Chapter 5
Risk and Return – Part III

Asset Allocation

- How to allocate your fund among the following asset classes?

Investment Funds

- Stock
- Bond
- T-Bills

Risky Assets
Riskfree Asset
Portfolio Weight

- Portfolio weight for an asset is the proportion of that asset in your total investment
- Example: If your portfolio consists of 100 shares of IBM at $90/share and 10 shares of 30-year treasury at $1100/share, what is your portfolio weights in IBM and 30-year bond?

Asset Allocation between One Risky and One Riskfree Asset

- Risky asset: a stock, a long-term bond, or a portfolio of stocks and long-term bonds ($p$)
- Riskfree asset: T-bill as proxy ($f$)
- Risk and expected return of the combined portfolio ($c$) with weight $w$ in risky asset:
  
  Mean: $E[r_c] = (1-w)r_f + wE[r_p] = r_f + w(E[r_p] - r_f)$
  
  Variance: $\sigma_c^2 = w^2\sigma_p^2$
  
  Std Dev: $\sigma_c = |w|\sigma_p$
An Example

- Risk and expected return of two assets
  - Assets: Mean, Std Dev, Weight
  - Risky: $E[r_p] = 15\%$, $\sigma_p = 22\%$, $w$
  - Riskfree: $r_f = 7\%$, $\sigma_f = 0\%$, $1 - w$

- What is the expected return of the combined portfolio if:
  - $w = 0.00$; $w = 0.50$; $w = 1.00$
  - What is the volatility risk you have to bear to achieve an expected return of $9\%$?
  - What is the maximum expected return if you wish to limit your portfolio volatility to $16.5\%$?

Capital Allocation Line

![Capital Allocation Line Graph]

- $E[r_p] = 15\%$
- $r_f = 7\%$
- $\sigma_p = 22\%$
Capital Allocation Line

- Can \( w > 1 \), what does that mean?
  - Find the \( E[r_c] \) and \( SD[r_c] \) with \( w = 2.0 \)
    - Mean: \( E[r_c] = 0.07 + 0.08w = 0.23 = 23\% \)
    - Std Dev: \( \sigma_c = 0.22w = 0.44 = 44\% \)

- Leverage
  - Investing 200\% of wealth in risky asset
  - Using margin borrowing
    - Initial margin and maintenance margin
  - Higher *expected* return than the risky asset
  - Higher volatility accompanies higher expected return

Buying on Margin (Details in CH3)

- Definition of margin:
  - Net Equity / Total Market Value of Stocks
- When the account is first opened, the investor needs to satisfy *initial* margin
- The investor needs to satisfy a *maintenance* margin all the time
  - Will receive a margin call if margin falls below maintenance margin requirement
  - Can sell stocks or contribute additional collateral upon margin call
Capital Allocation Line

- **Sharpe Ratio (reward-to-variability ratio)**

\[
S = \frac{E[r_p] - r_f}{\sigma_p}
\]

Where:
- \(E[r_p]\) is the expected return of the portfolio.
- \(r_f\) is the risk-free rate.
- \(\sigma_p\) is the standard deviation of the portfolio.

\[
\sigma_p = 22\%
\]

Example:
- \(E[r_p] = 15\%\)
- \(r_f = 7\%\)
- \(\sigma_p = 22\%\)

\[
S = \frac{15\% - 7\%}{22\%} = 0.36
\]

Risk Aversion and Asset Allocation

- Greater risk aversion leads to higher allocation to risk-free asset.
- Lower risk aversion leads to greater allocation to risky asset.
- Willingness to accept extremely high risk for higher return may lead to leveraged position.

- Can \(w < 0\), i.e. weight on stocks less than zero percent? How to implement that in practice?
Indifference Curve and Risk Aversion

\[ E[r_p] \]

\[ \sigma_p \]

Indifference curve

CAL

Y

X

Capital Market Line

- **CAL** is called Capital Market Line (CML) if
  - The risky asset is a broad index of common stocks
- **CML** is the investment opportunity set based on a passive strategy
  - based on the belief that securities are fairly priced (market efficiency)
  - Avoids costs in security analysis
Wrap-up

- Definition of risk premium and risk aversion
- Expected return and standard deviation with one risky and one riskfree security
- What is Capital Allocation Line (CAL) and Capital Market Line (CML)?
- What is Sharpe Ratio?
- How does risk aversion affect asset allocation?