1,2)} = \frac{Cov(r_1, r_2)}{\sigma_1 \times \sigma_2} \quad \text{for share 1 and share 2}$$

ρ and Diversification in a Two-Share Portfolio

- ρ is always in the range -1 to +1 inclusive
- What does ρ(1,2) = +1.0 imply?
  The two are perfectly positively correlated. Means?
  If ρ(1,2) = +1, then $\sigma(1,2) = W_1\sigma_1 + W_2\sigma_2$
- What does p(1,2) = -1.0 imply?
  The two are perfectly negatively correlated. Means?
  If ρ(1,2) = -1, then $\sigma(1,2) = \pm(W_1\sigma_1 - W_2\sigma_2)$
- It is possible to choose W_1 and W_2 such that σ(1,2) = 0

- What does -1 < **ρ**(1,2) < 1 imply?
  - There are some diversification benefits for combining shares 1 and 2 into a portfolio. $\mathbf{\sigma_p^2} = W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2Cov(r_1,r_2)$
    since $\mathbf{Cov(r_1,r_2)} = \rho_{(1,2)}\sigma_1\sigma_2$
    $\mathbf{\sigma_p^2} = W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\,\rho_{(1,2)}\sigma_1\sigma_2$
- The lower the correlation, the lower the portfolio risk
- The gain from diversification depends on correlation
- Note $W_B = 1 - W_A$; can use this to solve for min var. weights when = –1.

- Typically ρ is greater than 0 and less than 1 (lower correlation = lower risk)
- $\mathbf{\rho_{(1,2)}} = \mathbf{\rho_{(2,1)}}$ and the same is true for the COV
- The covariance between any share such as share 1 and itself is simply the variance of share 1, $\mathbf{\rho_{(1,1)}}$ = +1.0 by definition
- We have no measure for how three or more shares move together

Summary: Portfolio Risk & Return

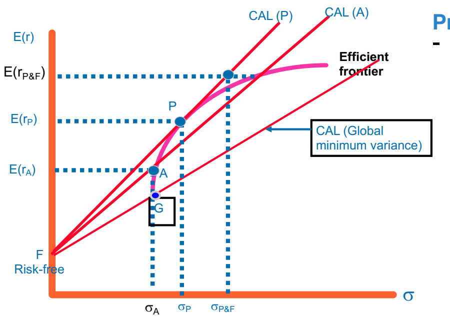
- Amount of risk reduction depends critically on correlations or covariances
- Adding securities with correlations < 1 will result in risk reduction
- Consider all possible combinations of securities, with all possible different weightings and keep track of combinations that provide more return for less risk or the least risk for a given level of return and graph the result
- The set of portfolios that provide the optimal trade-offs are described as the efficient frontier.
- The efficient frontier portfolios are dominant or the best diversified possible combinations
  - All investors should want a portfolio on the efficient frontier… Until we add the riskless asset

Including Riskless Investment

- The optimal combination becomes linear
- A single combination of risky and riskless assets will dominate

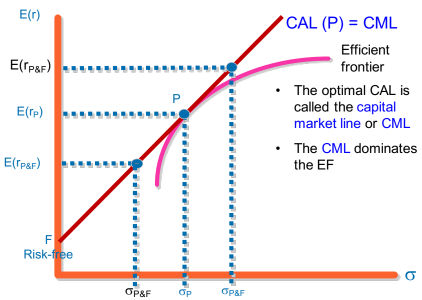
Alternative CALs

- There will only be one optimal capital allocation line. This line will be the line that passes through the risk free rate at 0 SD and is tangent to the efficient frontier. It will dominate all other capital allocation lines.



Capital Market Line or CML

- There will only be one optimal capital allocation line. This line will be the line that passes through the risk-free rate at 0 SD and is tangent to the efficient frontier. It will dominate all other capital allocation lines.



Dominant CAL with a Risk-Free investment (F)

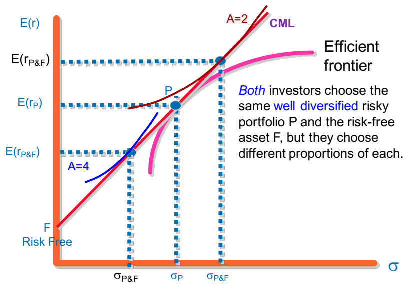
- CAL(P) = capital market line or CML dominates other lines because it has the largest slope
- Slope = $(E(r_p) - rf) / \sigma_p$
- Regardless of risk preferences some combinations of P & F dominate
- The tangency portfolio is referred to as Market Portfolio (*M*)
- The return to the combination of rf and any portfolio *P* on the efficient frontier (i.e. CML) takes the following form

$$E(R_p) = R_f + \left(\frac{E(R_m) - R_f}{\sigma_m}\right)\sigma_p$$

- So now it will just be back to the question of how much of your money you want in the risky portfolio and how much you want in the risk-free asset. Where the slope of the capital allocation line is the risk premium divided by the SD of the risky portfolio at the tangent point. The CAL at the tangent point P has the best returns for all levels of risk.
- (CML maximises the slope or the return per unit of risk or it equivalently maximises the Sharpe ratio)

Capital Market Line or CML

- There will only be one optimal capital allocation line. This line will be the line that passes through the risk-free rate at 0 SD and is tangential to the efficient frontier. It will dominate all other capital allocation lines.



Practical Implications

- The analyst or planner should identify what they believe will be the best performing well diversified portfolio, call it P.
  - P may include funds, stocks, bonds, international and other alternative investments.
  - This portfolio will serve as the starting point for all their clients.
  - The planner will then change the asset allocation between the risky portfolio and 'near cash' investments according to risk tolerance of client
  - The risky portfolio P may have to be adjusted for individual clients for tax and liquidity concerns if relevant and for the client's opinions.

MCQ1 If an investor does not diversify their portfolio and instead puts all of their money in one share, the appropriate measure o security risk for that investor is the: **Share's standard deviation**

MCQ2 Based on the outcomes in the table below choose which of the statements is/are correct

Scenario	Security A	Security B	Security C
Recession	Return > E[r]	Return = E[r]	Return < E[r]
Normal	Return = E[r]	Return = E[r]	Return = E[r]
Boom	Return < E[r]	Return = E[r]	Return > E[r]

I. The covariance of Security A and Security B is zero
II. The correlation coefficient between Security A and C is negative
III. The correlation coefficient between Security B and C is positive

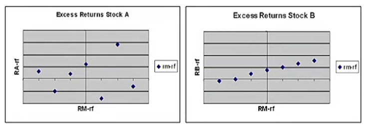
I and II are correct. As for III Sec B correlation never moves.

MCQ3 Which risk can be diversified away as additional securities are added to a portfolio.

I. Total risk
II. Systematic risk
III. Firm-specific risk

I and III

MCQ4 Which share is likely to further reduce risk for an investor currently holding his portfolio in a well-diversified portfolio of common share? Share A - chance of negative correlation with current portfolio



MCQ5

You put half of your money in a share portfolio that has an expected return of 14% and a standard deviation of 24%. You put the rest of you money in a risky bond portfolio that has an expected return of 6% and a standard deviation of 12%. The share and bond portfolio have a correlation 0.55. The standard deviation of the resulting portfolio will be ________.

A. More than 18% but less than 24%
B. Equal to 18%
C. More than 12% but less than 18%
D. Equal to 12%

Ans: C
Diversification benefits as long as the correlation is less than 1 not just when the correlation is negative

W3 - ASSET PRICING MODELS

Agenda

1. **Capital Asset Pricing Model**
2. **Multi-Factor Models**
3. **Arbitrage Pricing Theory (APT)**

Capital Asset Pricing Model (CAPM)

- Equilibrium model that underlies all modern financial theory
- Derived using principles of diversification, but with other simplifying assumptions
- Markowitz, Sharpe, Lintner and Mossin are researchers credited with its development
- CAPM provides a precise prediction of the relationship we should observe between the risk of an asset and its expected return. This relationship serves two vital functions. First, it provides a benchmark rate of return for evaluating possible investments. Second, the model helps us make an educated guess as to the expected return on assets that have not yet been traded in the marketplace

The Assumption of the CAPM - how consumers behave

- Think of a world where individuals are all very similar except for their initial wealth and their level of risk aversion
- Individual investors are price makers - that individuals do not affect prices. (Big assumption! An individual's behaviour does not affect price)
- Single-period investment horizon
- Investments are limited to traded financial assets
- No taxes and no transaction costs
- Information is costless and available to all investors
- Investors are rational mean-variance optimisers - all investors attempt to construct efficient frontier portfolios as discussed in **Chapter 7**.
- Homogeneous expectations - means that if two investors examine the same investment opportunity they will have identical beliefs about the expected returns, variance of returns and correlations with other investments

Resulting Equilibrium Conditions

- All investors will hold the same portfolio for risky assets; the 'market portfolio'
- Market portfolio contains all securities and the proportion of each security is its market value as a percentage of total market value
- The risk premium on the market portfolio will be proportional to the variance of the market portfolio and investors' typical degree of risk aversion.
- The risk premium on individual assets will be proportional to the risk premium on the market portfolio and to the *beta coefficient* of the security on the market portfolio
  - the rate of return on the market portfolio is the single systematic risk factor of the security market
  - the beta measures the extent to which returns on the share respond to the returns of the market portfolio

A. Free Cash Flow to Firm (cont.)

Valuation

- Discount year to year cash flows plus some estimate of the terminal value P_T:

$$\text{Firm value} = \left[\sum_{t=1}^{T} \frac{FCFF_t}{(1+WACC)^t}\right] + \frac{P_T}{(1+WACC)^T}$$

WACC = Weighted Average Cost of Capital
g = estimate of long run growth in free cash glow
T = time period when the firm approaches constant growth

$$P_T = \frac{FCFF_{T+1}}{WACC - g}$$

Equity value = Firm value - Market value of debt

B. Free Cash Flow to Equity Holders

(harder to manipulate 'cash' and potentially a more accurate model)

Approach

- Discount the free cash flow to the equity holders (FCFE) at the cost of equity capital (k_e) to get the **value of equity**
  FCFE = FCFF - interest expense x (1- tax rate) + increase in net debt
- Reconciling with the FCFE forecast in lecture 6:
  FCFE = net income - Δ net WC - Δ net LT assets + Δ net debt
  - Similar to FCFF reconciliation, FCFE forecast does not add depreciation back to net income
  - Analysts can forecast annual depreciation by constructing the fixed asset schedule

Valuation

- Discount year to year cash flows plus some estimate of the terminal value P_T where:

$$P_T = \frac{FCFE_{T+1}}{k_E - g}$$

k_e = cost of equity capital
g = estimate of long run growth in free cash flow
T = time period when the firm approaches constant growth

$$\text{Equity value} = \left[\sum_{t=1}^{T} \frac{FCFE_t}{(1+k_E)^t}\right] + \frac{P_T}{(1+k_E)^T}$$

4. Residual Income Model

Also known as 'Discounted Abnormal Earnings' method

- Abnormal earnings are those that differ from the expected return:

$$NI_t - k_e * BVE_0$$

where NI_t is net income in year t, BVE_0 is the current Book Value of Equity, and k_e is the cost of equity capital

- The dividend discount method can be modified to yield:
  Equity value = BVE_0 + PV expected future abnormal earnings

If Equity Value (market value) is less than BVE then it is very mis-priced (so BUY!), PV future abnormal earnings is -ve, or it's a very bad firm…

- if the firm doesn't know how to invest, EV is negative

$$Equity\ value = BVE_0 + \frac{NI_1 - k_e \times BVE_0}{(1+k_e)} + \frac{NI_2 - k_e \times BVE_1}{(1+k_e)^2} + \frac{NI_3 - k_e \times BVE_2}{(1+k_e)^3} + \cdots$$

Compared with other DCF models (DDM, FCFE, FCFF):

- Forecasting of future dividends and cash flows is often difficult; and
- Terminal value is not as important in RIM as in other DCF models

When to use RIM?

- Firms not paying dividends or having unpredictable dividend patterns
- Firms having negative cash flows for many years but expecting positive cash flows for some points in the future
- A great deal of uncertainty in forecasting terminal value

Drawbacks of RIM:

- The impact of different accounting methods on value estimates:
  - Valuations are based on earnings and book values
  - Accounting choices affect earnings and book values
  - Double-entry bookkeeping is by nature self-correcting
- Potential impact of earnings manipulation
- Strategic and accounting analyses are important steps to precede abnormal earnings valuation

5. Valuation using Price Multiples - assignment

P/E ratio

- P/E is a function of:
  - Required rates of return (k) (inverse relationship)
  - Expected growth in dividends (direct relationship)
- P/E is heavily used by analysts and investors
- Using firm's own b, k_e and g to calculate P/E for valuation is conceptually equivalent to the **constant growth** DDM

$$P_0 = \frac{D_1}{k-g} \quad \text{with } D_1 = E_1 \text{ (1-b)}$$

P/E using firm's own k_e, b and g:

- With positive growth, **g = ROE x b**,

$$\frac{P_0}{E_1} = \frac{(1-b)}{k-g}$$

- With zero growth, **b = g = 0**

$$\frac{P_0}{E_1} = \frac{1}{k}$$

- Riskier firms ➔ higher k ➔ lower P/E (could be cheap, but risky!)

P/E using firm's own k_e, b and g:

- Example. Non-zero growth
  - b = 60%, ROE = 15%, k = 12.5%, (1-b) = 40%, E_0 = \$2.50
    Find P/E and V_0

g = ROE x b = 15% x 60% = 9%
E_1 = \$2.50 (1.09) = \$2.725
P/E = (1 - 0.60) / (0.125 - 0.09) = 11.4
V_0 = P/E x E_1 = 11.4 x \$2.73 = \$31.14

Note: Assumption k=12% per year
Plowback Ratio (b): is the percentage of profits kept in the firm.
I.e. .25 is 25% of profits kept within the firm

If your ROE is 10% (which is less than k) then potentially your P/E ratio will be going down as people require you to pay them 12% but you're only earning 10% so the more money kept in the firm will make the P/E drop and hence should payout

	Plowback Ratio (b)			
	0	.25	.50	.75
	A. Growth rate, g			
ROE				
10%	0%	2.5%	5.0%	7.5%
12	0	3.0	6.0	9.0
14	0	3.5	7.0	10.5
	B. P/E ratio			
ROE				
10%	8.33	7.89	7.14	5.56
12	8.33	8.33	8.33	8.33
14	8.33	8.82	10.00	16.67

Whereas if your ROE is higher at 14% than k then it would be more beneficial to keep money in the firm than payout to shareholders in order to grow the firm

However, P/E ratio is dependent on 'earnings' and with a high reliance on earnings there can be earnings manipulation in management

- Earnings management is a serious problem
- A high P/E implies high expected growth, but not necessarily high stock returns
- If expected growth in earnings fails to materialise (in share price), the P/E will fall and investors may incur large losses

P/E using Target 'Forward P/E' ratio: (what many analysts use)

- Select peer firms, using historical data to calculate their target forward P/E = (stock price in $year_t$)/ (Earnings in $year_{t+1}$)
  - It may be difficult to identify direct peers
  - Industry averages may be used instead
- The average of these forward P/Es is the target forward P/E for our firm
- Multiply this target forward P/E ratio with the one-year-ahead earnings forecast of the firm being analysed to obtain equity value

P/E using Target 'Trailing P/E' ratio:

- Select peer firms, calculate their target trailing P/E = (current stock price) / (most recently available earnings)
  - It may be difficult to identify direct peers
  - Industry averages may be used instead
- The average of these trailing P/Es is the target trailing P/E for our firm
- Multiply this target trailing P/E ratio with the most recently available earnings of the firm being analysed to obtain equity value

P/B ratio (Price-to-Book value of equity):

- P/B can be analysed using the abnormal earnings valuation approach:

$$Equity\ value = BVE_0 + \frac{NI_1 - k_e \times BVE_0}{(1+k_e)} + \frac{NI_2 - k_e \times BVE_1}{(1+k_e)^2} + \frac{NI_3 - k_e \times BVE_2}{(1+k_e)^3} + \cdots$$

Divide both sides by book value of equity BVE_0:

$$\frac{P}{B} = 1 + \frac{ROE_1 - k_e}{(1+k_e)} + \frac{(ROE_2 - k_e)(1 + gbve_1)}{(1+k_e)^2} + \cdots$$

➔ P/B depends on:
  - The magnitude of future abnormal ROE
  - Growth in book value (*gbve*)

When growth in book value = constant,

$$\frac{P}{B} = 1 + \frac{ROE - r}{r - g}$$

- P/B can be calculated using firm's own forecast ROE, k_e, growth in book value of equity to generate the valuation equal to the **constant growth** dividend discount model (similar to P/E)
- A practical approach is to calculate target P/B and multiply with he book value of the firms being analysed (similar to the approach with P/E before)