

# Portfolio theory

## CAPM

1. The Capital Market Line (CML) relates the excess expected return on an efficient portfolio to its risk.

$$\mu_R = \mu_f + \frac{\mu_M - \mu_f}{\sigma_M} \sigma_R$$

- The slope of the CML can be interpreted as the ratio of the risk premium to the standard deviation of the market portfolio - Sharpe's reward to risk ratio
  - The reward-to-risk ratio for any efficient portfolio equals that ratio for the market portfolio.
  - The CAPM says that the optimal way to invest is to
    1. decide on the risk  $\sigma_R$  that you can tolerate,  $0 \leq \sigma_R \leq \sigma_M$
    2. calculate  $\omega = \sigma_R / \sigma_M$
    3. invest  $\omega$  proportion of your investment in an index fund, that is, a fund that tracks that market as a whole.
    4. invest  $1 - \omega$  proportion of your investment in risk-free Treasury bills, or a money-market fund.
2. The security market line(SML) relates the excess return on an asset to the slope of its regression on the market portfolio. The SML differs from the CML in that the SML applies to all assets while the CML applies only to efficient portfolios.
    - It follows from the theory of best linear prediction that  $\beta_j = \frac{\sigma_{jM}}{\sigma_M^2}$  is the slope of the best linear predictor of the jth security's returns using returns of the market portfolio as the predictor variable. This fact follows from equation for the slope of a best linear predictor of the jth security's returns using returns of the market portfolio as the predictor variable. This fact follows from equation for the slope of a best linear prediction equation.
    - Using CAPM, it can be shown that  $\mu_j - \mu_f = \beta_j(\mu_M - \mu_f)$ . In this equation  $\beta_j$  is a variable in the linear equation, not the slope; more precisely,  $\mu_j$  is a linear function of  $\beta_j$  with slope  $\mu_M - \mu_f$ . This point is worth remembering. Otherwise, there could be some confusion since  $\beta_j$  was defined earlier as a slope of a regression model. In other words,  $\beta_j$  is a slope in one context but is the independent variable in the SML. The  $\beta_j$  is a measure of how "aggressive" the jth asset is.
  3. Using the CAPM in Portfolio Analysis
    - There is a serious danger here: These estimates depend heavily on the validity of the CAPM assumptions. Any or all of the quantities beta,  $\sigma_\epsilon^2$ ,  $\sigma_M^2$ ,  $\mu_M$ , and  $\mu_f$  could depend on time t. However, it is generally assumed that the betas and  $\sigma_\epsilon^2$  of the assets as well as  $\sigma_M^2$  and  $\mu_M$  of the market are independent of t so that these parameters can be estimated assuming stationarity of the time series of returns.

## Factor Models and Principal Components

## Investments

1. Investment philosophy is a way of thinking about the markets and investor behavior.
  - view about how people learn
  - view about the behavior of markets. Its efficiencies and inefficiencies
  - build investment strategy, reflecting your beliefs
2. Investment strategy is a way of putting into practice an investment philosophy

3. Investors have the following important characteristics:
  - risk preferences
    - risk aversion vary across investors at any point of time
    - more risk implies higher expected return
  - time horizon
  - tax status
4. Asset Allocation determines proportion of equities, fixed-income and real assets in the portfolio
  - Passive asset allocation - based on the mean-variance framework
    - proportions determined by risk preference with statistical techniques
    - This approach is as good as its underlying assumptions. For example, if correlations between asset classes are unstable Markowitz portfolio approach is useless.
  - Active asset allocation (Market Timing) - determined by the view on the market. Allocate more than you normally would to assets/markets that are undervalued
    - Approaches
    - non-financial indicators:
      - \* feel good indicators. Usually are not leading indicators.
      - \* Hype indicators: measure stock price bubble.
    - technical indicators: price volume volatility
    - reversion to the mean: every asset has a normal range of value and revert to normal
    - fundamentals: intrinsic value for the market. It is shown that markets are correlated with fundamentals, however, it is hard to find leading indicators.
      - \* DCF
      - \* relative analysis
5. Security selection
  - based on fundamentals, technical analysis and ahead of information releases
  - Fundamental investors can be:
    - value investors ( buy low PE low PBV stocks - trade at less than the value of assets in place)
    - intrinsic value investors: do DCFs
    - relative value investors: use multiples and fundamentals to identify undervalued stocks
    - contrarian investors: invest in stocks others have given up
    - activists: invest in poorly managed stocks and try to influence them
    - growth investors ( buy high PE and high PBV stocks, expecting higher future growth)
  - Technical investors:
    - momentum
    - reversal

## Risk Parity

1. Risk Parity model is used to construct portfolios with equal contribution of each asset to the total risk. Usually have lower vol and higher SR.
  - Portfolios outperform equal-weighted asset allocation portfolios. The strategy's superior risk-adjusted returns are largely a function of its lower volatility and downside protection rather than superior returns.
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## References:

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3. On the properties of equally-weighted risk contributions portfolios <http://www.thierry-roncalli.com/download/erc.pdf>