

## Lecture 7 CAPM and Extensions

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FN 312 – INVESTMENTS

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### CAPM in Practice

- If the CAPM is true, all securities should lie on the SML
- Testing CAPM:

## Tests of CAPM

- First set of results (Lintner, and Miller and Scholes) based on 631 NYSE stocks for 10 years during 1954-1963

Coefficient:	$\gamma_0 = .127$	$\gamma_1 = .042$	$\gamma_2 = .310$
Standard error:	.006	.006	.026
Sample average:	$\overline{r_M - r_f} = .165$		

## Some Explanations

- Stock returns are extremely volatile, lessening precision (eg. average standard deviation of annual returns on the stocks in the S&P 500 is 40%)
- The market index is not the “market portfolio” of CAPM (The Roll critique)
- Security betas from the first stage regressions can be estimated with substantial sampling errors
- Investors cannot borrow at the risk free rate

## Some Anomalies

### 1) Size Effect:

- small stocks (low market cap) tend to have higher expected returns than the CAPM prediction
- large stocks (high market cap) tend to have lower expected returns than the CAPM prediction

→ Liquidity Risk: Small stocks are more illiquid and may thus command a higher premium

## Some Anomalies (cont.)

### 2) Value effect:

- value stocks (high book value-to-market value ratios) tend to have higher expected returns than the CAPM prediction
- growth stocks (low book-to-market ratios) have lower expected returns than the CAPM prediction

→ Distress risk: Value stocks tend to be stocks that have underperformed in the past. A lot of them are in the verge of bankruptcy and may be particularly risky. Investors require an additional premium in order to hold them

## Some Anomalies (cont.)

### 3) Momentum Effect:

- momentum stocks (those that have done well in the past year) have higher expected returns than the CAPM prediction
- loser stocks (those that have done poorly in the past year) have lower expected returns than the CAPM prediction

→ Under-reaction (bad news travels slowly), disposition effect (quickly selling winners to show success, holding on to losers to avoid admitting mistakes i.e. ride losses and realize gains)

## Extensions: Factor Models

- The CAPM stems from a theoretical background (equilibrium model) but it doesn't fit empirical asset returns well
- Problem with CAPM - the market portfolio may not capture all systematic risk
- What if assets are in fact exposed to other systematic risk factors? Use a more statistical approach and use "factors" to capture these additional risks

## Arbitrage Pricing Theory (APT)

- Conceived by Ross (1976)
- Unlike CAPM, the APT starts from a statistical point of view
- Idea: not all types of risk are captured by one market risk term of the CAPM
  - There is a big common component to stock returns ie. the comovement with the market
  - Beyond the market, some groups of stocks move together like computer stocks, small stocks, utility stocks, etc.
  - Individual stocks also have idiosyncratic movement
- APT does not say CAPM is incorrect – if CAPM's assumptions are correct it will hold

## Arbitrage Pricing Theory (APT)

- Based on the law of one price. Two items that are the same cannot sell at different prices
  - If they sell at a different price, arbitrage will take place in which arbitrageurs buy the good which is cheap and sell the one which is higher priced until all prices are equal.
  - In APT, the assumption of investors utilizing a mean-variance framework is replaced by an equilibrium factor model of security returns

## Factor Models

- A linear relationship between factors and assets:

Idiosyncratic risks are independent (diversifiable)

- APT can be implemented in three ways
  - Use statistical methods to synthetically create “factors” that best fit the observed stock price variations
  - Use macroeconomic variables
  - Use firm-specific characteristics

## Examples

- Chen, Roll and Ross Five-Factor Model

% change in industrial production

% change in expected inflation

% change in unanticipated inflation

excess return of long-term corporate bonds over long-term government bonds

excess return of long-term government bonds over T-bills

- Fama-French Three-Factor Model