Fall 2008, Hitotsubashi University
Monetary Economics 1
(Corporate Finance)

LECTURE 3

Valuation of Risky Investment Project and Capital structure

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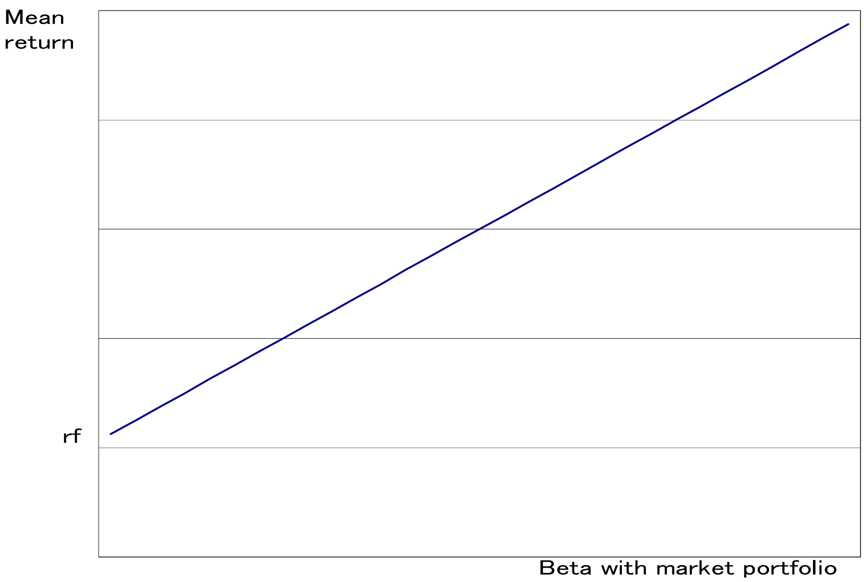
Use CAPM to determine risk-adjusted discount.

- CAPM: A Primer
- $E[r_i] - r_f = \beta_i (E[r_M] - r_f)$
  - r_i: return of asset i; r_f : return of riskless asset
  - r_M : return of market portfolio
  - $\beta_i = Cov(r_i, r_M)/Var(r_M)$
  - Please do read about the derivation of CAPM by yourself.

Interpretation of CAPM

$$E[r_i] - r_f = \beta_i (E[r_M] - r_f)$$

- Relation between expected excess returns of asset i and market portfolio.
- Higher the covariance with market portfolio, higher the expected excess return.
- What is relevant for valuation is covariance risk, not variance.
- If correlation is zero, no matter how large the variance was, $E[r_i] - r_f = 0$.



Implementation of CAPM

- $E[r_i]- r_f = \beta_i (E [r_M] – r_f) + \varepsilon_i$

- Regression of "excess return of asset *i*" on "excess return of market portfolio"
  - No constant term.
  - $Y_i = \beta_i X_M + e_i$

Why is the market portfolio a benchmark?

- By investing to many different assets, one can diversify risks.
- The risks that will disappear by diversification are not be priced, i.e. risk premium is zero.
- Only covariance with most diversified portfolio matters.
- Most diversified portfolio = the market portfolio

A digression: What is risk premium?

- Riskless asset: r_f
- Risky asset: r_i $E[r_i]$, $\mathrm{Var}(r_i)$
- $\mathrm{Var}(r_i) > 0 \rightarrow r_i > r_f$
- The condition that both riskless and risky assets are invested: $U(W \cdot r_f) = E[U(W \cdot r_i)]$
- Let "q" be the premium required for a risky asset over riskless asset return so that the condition above is satisfied: $E[r_i] = r_f + q$

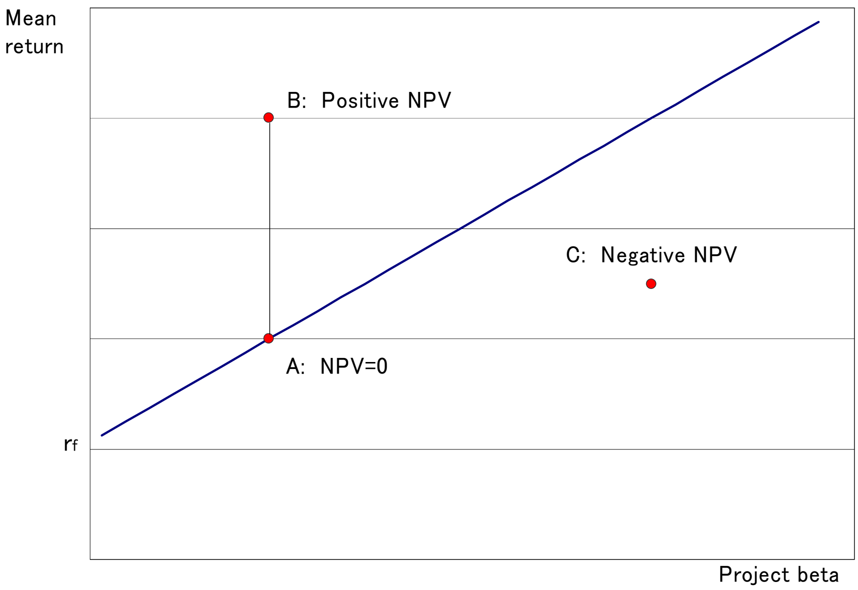
Determination of risk premium by CAPM

- Volatility of security i
  ＝"β_i × market risk " + "idiosyncratic risk"
- $E[r_i]$- r_f ＝ Risk premium of security i
  ＝ β_i × "risk premium of market risk"
  ＝ $\beta_i\ (E\ [r_M] - r_f)$
- The project should be invested if and only if:
  $E[r_{project}] \geq E[r_{comp.}]$
  $= r_f + \beta_{comp.}(E\ [r_M] - r_f)$

Graphical expression

- If the project was located on or at the left-side of SML, the investment project should be accepted.

- Given the estimated project beta, expected return is sufficiently large.



Risk-adjusted discount rate

- Forecast future cash flow： $\mathrm{E}[CF]$
- Estimate the project's beta：β
- Use β to calculate risk premium
- Discount forecasted future cash flow $\mathrm{E}[CF]$ by risk-adjusted discount rate

$$PV = \frac{\mathrm{E}[CF]}{1 + r_f + \beta(R_M - r_f)}$$

Important points

- Tracking portfolio approach is implicit in risk-adjusted discount rate method.
- We assumed full equity finance, i.e. no leverage, in the discussions so far.

The effect of leverage

- In general comparison firms are financed by both equities and debts (leverage).
- In such a case, beta of comparison firm's business is different from the firm's equity beta.

- We still make an important simplifying assumption:
  - Modigliani=Miller's theorem (MM theorem) is satisfied so that the financial structure does not affect the firm's value.

Equity vs debt

- Cost of debt financing＝interest rate payment on debt

- "Firm's value" minus "firm's debt value"
  ＝ Value of firm's equities

- Cost of equity financing: Equity's expected return (interest rate + risk premium)
- Risk premium is required so that equity holders will bear the volatility of stock prices.

Calculating WACC : simple case

- WACC=Weighted average cost of capital
- "Cost of equity financing" x "the amount financed by equities"
- "Cost of debt financing" x "the amount financed by debts"
- Summing them up, then divide by total amount = WACC

Algebraic derivation (1)

- The firm's total value: V
- The firm's future cash flow: CF
- The firm's cost of capital (= expected return from its business): r_{Firm}
- The firm's total value (assume annuity):
  $V = CF / r_{Firm}$
- Capital structure of the firm: V=E+D
- $r_{Firm} = CF/V = CF/(E+D)$

Algebraic derivation (2)

- Equity holders' future cash flow: CF- r_{Debt}D
- So, E=(CF-r_{Debt}D)/ r_{Stock}
- CF= r_{Stock}E + r_{Debt}D
  - LHS: Future cash flow from the firm's business
  - RHS: The amount required to payout for stock holders and debt holders.

WACC: general formula

- Divide both LHS and RHS by V=E+D
- Firm's cost of capital =
  "Ratio of equity finance" x "Equity cost of capital"
  + "Ratio of debt finance" x "interest rate on debt"

$$r_{Firm} = \left(\frac{E}{E+D}\right) r_{Stock} + \left(\frac{D}{E+D}\right) r_{Debt}$$

The role of MM theorem

- We assumed MM is satisfied:
  - MM says the firm's value is not affected by its financial structure.
  - So r_{Firm} is constant.
- r_{Stock} and r_{Debt} are determined in market and can be observed.
- We should use r_{Firm} to evaluate investment project, but r_{Firm} cannot be observed directly.