- Portfolio management: An Overview
- Risk management: An introduction

Portfolio management: An Overview

Portfolio perspective

- Evaluate individual investment by their contribution to the risk and return of portfolio
- Modern portfolio theory
  - Extra risk from holding only a single security is **not rewarded** with higher expected investment returns
  - Diversification -> reduce risk without reducing expected return
- Harry Markowitz
  - Use **standard deviation** to measure risk
  - Unless returns are perfectly positively correlated, risk is reduced by diversifying across assets
- Modern portfolio theory (MPT)
  - Equilibrium expected return for portfolio as a linear function of **market** risk
- Diversification ratio
  - Risk of equally **weighted** portfolio of n securities to a single security selected at **random (assume perfectly correlated)**
  - **Expected return: they are the same**
  - **Assume**
    - Equal weighted $\frac{1}{\mathrm{n}}$ with standard variation σ and pairwise correlation ρ
  - Correlation matrix
    - $\begin{bmatrix} 1 & \rho & \rho \\ \rho & 1 & \rho \\ \rho & \rho & 1 \end{bmatrix}$
  - Covariance Matrix
    - $\Sigma = \sigma^2 \times \begin{bmatrix} 1 & \rho & \rho \\ \rho & 1 & \rho \\ \rho & \rho & 1 \end{bmatrix}$
  - Weight vector
    - $\vec{w} = \left[\frac{1}{\mathrm{n}}, \frac{1}{\mathrm{n}}, \cdots, \frac{1}{\mathrm{n}}\right]$
  - Portfolio variance
    - $\sigma_{\mathrm{p}}^2 = \vec{w} \times \Sigma \times \vec{w} = \frac{1}{\mathrm{n}^2} \times (n\sigma^2 + n \times (n-1) \times cov) = \frac{\sigma^2}{n} + \frac{n-1}{n} cov$
  - **Portfolio variance**
    - $\sigma_{\mathrm{p}}^2 = \frac{1}{\mathrm{n}^2} \times (n + n \times (n-1) \times \rho) \times \sigma^2$
    - $\sigma_p = \sigma \sqrt{\frac{1}{n} + \left(1 - \frac{1}{n}\right) \times \rho}$
  - Randomly selected variance
    - $\sigma_{\mathrm{r}}^2 = \frac{1}{n^2} \times n \times \sigma^2$
    - $\sigma_r = \sigma \times \sqrt{\frac{1}{n}}$
  - Diversion ratio

        - $ratio = \frac{\sigma_p}{\sigma_r} = \sqrt{1 + (n-1) \times \rho}$
    - Works best for market operating normally

Investors

- Individuals
    - Pension plan, defined contribution pension plan
- Institutions
    - Endowment
        - Dedicated to providing financial support on an ongoing basis for a specific purpose, university
    - Foundation
        - **Charitable** purpose to support specific activities to found **research** related to a particular disease
    - **Features**
        - Long horizon, high risk tolerance, little liquidity
        - Planned spending needs
- Bank
    - Low risk, high liquidity
- Insurance
    - Life: long-term
    - P&C: shorter horizon
    - **High liquidity**
- Investment companies
    - Mutual funds
        - Pooled, particular style, subcategories, regions
        - **High** liquidity
- Sovereign wealth funds
    - Owned by a government

Figure 1: Characteristics of Different Types of Investors

Investor	*Risk Tolerance*	*Investment Horizon*	*Liquidity Needs*	*Income Needs*
Individuals	Depends on individual	Depends on individual	Depends on individual	Depends on individual
Banks	Low	Short	High	Pay interest
Endowments	High	Long	Low	Spending level
Insurance	Low	Long—life Short—P&C	High	Low
Mutual funds	Depends on fund	Depends on fund	High	Depends on fund
Defined benefit pensions	High	Long	Low	Depends on age

Pension plan

- Defined contribution

    - Employer: make fixed contribution
    - Employee: a separate account
    - Investment risk: employee
- Define benefit
    - Employer: make periodic payment after retirement
    - Employee: share one common account
    - Investment risk: employer

Investment Process

- Planning
    - **Analysis**
        - Risk tolerance, return objective, time horizon, tax purpose, liquidity, income, preference
    - **Investment policy statement (IPS)**
        - Objective and constraints
        - Update at least every few years and any time significantly change
- Execution
    - Analyse risk & return of assets and allocate budget
    - **Asset Allocation** - Top-down analysis
        - Current economic conditions and forecasts macroeconomic variables (GDP, inflation, interest rate)
        - Diversified across asset classes: cash, bond, stock, PE, hedge fund, real estate
    - **Security Selection** – bottom-up
        - Identify most attractive securities within asset class
        - Use model valuation to identify undervalued
- Feedback
    - Monitor change
    - Rebalance portfolio
    - Measure performance

Mutual funds

- Net asset value (NAV)
    - $\text{NAV} = \frac{\text{asset}-\text{liability}}{\text{shares}}$
- Open-end
    - Buy and redeem at NAV with the firm
    - Management Fee: percentage of NAV
    - Up-front fee
        - Fee charged for purchasing shares
    - Redemption fees
        - Fee charged for redeeming shares
    - No-load funds: do not charge up-front and redemption fees
    - Load funds: charger either up-front, redemption fees, or both
- Close-end
    - Cannot purchase or redeem shares
    - **Trade** shares like equity

Mutual funds types

- Money market: invest in less than one year
- Bond
    - Fixed-income securities
    - Maturity, issuer, rating, types
- Stock
- Index fund: passively managed
- Actively managed
    - Higher management fee
    - High **turnover**
    - Greater **tax** liabilities

ETF

- Similar to closed-end funds in that purchase and sales are in the market rather than with the fund itself
- Management
    - ETF: **passively** managed
    - Closed-end: actively managed
- Market Price
    - ETF: Market price can **differ** from NAV
- Trade time
    - ETF: sold short, purchased on margin, traded at **intraday** prices
    - Open-end: sold and redemption at the end of a day based on closing NAV
- Commission
    - ETF: pay brokerage commission, receive cash dividend, a spread
    - Open-end: reinvest in additional fund shares
- Capital gain tax liability
    - ETF: fewer capital gains tax lability
    - Open-end: redeem cause it to sell shares, incur capital gains tax liability

Separated managed fund

- A single investor

Hedge fund

- Number of investors limited
- Minimum
    - Between 250k to 1m
- Strategy
    - Long/short fund
    - market-neutral
    - Dedicated Bias
        - Long or short
    - Event-driven
    - Arbitrage
        - Fixed-income arbitrage

        - Convertible bond arbitrage
    - Global macro

Private equity

- Buyout fund
    - Take it private
- Venture capital funds

Risk management: An introduction

Risk management

- Process
  - Identify risk tolerance of a firm
  - Identify and measure risk the firm faces
  - Modify and monitor risks
- Not Goal
  - **Not** minimize or eliminate risks
  - **Not** maximize return but maximize a **utility** function
- **Goal**
  - **Maximize utility while bearing a tolerable level of risk**
  - Manage risk: increase exposure it can take and reduce exposure it avoids
- Control
  - Return are not under control
  - Overall and specific risks are under control

Risk management Framework

- Risk governance
- Risk tolerance
- Risk budgeting
- Risk identification and measurement
- risk manage and mitigation
- risk monitoring
- communication risk across organization
- strategic risk analysis

risk governance

- top-down process
- determine risk **tolerance**, find **strategy**, and **oversight** risk
- organization-wide management
- risk management committee

Risk tolerance

- risk decision to fit the overall goal
  - risk exposure it should take, reduced, avoid, transferred
- risk **within and outside** the firm
- chosen and communicated **before** a crisis

Risk budgeting

- **allocate resources** to assets, select asset by their risk characteristic
- consider risk **trade-offs**
- can be a single metric: beta, value at risk, duration, return variance
- based on categories of investment
- risk factor
  - identify **specific risk factors** that comprise the overall risk of the firm

    - aggregate them

Risk identification

- financial risk
    - credit risk: default or cannot fulfil obligation
    - market risk: market prices of assets
    - liquidity risk: selling without significantly drop in fair value
        - transaction liquidity – spread
        - funding/balance sheet liquidity – rating downgrade
        - endogenous: affect price, elasticity
        - exogenous: constant or variable spread
- non-financial risk
    - operating: human error or faulty process
    - solvency: run out of cash
    - regulatory
    - governmental or political (tax)
    - legal
    - model: asset valuation model
    - tail: extreme events
    - accounting: accounting policies and estimates
- individual
    - mortality risk
        - dead earlier
        - life insurance
    - longevity risk
        - live longer
        - lifetime annuity
    - health
        - health insurance
- interaction of risks

Risk measurement

- standard deviation
    - normal distribution
- beta – market risk
    - market risk, well-diversified portfolio
- duration – interest rate risk
    - debt price to interest rate
- derivative risks
    - Delta – underlying price
    - Gamma – delta to the underlying price (second derivative)
    - Vega – volatility of underlying price
    - Rho – risk-free rate
- Tail/downside risk – extreme risk
    - Value at risk (VaR)
    - Conditional VaR (CVaR) – Expected shortfall
        - Expected value of a loss, given that it exceeds a threshold

        - Similar to LGD
- Subjective and market-based estimates of Risks
    - Stressed testing – one key variable
        - Effects of specific (extreme) change in **a key** variable
    - Scenario analysis – what if multiple changes
        - What-if analysis of expected loss, multiple inputs
    - Difficult to quantify
        - Can use subjective estimate
        - Market prices of insurance, derivative or other **hedging** instruments
        - Unexpected change in tax low -> subjective
    - Operational risk
        - Hard to quantify
        - Sample a large sample of firms and average loss

Risk Exposure Modification

- Risk avoidance
    - Not engage in the activity
- Risk bear
    - **Diversification** offer efficiently bearing of a risk
    - **Self-insurance**: reserve account
- Risk transfer
    - **Insurance**
    - **Surety** bond
        - Insurance pay if a third-party **default**
    - **Fidelity** bond
        - Pay of losses resulting from **employee** theft or misconduct
- Risk shifting
    - Change the **distribution** of outcomes
    - **Derivative**
- Match risk profile with risk tolerance
    - Cost-benefit analysis