Lecture 10: Valuation Models (with an Introduction to Capital Budgeting).

I. Reading.
II. Introduction.
III. Discounted Cash Flow Models.
IV. Relative Valuation Approaches.
V. Contingent Claim Valuation.
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Lecture 10: Valuation Models (with an Introduction to Capital Budgeting).

I. Reading.
A. BKM, Chapter 18, except Section 18.6.
B. RWJ, Chapter 8, Section 8.1 and skim Sections 8.2-8.6.

II. Introduction.
A. Definition of Valuation.
1. Valuation is the art/science of determining what a security or asset is worth.
   a. sometimes we can observe a market value for a security and we are interested in assessing whether it is over or under valued (e.g., stock analysts).
   b. sometimes there is no market value and we are trying to construct one for bargaining or transaction purposes (e.g., a corporation is interested in selling a division.).
   c. sometimes we have a project that we are deciding whether to accept or reject.
2. The value of a security or asset is going to depend crucially on the asset pricing model we choose. (The effect is through the appropriate discount rate.)
3. The most common kinds of valuation problem are
   a. equity valuation.
      (1) seasoned equity.
      (2) IPOs.
   b. firm valuation.
   c. capital budgeting: project valuation.

B. Three Valuation Approaches.
1. Discounted Cash Flow (DCF) Models: values an asset by calculating the present value of all future cash flows
2. Relative Valuation: values an asset by looking at the prices of comparable assets and using multiples such as price/earnings (P/E).
3. Contingent Claim Valuation: uses option pricing tools to value assets with option features.
III. Discounted Cash Flow Models.

A. General Approach.

1. The intrinsic value of an asset $P_t^i$ is the present value of expected cash flows $E[D_t^i]$ on the asset discounted by the required rate of return on the asset $E[R_t^i]$:

$$
P_t^i = \frac{E[C_{F_1}^i]}{1 + E[R_t^i]} + \frac{E[C_{F_2}^i]}{(1 + E[R_t^i])^2} + ... + \frac{E[C_{F_{\tau}}^i]}{(1 + E[R_t^i])^\tau} + ...$$

$$
= \sum_{t=1}^{\infty} \frac{E[C_{F_t}^i]}{(1 + E[R_t^i])^t}
$$

B. Two items affect the intrinsic value of an asset.

1. Expected Return on the asset.

C. Discussion.

1. This formula highlights the relation between expected return and price and why we call a model that tells us something about expected return an asset pricing model.
2. We can see that holding expected cash flows fixed, asset price today is decreasing in expected asset return; the higher the expected return needed to compensate for the asset’s risk the lower the asset’s price.

D. Equity Valuation: Dividend Discount Model (DDM)

1. DDM is an example of a discounted cash flow model.
2. DDM assumes that the stock is bought, held for some time (dividends are collected), and then sold.
3. The share is valued as the present value of the expected dividends and the expected proceeds from the sale.
4. Assume that dividends are paid annually and that the time 0 dividend has just been paid.
5. If the stock is held one year, the return on the stock is

$$
R_t^i = \frac{D_t^i + P_{t+1}^i}{P_t^i} - 1
$$

where $D_t^i$ is firm i’s dividend per share at time t and $P_t^i$ is the stock price of the firm at t. Taking expectations and rearranging gives

$$
P_t^i = \frac{E[D_t^i + P_{t+1}^i]}{1 + E[R_t^i]}
$$
6. Notice that $E[R_i]$ here applies to the firm’s equity not the firm’s assets.

7. If the stock is held for two years, the present value is given by

$$P_0^i = \frac{E[D_1^i]}{1 + E[R_i]} + \frac{E[D_2^i + P_2^i]}{(1 + E[R_i])^2}.$$ 

8. If the stock is held until the company is liquidated, the present value is given by

$$P_0^i = \frac{E[D_1^i]}{1 + E[R_i]} + \frac{E[D_2^i]}{(1 + E[R_i])^2} + \ldots + \frac{E[D_τ^i]}{(1 + E[R_i])^τ} + \ldots$$

$$= \sum_{τ=1}^{∞} \frac{E[D_τ^i]}{(1 + E[R_i])^τ}$$

which is known as a dividend discount model (DDM).

E. Capital Budgeting Decisions.
1. A firm is constantly deciding whether to undertake various projects available to it: these are capital budgeting decisions.
2. The firm’s claimholders want the firm to undertake a project if its value to the firm is positive.
3. The discounted cash flow approach says to discount the expected cash flows from the project to the present using the appropriate expected return for the cash flows.
4. The sum of present values (including any initial outlay) is known as the net present value NPV of the project:

$$NPV_0^i = CF_0^i + \frac{E[CF_1^i]}{1 + E[R_i]} + \frac{E[CF_2^i]}{(1 + E[R_i])^2} + \ldots + \frac{E[CF_τ^i]}{(1 + E[R_i])^τ} + \ldots$$

$$= \sum_{τ=0}^{∞} \frac{E[CF_τ^i]}{(1 + E[R_i])^τ}$$

5. The firm should only undertake projects with positive NPVs.
6. The project cash flows include all incremental cash flows as a result of undertaking the project.
7. The appropriate expected return for discounting back the expected project cash flows depends on their riskiness.
8. Example. ZDF Co. is considering an expansion into a new line of business producing widgets. The new line will require an outlay of $20 million today and will generate an expected net cash flow of $5 million
per year for the next 10 years. Each year’s cash flow will be received at the end of the year. The required return on the firm’s equity is currently 20% p.a. while the required return on the firm’s assets is 18% p.a.. The required return on the assets for firms currently producing widgets is 15% p.a. Headquarters expects to use all its current idle administrative capacity to oversee the new business line. Headquarter overhead is $6 million per year and idle capacity is currently 25% of total capacity. Should ZDF Co. expand into the new line of business?

a. Use the required return on assets in the new business line of 15% p.a..
b. Ignore headquarter overhead since it is a sunk cost.
c. Calculate the NPV of the expansion:
\[ \text{NPV}_0 = -20 + 5 \times \text{PVAF}_{15\%,10} = -20 + 5 \times 5.0187 = 5.09. \]
d. Since the \( \text{NPV}_0 > 0 \), ZDF Co. should undertake the expansion.

IV. Relative Valuation Approaches.
A. Definition of P/E ratio.
1. The Price/Earnings or P/E ratio is defined as the price per share divided by the earnings per share (after interest).
2. IBM Example.
   a. As of the end of December 2000, the P/E ratio for IBM is given as 19.1 by Bloomberg. This can be obtained by dividing the price per share at the end of December 2000 by the earnings per share for 2000: \( \frac{85}{4.44} = 19.1 \).
3. The P/E ratio is sometimes used to describe the price as “IBM is selling at 19.1 times earnings”.
B. Use of P/E ratio.
1. The P/E ratio is sometimes used to get a rough measure of the intrinsic value of a company that is not publicly traded.
2. When valuing the equity of a firm, the approach requires a set of comparable firms to be identified.
3. An average P/E ratio is calculated for the set of comparable firms.
4. The current earnings of the firm are multiplied by this average P/E to obtain an estimate of the firm’s intrinsic value.
C. Advantages of relative valuation.
1. Simple and quick.
D. Disadvantages of relative valuation.
1. Definition of a comparable firm is subjective.
2. Accounting earnings are subject to distortions across firms due to unstable accounting practices.
Lecture 10 Foundations of Finance

V. Contingent Claim Valuation.
   A. Equity:
      1. Can view equity as a call option on the assets of the firm with:
         a. a strike price equal to the promised payment on the debt; and,
         b. an expiration date equal to the debt’s maturity date.
   B. Debt:
      1. Firm asset value equals equity value plus debt value.
         a. So can think of debt as a long position in the firm’s assets and a
            short position in the firm’s equity.
      2. Can view debt as:
         a. a long position in the firm’s asset value
         b. a short position in a call on the firm’s asset value with a strike
            price equal to the promised debt payment and an expiration date
            equal to the debt’s maturity date.
   C. Example: Suppose XYZ Co’s assets pay off a random amount CF in 1 year’s time
      and XYZ has issued debt with a promised payment of $100 in 1 year’s time, and
      equity.

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D. Application to capital budgeting.
   1. Choosing a criterion for making capital budgeting decisions.
      a. The appropriate objective when making capital budgeting
         decisions is maximization of firm value.
      b. A firm’s manager however may instead act in the best interests of
         the firm’s equityholders.
      c. When the firm’s debt is riskless, maximizing equity value is the
         same as maximizing firm value. But when the firm’s debt is risky,
         maximizing equity value may not be the same as maximizing firm
         value.
      d. A project could reduce firm value while increasing equity value at
         the expense of debtholders: i.e.,

\[ V(0)\downarrow = S(0)\uparrow + B(0)\uparrow \]

where V is total firm value, S is equity value and B is debt value.

e. Example: Project has a NPV(0) = -5 but its acceptance increases equity value.
V(0) = S(0) + B(0)

without project:  120 = 30 + 90
with project:     115 = 35 + 80

2. Black-Scholes option pricing model can be used to understand when equity value is likely to positively affected by acceptance of a project.
   a. It is possible to express firm value as follows:

   V(0) = S(0) + B(0)
   V(0) = C_{P,T}(0) + \{V(0) - C_{P,T}(0)\}

   where \(C_{P,T}(0)\) is the value of a call option on the firm’s assets with a strike equal to the debt promised payment \(P\), and \(T\) is the maturity date of the debt.

   b. Black-Scholes tells us that
      (1) current call price is increasing in the current value of the underlying asset.
      (2) current call price is increasing in the volatility of return on the underlying asset.

3. Asset substitution or risk shifting.
   a. Consider a project with a negative NPV that increases the volatility of the return on the firm’s assets \(\sigma_V\).
   b. Firm debt is risky.
   c. Know firm value \(V(0)\) drops since \(\text{NPV}(0)<0\).
   d. For the equity (which is a call option on the firm’s assets):
      (1) reduction in \(V(0)\) causes equity value \(S(0) = C_{P,T}(0)\) to drop; but
      (2) increase in \(\sigma_V\) causes equity value \(S(0) = C_{P,T}(0)\) to increase.
      (3) net effect could be to increase \(S(0)\) if increase in \(\sigma_V\) is sufficiently large relative to the drop in \(V(0)\).
   e. Since firm value \(V(0)\) drops, any increase in \(S(0)\) is more than offset by the drop in debt value \(B(0)\).
   f. A manager who cares about equity holders would accept this project even though it has a negative NPV.
   g. The manager is engaging in what is called risk-shifting behavior.
   h. Risk-shifting behavior is an example of the potential conflicts of interest that can arise between equityholders and debtholders.
VI. Expected Return Determination.

A. Approaches:
   1. In a CAPM framework, use the SML; this approach allows you to explicitly make adjustments to your Beta estimate to reflect your assessment of the future Beta of the stock.
   2. If valuing existing equity, can also use a historical average return as an estimate of expected return.
   3. Can also adjust the estimate to take into account the predictability of returns and to allow for the sensitivity of the stock to other sources of risk (in an I-CAPM setting); we will not focus on these adjustments here.
   4. For simplicity, we will ignore tax considerations.

B. Equity Beta versus Firm Beta.
   1. Can think of the firm as a portfolio of assets/projects or a portfolio of claims on those assets:

\[
V = A_1 + A_2 + \ldots + A_J
\]
and

\[
V = S + B
\]

where

- \( V \) is the value of the firm;
- \( A_j \) is the value of the jth asset of the firm;
- \( S \) is the market value of the firm’s equity;
- \( B \) is the market value of the firm’s debt.

2. Recall that Beta with respect to the market for a portfolio is a weighted average of the Betas of the assets that comprise the portfolio where the weights are the portfolio weights. In an I-CAPM context, the same is true for Beta with respect to other variables individuals care about.

3. It follows that for Beta with respect to any variable (which of course includes Beta with respect to the market):

\[
\beta_V = \frac{A_1}{V} \beta_{A_1} + \frac{A_2}{V} \beta_{A_2} + \ldots + \frac{A_J}{V} \beta_{A_J}
\]

and

\[
\beta_V = \frac{S}{V} \beta_S + \frac{B}{V} \beta_B
\]

where

- \( \beta_V \) is the Beta of the firm;
- \( \beta_{A_j} \) is the Beta of the jth asset of the firm;
- \( \beta_S \) is the Beta of the firm’s equity;
- \( \beta_B \) is the Beta of the firm’s debt.
4. Note
   a. If the firm’s assets are unchanged, then firm Beta with respect to any variable is unchanged.
   b. Each asset or project of the firm can have a different Beta from the firm Beta.
   c. Equity Beta can be calculated by rewriting the above formula:

$$\beta_S = \frac{V}{S} \beta_V - \frac{B}{S} \beta_B = \beta_V + \frac{B}{S} [\beta_V - \beta_B]$$

d. Can see that equity Beta depends on:
   (1) the Betas of the firm’s assets;
   (2) the level of debt of the firm; and
   (3) the Beta of the firm’s debt.

e. If the firm’s debt is riskless, debt Beta with respect to any variable is 0 and so equity Beta can be calculated:

$$\beta_S = \frac{V}{S} \beta_V$$

5. Deciding which Beta to use for a particular valuation problem.
   a. When using DCF methods to value the firm directly, use firm Beta to calculate the expected return on the firm’s assets.
   b. When using DCF methods to value the firm’s equity directly, use equity Beta to calculate the expected return on the firm’s equity.
   c. When valuing or evaluating a specific project, always use the Beta of the project (which could be different from the firm’s Beta).

C. Examples.
   1. Suppose ZX company has a two assets. The first has a Beta with respect to the market of 1.5 while the second has a Beta with respect to the market of 0.9. The first asset is worth $12M and the second is worth $8M. The firm has $4M of riskless debt. The CAPM holds for the economy, the riskless rate is 5% p.a. and the expected return on the market portfolio is 13% p.a. What is the expected return on ZX’s equity?
   a. First, get the Beta of the firm:

$$\beta_{V,M} = \frac{A^1}{V} \beta_{A1,M} + \frac{A^2}{V} \beta_{A2,M} = \frac{12}{12+8} 1.5 + \frac{8}{12+8} 0.9 = 1.26.$$  

b. Second, get the Beta of the equity:

$$\beta_{S,M} = \frac{V}{S} \beta_{V,M} = \frac{20}{20-4} 1.26 = 1.575.$$
c. Third, use the SML to get the expected return on the equity:

\[ E[R_S] = R_f + \{E[R_M]- R_f\} \beta_{S,M} = 5\% + \{13\%-5\%\} 1.575 = 17.6\% \]

2. Project Beta is likely to differ from firm Beta when:
   a. The firm is a conglomerate.
   b. The project represents an entry into a new industry by the firm.

3. IBM Example: Value IBM equity as of the end of 12/00.
   a. To use DCF techniques, need an estimate of the expected return on IBM stock: \( E[R^{S-IBM}] \)
   b. CAPM
      (1) Inputs:
          (a) market expected excess return \( (E[R^M] - R_f) \)
              i) average monthly excess return on the S&P 500 for the period 1/26 to 12/00 is 0.6776%
              ii) annualized gives 12 x 0.6776\% = 8.131\%.
          (b) \( R_f \): based on yield curve at end of 12/00, use 5\%.
          (c) \( \beta_{S-IBM,M} \) can be obtained from the Bloomberg screen:
              1.07 is the Beta obtained using monthly data from 1/91 to 12/00.
      (2) Using the SML:
          \[ E[R^{S-IBM}] = 5\% + 1.07 \times 8.131\% = 13.70\% \]
   c. Could also use an estimate of expected equity return based on historical average return.
VII. Constant Growth DDM.

A. Model.
1. Suppose $E[D_1^i] = D_0^i (1 + g^i)$, $E[D_2^i] = E[D_1^i] (1 + g^i)$, ..., $E[D_{\tau+1}^i] = E[D_{\tau}^i] (1 + g^i)$.
2. So $g^i$ is the growth rate of the expected dividend which is assumed constant.
3. Can show that the DDM can be written:

$$P_0^i = \frac{D_0^i (1 + g^i)}{\frac{E[R^i]}{P_0^i} - g^i} = \frac{E[D_1^i]}{E[R^i] - g^i}$$

which is valid so long as $E[R^i] > g^i$.

B. IBM Example.
1. Aim is to value IBM stock as at 12/31/00.
2. Inputs.
   a. The total dividends paid in 2000 were $0.51 per share.
   b. Using the CAPM gives a discount rate of 13.70% p.a.
   c. The Earnings Estimates table indicates a growth rate in annual earnings over the next 5 years of 13.18%; this will be our estimate of $g^{IBM}$.
3. Using the constant growth DDM,

$$P_0^{IBM} = D_0^{IBM} (1 + g^{IBM}) / \{E[R^{IBM}] - g^{IBM}\} = \frac{0.51 \times (1+0.1318)}{0.1370-0.1318} = 111.00.$$ 

4. Compare this to the price of IBM at the end of December 2000 of $85.00. If we had full faith in our valuation we would consider IBM to be undervalued and issue a buy recommendation.

C. Other Implications of the Constant Growth DDM.
1. Can rewrite the basic model:

$$E[R^i] = \frac{E[D_1^i]}{P_0^i} + g^i.$$ 

   a. This formula breaks required return into the expected dividend yield plus expected capital gain.
   b. So $g^i$ is the expected capital gain on the stock (assuming no stock splits or stock dividends); can show this explicitly:

$$E[P_1^i] = \frac{E[D_1^i] (1 + g^i)}{E[R^i] - g^i} = P_0^i (1 + g^i).$$

2. If we assume the stock is correctly valued, we can use the stock’s dividend yield and earnings growth rate to calculate an estimate of expected return.
VIII. Investment Opportunities.

A. Introduction.
   1. Let \( K^i_{\tau} \) be the book value of a share of equity at time \( \tau \).
   2. The book value per share evolves through time in the following way:
      \[
      K^i_{\tau} = K^i_{\tau-1} + (E^i_{\tau} - D^i_{\tau})
      \]
      where \( E^i_{\tau} \) are firm \( i \)'s earnings (after interest) per share in period \( \tau \). Any earnings not paid out as a dividend get added to the book value.

B. Assumptions.
   1. The constant growth DDM correctly values stock.
   2. Each year firm \( i \)'s assets generate an expected after interest cash flow which is a constant fraction \( \text{ROE}^i \) of the book value of the equity. This \( \text{ROE}^i \) is known as the expected return on book equity. So the firm’s expected earnings after interest for period \( (\tau+1) \) are equal to the book value of the equity at the start of the period multiplied by \( \text{ROE}^i \). In per share terms:
      \[
      E[E_{\tau+1}^i] = K^i_{\tau} \text{ROE}^i.
      \]
   3. Firm \( i \) pays a constant fraction \((1-b^i)\) of its earnings as a dividend. So
      \[
      D^i_{\tau+1} = (1-b^i) E^i_{\tau+1}
      \]
      for any \( \tau \).
      a. \((1-b^i)\) is called the payout ratio.
      b. \(b^i\) is called the plowback or retention ratio.
   4. IBM Example:
      a. Inputs.
         (1) Earnings per share for IBM for 2000 was $4.44.
         (2) \( D_0^{\text{IBM}} = $0.51 \).
      b. Can calculate \( b^{\text{IBM}} \):
         \[
         (1-b^i) = D_0^i / E_0^i = 0.51 / 4.44 = 11.49\% \text{ and } b^i = 88.51\%.
         \]
C. Implications.

1. Since dividend per share is a fixed fraction of earnings per share, it follows that expected earnings per share also grow at $g^i$:

\[
\frac{E[E_{1}^i]}{E_0^i} = \frac{E[D_{1}^i]}{E_0^i (1 - b^i) D_0^i} = \frac{E[D_{1}^i]}{D_0^i} = \frac{1 + g^i}{\bar{g}_i}.
\]

2. IBM Example.
   a. Taking the earnings growth estimate as our estimate of $g^{IBM}$ is consistent with this constant payout model.
   b. Inputs:
      (1) $g^{IBM} = 13.18\%$.
      (2) $E_0^{IBM} = 4.44$.
   c. Can calculate $E[E_{1}^{IBM}]$:
      \[
      E[E_{1}^{IBM}] = E_0^{IBM} [1 + g^{IBM}] = 4.44 [1 + 0.1318] = 5.025.
      \]

3. What is the expected book value per share at time 1?

\[
E[K_{1}^i] = E[K_0^i + (E_1^i - D_1^i)] = K_0^i + K_0^i \text{ROE}^i - K_0^i \text{ROE}^i (1 - b^i) = K_0^i (1 + \text{ROE}^i - b^i).
\]

Can show that the book value per share is also expected to grow at $g^i$:

\[
\frac{E[K_1^i]}{K_0^i} = \frac{E[E_{2}^i]}{ROE^i E[E_{1}^i]} = \frac{E[E_{2}^i]}{E[E_{1}^i]} = 1 + g^i.
\]

Thus, have shown that $b^i \text{ROE}^i = g^i$.

4. IBM Example.
   a. Inputs:
      (1) $b^{IBM} = 88.51\%$.
      (2) $g^{IBM} = 13.18\%$.
      (3) $E[E_{1}^{IBM}] = $5.025.
   b. Can calculate $\text{ROE}^{IBM}$:
      \[
      \text{ROE}^{IBM} = g^{IBM} / b^{IBM} = 0.1318 / 0.8851 = 14.89\%.
      \]
   c. Can then calculate $K_0^{IBM}$ implied by the model:
      \[
      K_0^{IBM} = E[E_{1}^{IBM}] / \text{ROE}^{IBM} = $5.025 / 0.1489 = $33.75
      \]
      which can be compared with the actual book value at the end of 2000 of $11.56$. The difference between the two is a measure of the extent to which the assumptions about the evolution of book value hold for IBM.
D. Uses of the Model.

1. Valuation.
   a. Can easily show that the following formula must hold for the stock price of firm $i$:

$$P_0^i = \frac{D_0^i(1 + g^i)}{E[R_i^i] - g^i} = E_0^i(1 + g^i)(1 - b^i) = \frac{E[E_i^i](1 - b^i)}{E[R_i^i] - b^iROE_i^i}.$$

2. Optimal Plowback Ratio.
   a. If firm $i$ paid out all its earnings as a dividend ($b^i = 0$), its stock price at time zero would be $E[E_1^i]/E[R_i^i]$. The difference between this value and the constant growth DDM value is due to growth. Thus,

$$P_0^i = \frac{E[E_1^i]}{E[R_i^i]} + PVGO_0^i = \frac{E_0^i(1 + g^i)}{E[R_i^i]} + PVGO_0^i.$$

where $PVGO_0^i$ is the value at time 0 of firm $i$'s growth opportunities.

b. Note that:

(1) If $E[R_i^i] > ROE_i^i$:
   (a) $PVGO_0^i \leq 0$; and,
   (b) $b^i = 0$ maximizes $P_0^i$.

(2) If $E[R_i^i] < ROE_i^i$:
   (a) $PVGO_0^i \geq 0$; and,
   (b) $P_0^i$ is increasing in $b^i$.

(3) If $E[R_i^i] = ROE_i^i$:
   (a) $PVGO_0^i = 0$; and,
   (b) $P_0^i$ is unaffected by choice of $b^i$.

c. IBM Example.

(1) Inputs.
   (a) $P_0^{IBM} = $111.00.
   (b) $E[E_1^{IBM}] = $5.025.
   (c) $E[R_i^{IBM}] = 13.70\%$.
   (d) $ROE_i^{IBM} = 14.89\%$.

(2) Can calculate $PVGO_0^{IBM}$:

$$PVGO_0^{IBM} = P_0^{IBM} - \frac{E[E_1^{IBM}]}{E[R_i^{IBM}]} = $111.00 - $5.025/0.1370 = $111.00 - $36.68 = $74.32.$$

(3) Note that $PVGO_0^{IBM} \geq 0$ as would be expected since $13.70\% = E[R_i^{IBM}] < ROE_i^{IBM} = 14.89\%$. 
Lecture 10: Market Efficiency

I. Reading.
II. Definition of Market Efficiency.
III. Features of Market Efficiency.
IV. Levels of Market Efficiency
V. Costly Information Acquisition and Costly Trading.
VI. How efficient are U.S. financial markets.
VII. Joint Test Problem.
VIII. Predictability of Returns.
IX. Example of Semi-strong Form Inefficiency
Lecture 10: Market Efficiency

I. Reading.
   A. BKM, Chapter 12. Read Sections 12.1 and 12.2 but only skim Sections 12.3 and 12.4.

II. Definition of Market Efficiency.
   A. In an efficient market, the price of a security is an unbiased estimate of its value.
   B. Notice that the level of efficiency in a market depends on two dimensions:
      a. The amount of information incorporated into price.
      b. The speed with which new information is incorporated into price.

III. Features of Market Efficiency.
   A. To assess the level of market efficiency need to know the security’s value; which
      requires knowing how assets are priced.
   B. Market efficiency says that:
      1. if a piece of news is always followed by a another piece of news than the
         market incorporates the likely impact of the second piece of news at the
         time that the first piece of news becomes available.
      2. so even if news is correlated, price changes will not be.
      3. Tomorrow’s Price = Today’s Price (1 + Expected Return) + Unpredictable Disturbance.
IV. Levels of Market Efficiency

A. Weak form.
   1. Price reflects all information contained in past prices.
   2. So an investor can not use past prices to identify mispriced securities.
   3. Technical analysis:
      a. refers to the practice of using past patterns in stock prices to identify future patterns in prices.
      b. is not profitable in a market which is at least weak form efficient.

B. Semi-strong form.
   1. Price reflects all publicly available information.
   2. So an investor can not use publicly available information to identify mispriced securities.
   3. Fundamental analysis:
      a. refers to the practice of using financial statements and other publicly available information about firms to pick stocks.
      b. is not profitable in a market which is at least semi-strong form efficient.
   4. If a market is semi-strong form efficient, then it is also weak form efficient since past prices are publicly available.

C. Strong form.
   1. Price reflects all available information.
   2. So an investor can not use any available information to identify mispriced securities.
   3. Insider trading:
      a. refers to the practice of using private information about firms to pick stocks.
      b. is not profitable in a market which is at least strong form efficient.
      c. is illegal.
   4. If a market is strong form efficient, then it is also semi-strong and weak form efficient since all available information includes past prices and publicly available information.
V. Costly Information Acquisition and Costly Trading.
   A. A Contradiction
      1. If markets are efficient, all information is reflected in price.
      2. But then there is no incentive to gather costly information and trade on it.
      3. So how does the information get into price?!
   B. An Alternate Argument.
      1. Could have an equilibrium where some investors choose to gather information and some do not.
      2. Those that do earn better returns which offset the costs of acquiring the information and trading on it.
      3. The market is not fully efficient in the sense discussed above.

VI. How efficient are U.S. financial markets.
   A. Probably semi-strong form efficient but not strong form efficient.
   B. Can find rare examples of semi-strong form inefficiency.

VII. Joint Test Problem.
   A. The question whether price fully reflects a given piece of information always depends on the model of asset pricing that the researcher is using. It is always a joint test.
   B. Example: Taking the CAPM as the model of asset pricing, finding a relation between expected return and size after controlling for Beta with respect to the market implies semistrong market inefficiency since size is publicly available. However, taking a multifactor model as the model of asset pricing, the relation between a size and expected return may be due to a stock’s size being correlated with the stock’s risk loading for a relevant factor.

VIII. Predictability of Returns.
   A. Can forecast long horizon returns using:
      1. past long horizon returns (negative relation) (p 29).
      2. information variables related to the business cycle (p 29);
         a. aggregate dividend yield at the start of the return period (positive relation).
         b. term spread (long term high grade corporate bond yield less one month T-bill rate) which is known at the start of the return period (positive relation).
         c. these information variables are counter cyclical.
   B. These findings are consistent with two stories:
      1. time varying expected returns and semistrong market efficiency.
      2. constant expected returns and semistrong market inefficiency.
IX. Example of Semi-strong Form Inefficiency
A. Stocks added and deleted from the S&P 500.
   1. see pp 30-32.