**Stock Valuation Based on Earnings**

The PV approach to stock valuation discounts dividends $D_t$, not earnings $E_t$:

$$P_0 = \sum_t \frac{D_t}{(1+r)^t}.$$

If we were to discount earnings $\sum_t \frac{E_t}{(1+r)^t}$ instead, we would overestimate the value of the stock by the PV of *retained earnings* $\sum_t \frac{E_t - D_t}{(1+r)^t}$.

Of course, if the entire earnings are distributed as dividends each year ($E_t = D_t$), then $P_0 = \sum_t \frac{E_t}{(1+r)^t}$. In this case, the firm does not invest any of its own capital to grow; it is thus plausible to assume that dividends=earnings stay constant over time. Call this SCENARIO A. Then, applying the perpetuity formula,

$$P_0 = \frac{D_1}{r} = \frac{E_1}{r}.$$

Thus, in this case, the Price-Earnings ratio is given by

$$\frac{P_0}{E_1} = \frac{1}{r}. \tag{1}$$

- Yardeni's Fed Model is similar, as it says:

  $$\frac{P_0}{E_1} = \frac{1}{r_{10}},$$

  where $r_{10}$ is the interest rate on 10-year government bonds.

SCENARIO B.

Now assume that the firm retains some earnings, but invests them at the "required rate of return" $r$; *in other words, the firm invests its earnings in 0-NPV investments.* Clearly, this cannot change the value of stock, that is: the PV of the dividends. Thus, the formulas

$$P_0 = \frac{E_1}{r} \tag{2}$$

and $\frac{P_0}{E_1} = \frac{1}{r}$ still apply. Of course, now both earnings and dividends will grow.

**Example.**
$E_1 = \$10$, $r = 0.1$. (I am using always per-share values).

- In scenario A, $P_0 = \frac{\$10}{0.1} = \$100$.
- In scenario B, applying the formula (2), once again $P_0 = \frac{\$10}{0.1} = \$100$. Magically, this will be true however much the firm retains and whatever the resulting dividend pattern is.

  For example, suppose the firm retains always 50% of its earnings, and pays out 50% as its dividends. Thus, $D_1 = \$5$. Then one can show that if retained earnings make a return of $r$ =10% (as assumed), and if dividends grow at a constant rate $g$,

  $$g = 0.5 \times 0.1 = 0.05. \tag{3}$$

  - Of course, the stock price must again be equal to the PV of future dividends. Indeed, applying the Gordon growth formula, we get

  $$P_0 = \frac{D_1}{r - g} = \frac{\$5}{0.1 - 0.05} = \$100!$$

- Equation (3) is a special case of the following formula

  $$g = (1 - \delta)\pi, \tag{4}$$

  where $\delta = \frac{D_t}{E_t}$ is the *payout ratio* (assumed constant over time), and $1-\delta = \frac{E_t - D_t}{E_t}$ is the *retention ratio*, and $\pi$ is the return on retained earnings. See section 5.5 of the textbook for further explanation; equation (4) is the same as equation (5.8) there. Assuming that the firm's investments have zero NPV is the same as assuming that $\pi = r$.

  You don't need to understand equation (4) fully, but you should understand the basic intuition behind it: earnings (and hence dividends) will grow the more rapidly, the more the firm invests (here, for simplicity all investment is assumed to come from retained earnings), and the more profitable those investments are.

**SCENARIO C:**

Suppose now that the firm keeps reinvesting its earnings in positive NPV projects. Specifically, suppose that the return on its retained earnings is 12% rather than 10% as in B. Then its stock price will be accordingly higher. Indeed, the constant growth rate will now be

$$g = 0.5 \times 0.12 = 0.06,$$

hence

$$P_0 = \frac{D_1}{r-g} = \frac{\$5}{0.1 - 0.06} = \$125.$$

The difference $P_0 - \frac{E_1}{r} = \$125 - \$100 = \$25$ is the *Net Present Value of Growth Opportunities* (NPVGO).

**SCENARIO D:**

If the firm keeps making bad investments, the NPVGO may be negative. For example, if the return on its investments is only 8% (less than investor's required rate of return of 10%), it destroys value. Indeed, the constant growth rate will now be

$$g = 0.5 \times 0.08 = 0.04,$$

hence

$$P_0 = \frac{D_1}{r-g} = \frac{\$5}{0.1 - 0.04} = \$83.33,$$

yielding an NPVGO of $\$ - 16.67$.

- Scenarios C and D contain an important general lesson: earnings growth justifies higher P/E-ratios only if it is based on genuinely profitable (i.e. positive NPV) investments. A firm's growth is however often profit neutral (zero NPV); for example, this is typically the case if the firm grows by acquiring other companies.