Empirical Evidence on Security Returns

Chapter 13

Acceptance of CAPM or APT

- portfolio managers use beta to evaluate risk
- regulatory commissions use the expected return-beta relationship to estimate the cost of capital for regulated firms
- courts sometimes use the expected return-beta relationship to find discount rates used to estimate present values
- budgeting decisions

CAPM vs. APT

- CAPM predicts a relationship between expected return and risk (beta)
- APT (factor models) predicts a relationship between returns and risk factors
- when testing the CAPM, we don't have *expected* returns, but rather returns ➔ we estimate an index (factor) model and relate it to the CAPM
- hence, tests of the CAPM are also tests of the APT

Test of the Single Index Model/CAPM

- recall the CAPM relationship:

  $E(r_i) = r_f + \beta_i [E(r_M) - r_f]$
- tests of the CAPM are conducted in two steps:
  - estimate the SCL for each stock using historical data:

    $r_{it} - r_{ft} = a_i + b_i (r_{Mt} - r_{ft}) + e_{it}$

    or, letting R denote excess returns:

    $R_{it} = a_i + b_i R_{Mt} + e_{it}$
  - estimate the SML using the estimated coefficient and variance of firm-specific component:

    $AR_i = \gamma_0 + \gamma_1 b_i + \gamma_2 \sigma^2_{ei}$

    where AR_i is the average historical return for stock i

Test of the Single Index Model/CAPM (cont.)

- note that both equations are based on the CAPM equation
- if the CAPM/single index model is correct, the estimated coefficients in the second step should be
  - $\gamma_0 = 0$
  - $\gamma_1 = AR_M$ (average excess return on market index)
  - $\gamma_2 = 0$
- early tests found evidence against the CAPM:
  - $\gamma_0 \neq 0,\ \gamma_2 \neq 0$
  - $\gamma_1 < AR_M$ (the SML is "too flat")

Caveats to the Test

- stock returns are very volatile, meaning that the average returns are not very precise
- the market index is not necessarily the market portfolio
- the betas estimated in the first stage might be estimated with error, which is carried over in the second stage
- investors cannot borrow at the risk-free rate, as assumed by the CAPM (if we assume a zero-beta model, then γ_0 can be different from zero)

Roll's Critique

- the only testable hypothesis of the CAPM is that the market portfolio is efficient – all other implications of the model follow from this and thus are not directly testable
- using *ex post* data is not the same as using *ex ante* data
- the theory is not testable unless *all* securities are included and we know the true structure of the market portfolio
- using a market index can cause problems:
  - it can be efficient even if the market portfolio is not
  - it may not be efficient even if the market portfolio is

Expanding Roll's Critique

- it can be shown that there are cases when the market index is inefficient, the CAPM holds, but the estimated coefficient γ_1 in the second stage is almost zero
- even if we use sophisticated techniques, this problem can persist
- what we need is an efficient market index to "proxy" for the market portfolio
- however, we cannot tell if the market index is efficient or not because we cannot construct the mean-variance frontier

Measurement Error in Beta

- even if we were to have data on the true market portfolio, we would still have problems because of estimation errors in the first stage
- one solution is to construct portfolios and use their returns in the first stage, as this reduces the firm-specific risk component and thus the error in estimating the betas
- the drawback is that we are left with few observations for the second stage (the number of portfolios vs. the number of securities)
- tests using this strategy could not reject the CAPM, but did not provide strong evidence in its favor either

Conclusions of Tests of CAPM

- expected returns seem to depend linearly (and positively) on betas
- expected returns are not affected by non-systematic risk
- hence, the CAPM seems to be *qualitatively* correct
- *but*: the predicted relationship is not fully consistent with the data
- therefore, the CAPM predictions cannot be validated *quantitatively*

Accounting for Human Capital and Cyclical Variations in Betas

- the most important non-traded asset is human capital
- CAPM assumes that *all* assets are traded and included in the market portfolio
- also, market fluctuations can cause fluctuations in betas
- can account for these effects with a multi-factor model (market index, labor income, indicator of business cycles)
- this specifications improves significantly on the empirical performance of the CAPM

Tests of Multifactor Models

- problems:
  - need to identify factors
  - need to construct factor portfolios
  - need to find a technique to group securities in portfolios
- results show that there might be some factors other than market risk

Fama-French Three Factor Model

- Fama and French argue that we should take the book-to-market effect and the size effect into account
- they also find a strategy to construct factor portfolios for these two factors
- their estimates are that a model accounting for these two effects (plus a market index) performs much better than the CAPM
- however, the model using human capital and time-varying betas seems to eliminate these two effects

Equity Premium Puzzle

- researchers looked at the historical evolution of (excess) returns
- the result is that the average excess return is inconsistent with reasonable levels of risk aversion
- in other words, returns are “too high” relative to the risk-free rate: people should have been extremely risk averse to require such a high risk premium
- a possible explanation is unexpected capital gains (expected vs. realized returns)