E&G, Ch. 18: The Valuation Process

Overview: What determines the **value** of a common stock?

Stock Price (P_t) depends on:
1) earnings;
2) dividends;
3) the cost of money;
4) future growth;
5) risk.

A **valuation model** incorporates these factors
to determine or forecast the "appropriate value" of stocks,
and thereby identify "undervalued" stocks.

- Formalizes relation between corporate & economic factors, and the market's valuation of these factors.
- Inputs: economic variables like future earnings, dividends, variability of earnings, …
- Output: expected (forecasts of) market value or return, or at least a buy/sell/hold recommendation.

Explicit Valuation Models can be broken into 3 components:
1) Forecasting relevant inputs;
2) Valuing securities;
3) Forming portfolios.

I. Discounted Cash Flow (DCF) Model

A. Concept:

Value (Pt) of a share of stock = NPV of expected future dividends.

$P_t = D_{t+1}/(1+k) + D_{t+2}/(1+k)^2 + \ldots$

where D_{t+i} = dividend @ time t+i; k = discount rate (cost of capital).

1. Note: Earnings do not appear explicitly, but appear implicitly:

   Earnings can be:
   a. paid to stockholders in dividends (D_{t+1});
   b. reinvested in firm.

   If b., should result in higher D_{t+i}.

   To incorporate future earnings and D_{t+i} would be double-counting.

B. Implementation of DCF Model - 3 ways:

1. estimate future D_{t+i} and appropriate k, and solve for implied P_t^*.

2. estimate future D_{t+i}, use current P_t,
   and solve for k^*, the implied cost of capital.

3. divide both sides by earnings (E_t), plug in forecasted D_{t+i}, E_t, & k,
   and solve for the implied (P_t^*/E_t) ratio.

C. Problem with DCF model – must forecast D_{t+i}.

Impossible to do precisely, far into future.

Must make simplifying assumptions
about how D_t will grow over time:

1. Constant growth model, or 1-period model:
   Constant growth at rate, g, to ∞.

2. 2-Period Growth Model:
   Constant growth for N periods at g_1,
   and thereafter (N+1, …) at rate, g_2,
   same growth as typical firm.

3. 3-Period Growth Model:
   Constant growth for N periods at g_1,
   then a period when g_1 declines to g_2,
   and thereafter at g_2.

4. Could extend these to N-Period growth model.
   As we move toward more complex models,

   a. assumptions more heroic;

   b. data (forecasting) requirements are
      more demanding (likely more noise).

1. Constant (One-Period) Growth Model.

Assume: D_t will grow at g through ∞; $g < k$; $D = D_{t+1}$.

$$P_t^* = D/(1+k) + D(1+g)/(1+k)^2 + D(1+g)^2/(1+k)^3 + \ldots + D(1+g)^{N-1}/(1+k)^N + \ldots$$

Geometric Series with common ratio, $(1+g)/(1+k) < 1$,
converges to (first term)/[1 – (common ratio)]:

$$P_t^* = \frac{D/(1+k)}{1-(1+g)/(1+k)} = \frac{D/(1+k)}{(1+k)/(1+k)-(1+g)/(1+k)}$$

$$= \frac{D}{(1+k)-(1+g)} = \frac{D}{k-g}$$

$$P_t^* = D/(k-g)$$

Or: $$k^* = D/P_t + g$$

Procedure:

I. Estimate D, g, and k; get P_t^*. If $P_t^* > P_t$, buy.

II. Estimate D and g, use current P_t, get k*.
If k* > k warranted by risk of stock,
then expect P_t to increase; earn > k*.

a. Example using One-Period Growth Model.

At time t_0, ABC stock selling for P_t = \$65/share;
E_t = \$3.99/share; D_{t+1} = \$2.00/share; k = 13%.

Suppose you estimate g = 12%;

Then P_t^* = \$2.00/(.13 - .12) = \$200.

At P_t = \$65, buy!

This result is sensitive to estimates of k and g!

If g = 9%, P_t^* = \$2.00/(.13 - .09) = \$50; sell!

Firms with high growth rates will not likely continue,
and firms with low growth rates may improve.
Means volatility in P_t^*.

b. ***Criticisms*** **of Constant Growth Model:**

i. too simple;
ii. assumption of constant growth unrealistic;
iii. too hard to forecast appropriate g;
iv. Results (P_t^*, k^*) sensitive to choice of g.

c. ***Justification*** **for Constant Growth Model:**

Assume:

i. firm will maintain stable dividend policy;
   - retained earnings = bE_t = I_t (investment);
   - dividends = D_t = $(1-b)E_t$.

ii. firm will earn stable return on investment (r).

Given these assumptions, can derive an expression for **growth** in earnings, E_t, and thus in dividends, D_t.

Earnings at time t are:
$$EPS = E_t = E_{t-1} + r I_{t-1}$$
$$= E_{t-1} + r bE_{t-1}$$
$$= (1 + rb) E_{t-1}$$

If $b\uparrow$ or $r\uparrow$, then $E_t\uparrow$ faster.

Then **growth** in Earnings is:

$$g = (E_t – E_{t-1}) / E_{t-1} = [E_{t-1}(1+rb) – E_{t-1}] / E_{t-1} = rb.$$

Given (i), Dividends grow at same rate as Earnings;

$$g_D = g_E = rb.$$

d. Implications for growth in Stock Price (g_P).

We have: $P_t^* = D/(k - g) = D/(k - rb)$

$k^* = D/P_t + g = D/P_t + rb$

Given assumptions c.i. & c.ii.,
Consider implications for growth in stock prices:

$$g_P = (P_{t+1} - P_t) / P_t .$$

But: $P_t = [D/(k - rb)]$ and $P_{t+1} = [D(1 + rb)/(k - rb)]$.

$$\text{Thus:} \quad g_P = \frac{\dfrac{[D(1 + rb) - D]}{(k - rb)}}{\dfrac{D}{(k - rb)}} = \frac{D + Drb - D}{D} = rb.$$

Given these assumptions, Dividends, Earnings, & Prices
Are all expected to grow at the same rate, rb.

If r or b is higher, g will be higher.

e. Implications of assumption c.ii.

[ii. firm will earn stable return on investment (r).]

Rate of return on investment is some fraction of firm's k:
$r = ck$ (c may be > 1).

Substitute into our valuation formula:

$$k^* = D/P_t + (r)b = D/P_t + (ck^*)b.$$

But $D = (1\text{-}b)E_t$;

Thus $k^* = (1\text{-}b)E_t/P_t + ck^*b$

$$k^*(1 - cb) = (1 - b)E_t/P_t$$

$$k^* = \frac{(1 - b)\, E_t}{(1 - cb)P_t}$$

Implications:

i. If firm can only earn $r = k$ on investmt opportunities, $c = 1$, and $k^* = E_t/P_t$.

ii. If firm can earn $r > k$, $c > 1$, and $k^* > E_t/P_t$.

i.e., the (earnings / price) ratio will be below the rate of return required by investors.

iii. Alternatively, $P_t = D/(k – rb) = D/(k – ckb)$;
If c ↑ so $c > 1$, good investment opportunities,
Then P_t ↑ and E_t/P_t ↓.

iv. Alternatively, $P_t = D/(k – rb) = [(1\text{-}b)E_t] / (k – ckb)$.
If we divide both sides by earnings, we have:

$$\frac{P}{E} = \frac{1 - b}{k - ckb} = \frac{1 - b}{k(1 - cb)}$$

Again, if firm can earn higher r, then c↑, and P/E ↑.

2. Two-Period Growth Model.

[Constant growth for N periods at g_1, and thereafter at g_2.]

a. Let P_N = stock price in period N;

Then $P_t^* = D/(1+k) + D(1+g_1)/(1+k)^2 + \ldots$
$+ D(1+g_1)^{N-1}/(1+k)^N + P_N/(1+k)^N$

The first (N-1) terms are the sum of a geometric progression.

If an infinite series, converges to:
(first term)/(1 – common ratio).

If a finite series, *first N terms* converge to:
(first term)[1 – (common ratio)^N] / [1 - common ratio].

Thus, first N terms of P^* are:

$$\frac{\frac{D}{1+k}\left[1-\left(\frac{1+g_1}{1+k}\right)^N\right]}{1-\frac{1+g_1}{1+k}} = \frac{\frac{D}{1+k}\left[1-\left(\frac{1+g_1}{1+k}\right)^N\right]}{\frac{1+k}{1+k}-\frac{1+g_1}{1+k}} = \frac{D}{k-g_1}\left[1-\left(\frac{1+g_1}{1+k}\right)^N\right]$$

Adding the last term, we get:

$$(1^*) \qquad P_t^* = \frac{D}{k-g_1}\left[1-\left(\frac{1+g_1}{1+k}\right)^N\right] + \frac{P_N}{(1+k)^N}$$

$$(1^*) \qquad P_t^* = \frac{D}{k-g_1}\left[1 - \left(\frac{1+g_1}{1+k}\right)^N\right] + \frac{P_N}{(1+k)^N}$$

b. Given our assumptions about constant growth (at g_2), after period N, we can use earlier model to value P_N:

$$P_N = D_{N+1} / (k - g_2) .$$

But we assumed D grows at g_1 for the first N periods:

Thus, $D_{N+1} = D(1+g_1)^N (1+g_2)$,

So that $P_N = [D(1+g_1)^N (1+g_2)] / (k - g_2)$,

And finally:

$$(2^*) \qquad P_t^* = \frac{D}{k-g_1}\left[1 - \left(\frac{1+g_1}{1+k}\right)^N\right] + \frac{D(1+g_1)^{N-1}(1+g_2)}{(1+k)^N (k-g_2)}$$

Thus, given assumptions of 2-period model, and given projections of D, k, g_1, and g_2, can compute P_t^*.

(1*) $$P_t^* = \frac{D}{k-g_1}\left[1 - \left(\frac{1+g_1}{1+k}\right)^N\right] + \frac{P_N}{(1+k)^N}$$ Focus on the last term -- an alternative model.

c. May prefer, in terms of projected earnings & P/E ratios.

If you assume this stock behaves like average stock after N pds, then it must be the same as the *average P/E ratio*:

$$P_N/E_N = M_g\,.$$

Thus, $P_N = (P_N/E_N)\,E_N = M_g E_N\,.$

Further, under our assumptions earnings grow at g_1 for N-1 pds.

Thus, $E_N = E(1+g_1)^{N-1}$ and $P_N = M_g\,E(1+g_1)^{N-1}$

Substituting for P^N in our earlier formula, (1*):

(3*) $$P_t^* = \frac{D}{k-g_1}\left[1 - \left(\frac{1+g_1}{1+k}\right)^N\right] + \frac{M_g\,E(1+g_1)^{N-1}}{(1+k)^N}$$

Observe, g_2 has disappeared from this model, since we assumed in period N this stock will sell at the same P/E ratio as avg stock.

(3*) as no advantage over (2*), except it is expressed in terms of projected P/E ratios (M_g).

Again, given projections of k, D, g_1, E, and M_g, can compute P_t^* and make recommendations.

(3*) $$P_t^* = \frac{D}{k-g_1}\left[1 - \left(\frac{1+g_1}{1+k}\right)^N\right] + \frac{M_g\, E(1+g_1)^{N-1}}{(1+k)^N}$$

Or:

(3*) $$P_t^* = \frac{D}{k-g_1}\cdot\frac{(1+k)^N - (1+g_1)^N}{(1+k)^N} + \frac{M_g\, E(1+g_1)^{N-1}}{(1+k)^N}$$

d. Example using Two-Period Growth Model.

Stock ABC again; Assume:
$k = 13\%$; $D = \$2.00$; $E = \$3.99$;
$g_1 = 12\%$ will continue for 15 years, then avg growth;
after 16 years, has avg P/E = $M_g = 9.5$.

$$P_t^* = \frac{\$2.00}{.13 - .12}\cdot\frac{(1.13)^{15} - (1.12)^{15}}{(1.13)^{15}} + \frac{(9.5)(\$3.99)(1.12)^{14}}{(1.13)^{15}}$$

$$= \$54.59$$

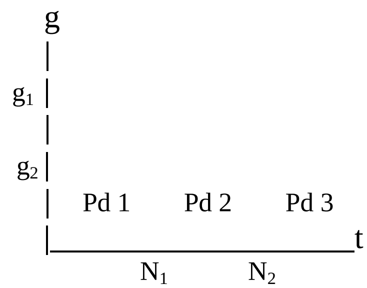
e. Criticism of Two-Period Growth Model.

Pattern of growth assumed is unrealistic.
Rather than adjusting instantaneously after N years,
Firm likely adjusts gradually from g_1 to g_2 .

3. Three-Period Growth Model.

Figure 1. Must assume:

a. Growth rate, g_1;
b. Length of Pd. 1, N_1;
c. Pattern of adjustmt;
d. Length of adj pd, N_2;
e. LR growth, g_2.



For c., typically assume *linear* adjustment pattern.

> Note: the third period in the 3-Pd Model
> is like the second period in the 2-Pd Model;
> can be modeled the same way (recall M_g).

As we go from 1-Pd to 2-Pd to 3-Pd Model, etc.,
increase complexity of Model & inputs required;

Hopefully gain some information & improve forecasts.

- if growth patterns are too simple,
  forecasts could be improved by adding info.

- if too complex, noise from all inputs required
  may swamp the useful information added,
  and make the forecasts less accurate.

  Tradeoff – simplicity vs complexity.

D. Valuation Models Based on Fundamental Ratio (Multiple) Analysis.

1. Price to Earnings Multiple.

   P* = (P/E)* x (E)*

2. Price to Book Value Multiple.

   P* = (P/Book Value of Equity)* x (Book Value of Equity)*

3. Sales Multiple.

   P* = (P/Sales)* x (Sales)*

4. EBITDA Multiple.

   P* = (P/EBITDA)* x (EBITDA)*

5. EBIT Multiple.

   P* = (P/EBIT)* x (EBIT)*

6. FCF Multiple.

   P* = (P/FCF)* x (FCF)*

In each case, the analyst projects the relevant ratio (multiple), and the underlying performance measure, and thereby arrives at a valuation.

The relevant ratio (multiple) to consider depends on the firm & industry.

What determines the analyst's projection of the relevant multiple? These multiples should depend on the company's ongoing performance in the economy, the industry, and the marketplace. For example,

(P/Sales)* = f(market share, gross margin %, dividends, …).

That is, if the company has greater market share, margins, dividends, etc, such performance indicates market power and pricing power, and may make investors willing to pay a higher multiple.

E. Examples applying ratio (multiple) analysis in different industries.

1. Capitol Federal is a financial company (bank) that should be valued as a multiple of Price to Book Value (Price / Book Value of Equity = Mkt Cap / Bk Value).
   Most financial companies are valued in this way.
   It is often easier to value a book of financial assets than a book of real assets.
   Why do some banks have a higher multiple than others?
   Ratio should depend on quality of their book of assets, market power, mgt, etc.

   Capitol Federal's multiple should be higher than the typical bank, given their conservative approach toward managing their loan portfolio, and the resulting quality of their book of assets, as evidenced by their past performance on troubled loans and loan loss reserves, as well as their stable dividend policy.

   Beverly Hills Bancorp (BHBC) is a different bank that has lower multiples.
   It's former CEO is in jail, & the bank has been under the cloud of past mistakes.
   One way to value BHBC is to focus on the aspects of their business that would make investors willing to pay a higher (or lower) multiple over book value in the future.

2. International de Ceramica is a Mexican tile manufacturer. Regular business is based on performance in the construction sector.
   This business is valued as a multiple of FCF.
   In 2003 it's major competitor in the U.S., Dal Tile (DAL) was acquired by Mohawk (MHK) for 10 times FCF (i.e. Price / FCF = Mkt Cap / FCF = 10).
   A reasonable way to value International de Ceramica would be to project FCF and then apply this multiple.
   The story would then be, if this company is eventually acquired, it may attract a multiple like DAL did.
   Then you would go further to consider economic factors that might make their (Price / FCF) multiple larger or smaller than that applied to DAL.

3. Garmin (GRMN) can be valued as a multiple of FCF or EBITDA or Sales, etc.
   What makes Garmin's multiples higher than other companies in this sector?
   They use R&D to keep producing new & unique products protected by patents.
   If consumers want their products they have to come to Garmin.
   This monopolistic approach allows Garmin pricing power attractive margins.

   In the past the company has been able to establish & maintain gross margins around 50% or higher.
   Garmin's business plan focuses on R&D to try to maintain these margins.
   Recently analysts have expressed concern that increasing competition in this industry is likely to put pressure on Garmin's margins.
   If so, then their multiples are likely to suffer (i.e., their share price will fall).

II. Cross-Sectional Regression Analysis.

An approach to estimate (predict) the appropriate multiple (ratio).

A. The Model.

P/E = f(growth, dividend policy, risk, earnings, …)

Explicitly:

$$(P/E)_i = a_0 + a_1 G_i + a_2 D_i + a_3 \sigma_i + a_4 E_i + \ldots + \varepsilon_i$$

where $(P/E)_i$ = P/E ratio for i^{th} firm;

G_i = earnings growth rate for i^{th} firm;

D_i = dividend payout rate (b) for i^{th} firm;

σ_i = std deviation in G_i for i^{th} firm;

E_i = earnings for i^{th} firm;

and ε_i = noise term for i^{th} firm –
[reflects variation in $(P/E)_i$ not due to other stuff].

1. Asks how do these determinants affect $(P/E)_i$?
2. Get data on all factors (forecasts of G_i, D_i, σ_i, & E_i) for N firms at a point in time.
3. Estimate the a_i and thus $(P/E)_i$.

B. The Procedure.

1. Use data on $(P/E)_i$, G_i, D_i, σ_i, and E_i, …

2. Then, given a firm's G_i, D_i, σ_i, and E_i,

   its theoretical value, $\widehat{(P/E)}_i$ should be on the line:

   $$\widehat{(P/E)}_i = \hat{a}_0 + \hat{a}_1 G_i + \hat{a}_2 D_i + \hat{a}_3 \sigma_i + \hat{a}_4 E_i$$

   If actual $(P/E)_i > \widehat{(P/E)}_i$, overvalued – sell.

   If actual $(P/E)_i < \widehat{(P/E)}_i$, undervalued – buy.

3. Example: Whitbeck & Kisor estimated model –

   $$\widehat{(P/E)}_i = 8.2 + 1.5\, G_i + .067\, D_i - .2\, \sigma_i$$

   Coefficients reflect the weights the market
   placed on each variable at that point in time.
 -- Signs reflect direction of impact ($\uparrow G_i \uparrow P/E$, …).
 -- Magnitudes reflect extent of impact.

   Suppose for firm i, $G_i = 12\%$; $D_i = 50\%$; $\sigma_i = 5$:

   Then $\widehat{(P/E)}_i = 8.2+1.5(12)+.067(50)-.2(5) = 28.6$

   Ask, was actual $(P/E)_i$ > or < 28.6 at this time?

C. Pros and Cons of Cross-Sectional Regression.

1. Pros:
   a. Models have relatively high R^2 values.
   b. Variables 'explain' much of variation in (P/E)'s at a point in time.
   c. Helpful in identifying variables & estimates that determine (P/E) at a point in time.

2. Cons:
   a. Models not very successful at picking winners.

3. Why not?
   a. Idea – model finds over- or under-valued stocks (above or below estimated line), and presumes the actual price will converge to theoretical price before the theoretical price (the line) changes.

   b. 4 reasons this may not happen (4 problems with cross-sectional regression):
      i. Market tastes change over time;
      ii. Inputs change over time;
      iii. Firm effects are not captured;
      iv. Values are only estimates.

3.b. Four Problems with Cross-Sectional Regression.

i. Market Tastes Change.

The importance of certain variables in the mkt changes over time, as mkt conditions change.

Study compared importance of growth (G_i) in bull versus bear markets:

Bull: $\widehat{(P/E)}_i = 4 + 2.3\, G_i$

Bear: $\widehat{(P/E)}_i = 3 + 1.8\, G_i$

Growth is more important in Bull Mkt.

If company's estimated G_i was 20%:

Bull: $\widehat{(P/E)}_i = 4 + 2.3(20) = 50;$

Bear: $\widehat{(P/E)}_i = 3 + 1.8(20) = 39.$

ii. Inputs Change Over Time.

Even if market weights didn't change over time, estimated (P/E)'s will change because input forecasts will change.

e.g. expected G_i will likely be different
in bull and bear years.

iii. Firm Effects.

Some firms lie above the line; some below, and continue to do so period after period.

- do not converge to estimated value.
- Firm Effects, due to persistent influences are not captured by the model.

Example; tobacco stocks *may stay below line* because regression model does not capture the threat of gov't intervention (actual price does).

Other firms *may stay above the line* because the market likes management, or because of monopoly power, pricing power, or because of some growth story, etc.

iv. Values are Only Estimates.

May have more or less confidence in estimates.
Why? More or less confidence in:

1. forecasts of inputs;

2. forecasts of $(P/E)_i$;

3. statistics of regression analysis.

   Wire-through-pipe analogy:
   a. bigger diameter?
   b. nonlinear?