Artificial Intelligence (AI) for Investments

Lesson 5: Valuation of common stocks

Introduction

In this lesson we will cover the following topics:

- Introduction to common stocks and trading operations
- Fundamental principles of stock valuation
- Single-period and multi-period DCF approaches to stock valuation
- Valuation of common stock for growth and income stocks
- Dividend discount model and cost of equity
- Summary and concluding remarks

Trading of securities on exchanges

- Market microstructure and trading operations
- Primary and secondary markets
- Trading in modern financial markets: electronic communication networks and limit order books
- Role of designated market makers in quote driven markets

Market value of common stocks

	Market-to-Book-Value Ratio		Price–Earnings Ratio	
	Company	Competitors*	Company	Competitors*
Johnson & Johnson	3.4	3.0	11.3	10.9
PepsiCo	6.4	3.0	15.6	12.9
Campbell Soup	9.0	4.6	8.8	11.3
Wal-Mart	3.0	2.1	14.6	13.4
Exxon Mobil	2.9	1.2	7.6	5.3
Dow Chemical	0.5	3.0	12.5	10.6
Dell Computer	4.5	3.7	7.9	11.1
Amazon	11.2	2.7	46.9	22.2
McDonald's	4.4	3.1	14.1	13.6
American Electric Power	1.1	1.1	8.1	11.0
GE	1.0	1.7	4.6	8.8

Fundamental valuation of stocks-I

- The comparable valuation method provides estimates of value that are more aligned to the current market expectations
- Fundamental valuation methods provide estimates, independent of market valuation, and depend on the assumptions
- What are these factors that affect stock prices?
- PV of Stock = PV of expected future dividend income
- Expected Returns= $r = \frac{DIV_1 + P_1 - P_0}{P_0}$

Fundamental valuation of stocks-I

- Consider a company ABC with the current price P_0= \$100; dividend $DIV_1 = \$5$, and an expected price of \$110 at the end of the year. Then the expected returns by shareholders would be computed as shown here
- $r = \frac{DIV_1 + P_1 - P_0}{P_0} = \frac{5+110-100}{100} = 15\%$
- Assume that 15% is the interest that you (or other investors) are expected from this stock and those stocks having similar risk
- $P_0 = \frac{DIV_1 + P_1}{1+r} = \frac{5+110}{1.15} = \$100$
- $P_0 = \frac{DIV_1 + P_1}{1+r}$

Fundamental valuation of stocks-II

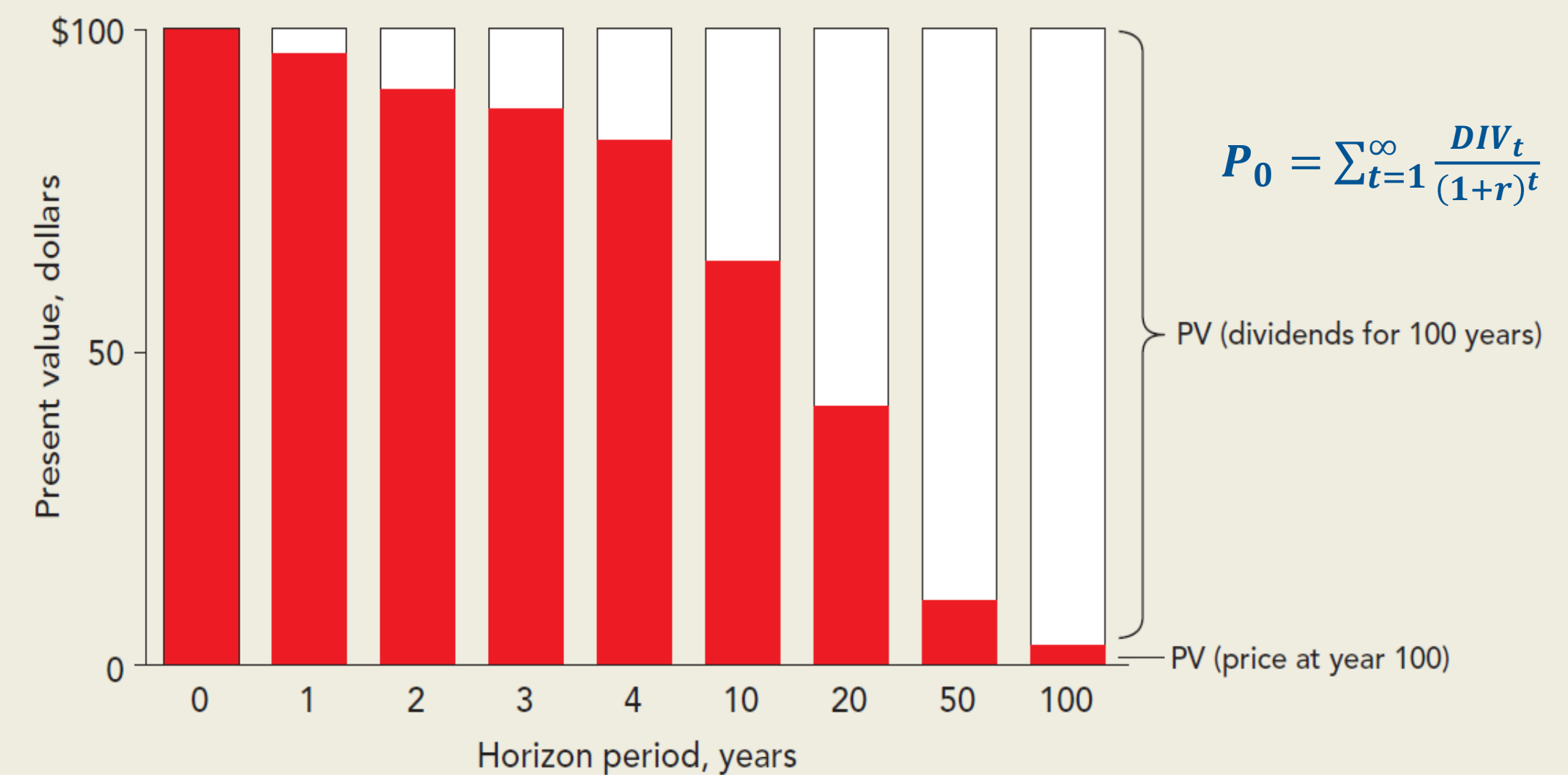
- Let us examine the price of stock next year P_1. Similar to P_0, we can also write this price P_1 in terms of dividend DIV_1 and the discount rate r
- $P_1 = \frac{DIV_2 + P_2}{1+r}$
- Subsequently, we can also write the current price (P_0) in terms of dividends for next two years, DIV_1 and DIV_2
- $P_0 = \frac{DIV_1}{1+r} + \frac{DIV_2}{(1+r)^2} + \frac{P_2}{(1+r)^2}$
- Let us further consider the previous example of the company ABC. The investors are expecting a dividend of $5.50 in year 2 a price of $121 at the end of year 2
- $P_0 = \frac{5.00}{1.15} + \frac{5.50}{1.15^2} + \frac{121}{1.15^2} = 100$
- $\mathbf{P_0 = \frac{DIV_1}{1+r} + \frac{DIV_2}{(1+r)^2} + \frac{DIV_3}{(1+r)^3} + \cdots + \frac{DIV_H + P_H}{(1+r)^H} = \sum_{t=1}^{H} \frac{DIV_t}{(1+r)^t} + \frac{P_H}{(1+r)^H}}$

Fundamental valuation of stocks-II

- For company ABC, let us consider a 100-period horizon with 10% growth in dividends and prices year-on-year

	Expected Future Values		Present Values		
1.HorizonPeriod (H)	2.Dividend (DIVt)	3.Price (Pt)	4.Cumulative Dividends	5.Future Price	6.Total
0	—	100	—	—	100
1	5.00	110	4.35	95.65	100
2	5.50	121	8.51	91.49	100
3	6.05	133.10	12.48	87.52	100
4	6.66	146.41	16.29	83.71	100
10	11.79	259.37	35.89	64.11	100
20	30.58	672.75	58.89	41.11	100
50	533.59	11,739.09	89.17	10.83	100
100	62,639.15	1,378,061.23	98.83	1.17	100

Fundamental valuation of stocks-II



$$P_0 = \sum_{t=1}^{\infty} \frac{DIV_t}{(1+r)^t}$$

Dividend discount model and cost of equity capital

- Assume a constant long-term growth rate of ‘g’ in dividends and an appropriate discount rate ‘r’
- Assuming a dividend of DIV_1 in the first year, this perpetuity can be valued using the formula shown here: $P_0 = \frac{DIV_1}{r-g}$
- If the current price (P_0) is observed, this formula can be used to estimate ‘r’ as shown here: $r = \frac{DIV_1}{P_0} + g$

Dividend discount model and cost of equity capital

- Firm XYZ has a share price of $42.45 at the start of the period, expected dividends starting from the year end amount to $1.68 per share, payout ratio is 60%
- he dividend yield for this stock can be simply computed as Dividend yield= $\frac{DIV_1}{P_0} = \frac{1.68}{42.45} = 4.0\%$
- $\text{Plowback raio} = 1 - \text{payout ratio} = 1 - \frac{\text{DIV}}{\text{EPS}} = 1 - .60 = 0.40$
- Then your overall estimate of cost of equity capital: r= $\frac{DIV_1}{P_0} + g = 4.0\% + 4.0\%$=8.0%
- Such estimates are often noisy and prone to errors of estimation
- Constant growth dividend discount formula employed earlier is extremely sensitive to changes in the values of ‘g’ and ‘r’

Dividend discount model and cost of equity capital

- Consider the example of a firm with equity of \$25, $DIV_1 = \$0.5$ and $P_0 = \$50.0$. The firm has an ROE of 25% and payout ratio of 20%
- Let us first compute the cost of equity for this firm
- (1) Dividend growth rate= (1-Payout ratio)*ROE= (1-0.20)*0.25= 20%
- $r = Dividend\ yield + g = \frac{0.5}{50} + 20\% = 1\% + 20\% = 21\%$
- No firm can sustain a growth rate of 21% infinitely into future. In real life such growth rates drop gradually over the years and attain that lower long-term growth that is sustainable

Dividend discount model and cost of equity capital

- To simplify things here, assume that the firm ROE drops to 16% in the third year. Also that the payout ratio increases to 50%

- So now we have new growth figure, i.e., g= 0.50*16%= 8%.

Years	1	2	3	4
Equity	10.00	10*1.20=12.00	12*1.20=14.40	14.40*1.08=15.55
Return on equity, ROE	0.25	0.25	0.16	0.16
Earnings per share, EPS	10*0.25=2.50	12*0.25=3.00	14.40*0.16=2.30	15.55*0.16=2.49
Payout ratio	0.20	0.20	0.50	0.50
Next year growth= (1-Payout)*ROE	-	(1-0.2)*0.25=0.20	(1-0.5)*0.16=0.08	(1-0.5)*0.16=0.08
Dividends per share, DIV	2.5*0.2=0.50	3*0.20=0.60	2.30*0.5=1.15	2.49*0.5=1.245

Dividend discount model and cost of equity capital

- In order to compute the current price (P_0), one needs to use the DCF formula in two stages
- In the high-growth phase, we need to value the three dividend inflows in year 1, 2, and 3.
- Present value of dividends obtained in years 1, 2, and 3: $\frac{DIV_1}{1+r} + \frac{DIV_2}{(1+r)^2} + \frac{DIV_3}{(1+r)^3}$
- Steady state growth phase with cash flows in perpetuity: $\frac{P_3}{(1+r)^3} = \frac{DIV_4}{(r-g)} * \frac{1}{(1+r)^3}$
- $50 = \frac{0.50}{1+r} + \frac{0.60}{(1+r)^2} + \frac{1.15}{(1+r)^3} + \frac{1.245}{(r-0.08)} * \frac{1}{(1+r)^3}$; current price is $50
- Solving for above equation, we get a value of r=9.94%

Stock price, growth, and earnings per share

- Investors often contrast growth with income stocks
- Growth stocks offer capital gains; Contrast this to income stocks that offer regular income in the form of cash dividends
- Consider the example of a company that doesn't grow and pay most of the earnings as dividends ($10), it is currently valued at $100
- Expected returns = dividend yield = $\frac{DIV_1}{P_0}=\frac{10}{100} = 10.0\%$
- Also, if one discounts the dividends of this company, till perpetuity ($P_0 = \frac{DIV_1}{r}$), one should be able to obtain the current price that is $100

Stock price, growth, and earnings per share

- Let us consider the case of a growth firm
- The firm invests most of its earnings internally, investment of $10 at the end of year t=1
- The company also expects that this investment opportunity has a return of 10%, same as market capitalization rate
- NPV of this project= $-C_0 + \frac{DIV_1}{r} = -10 + \frac{1}{0.10} = 0$
- Investors were expecting a return of 10% on their investment in the firm
- Even if the firm distributed these cash flows to investors, they would've obtained the same 10% returns by investing in financial market instruments

Stock price, growth, and earnings per share

- Let us consider four examples of different returns from this project

Project Rate of Return	Incremental Cash Flows	Project NPV in year 1	Project contribution to firm value at T=0	Share Price at T=0, P0	P0/EPS1	r
0.05	.50	-10+0.5/0.10=- 5.00	-4.55	95.45	9.545	0.10
0.10	1.00	-10+1.0/0.10=0	0	100.00	10.000	0.10
0.15	1.50	-10+1.5/0.10= 5.00	+ 4.55	104.55	10.455	0.10
0.20	2.00	-10+2.0/0.10= 10.00	+ 9.09	109.09	10.909	0.10

- Please observe that in those cases where NPV is negative, the price to earnings ratio is less than 10 and more than 10 where NPV is positive
- The value of price can be distributed in two components. First component, the capitalized value of earnings under no-growth policy; Second component, is the present value of growth opportunities (PVGO)
- $P_0 = \frac{EPS_1}{r} + PVGO$ or $\frac{EPS_1}{P_0} = r(1 - \frac{PVGO}{P_0})$

Stock price, growth, and earnings per share

- Consider a company COM with market capitalization rate of 15% and ROE=25%. COM has earnings of $8.33 and a payout ratio of 0.6. The company is expected to pay a divided of $5 in the next year, and thereafter, the dividend is expected to increase indefinitely by 10% a year

- $P_0 = \frac{DIV_1}{r-g} = \frac{5}{15\%-10\%} = \$100$

- The company is plowing back 40% of earnings with an ROE of 25%. Growth rate of the firm ‘g’= 0.40*25%=10%

- Assume a no-growth policy: $\mathrm{P}' = \frac{EPS}{r} = \frac{8.33}{0.15} = \$55.56$

- $\text{Thus, PVGO} = P_0 - \mathrm{P}' = 100 - 55.56 = 44.44$

Stock price, growth, and earnings per share

- Let us try and break-down this figure of $44.44
- The company plows back 40% of earnings. In the first year, this amount is 8.33-5=$3.33. This amount is invested at a return of 25%, that is 3.33*25%=$0.83 earnings starting from year 2
- The present value of this investment at T=1 can be computed as shown here: $-3.33 + \frac{0.83}{0.15} = \$2.22$
- Also, it is known to us that firm earnings are growing at 10%. Therefore, we can expect this $2.22 additional earnings to also grow at the same rate of 10%. That means, in the second year, we will have additional earnings of 2.22*1.10= $2.44 and 2.44*1.10=$2.69 in the third year and so on
- At 10% capitalization rate, let us compute the present value of all these incremental cash flows, starting from year 1 at $2.22
- $\mathbf{PVGO} = \frac{2.22}{0.15-0.10} = \$44.44$ **or** $\mathbf{P_0} = \frac{\mathbf{EPS_1}}{\mathbf{r}} + \mathbf{PVGO} = 55.56 + 44.44 = 100$

A simple example of business valuation

- Let us start with some basic information and assumptions about this business
- The business has an appropriate discount rate of 10%. The business grows at a rapid pace of 20% per annum for five years, the falls to 13% for years 6-7, and finally settles down at a 6% steady state growth rate thereafter. Returns on asset (RoA) amount to a constant 12%. The plowback ratio is derived from the expected growth of the business, using the formula g= RoA (or RoE)* Plowback ratio. Starting with a size of $10Mn in the first year, the cash flows are provided here

Years	1	2	3	4	5	6	7	8	9	10
Growth (%)	20%	20%	20.0%	20.0%	20.0%	13%	13%	6%	6%	6%
Asset value ($Mn)	10.00	12.00	14.40	17.28	20.74	23.43	26.48	28.07	29.75	31.54
RoA*	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%
Earnings ($Mn)	1.20	1.44	1.73	2.07	2.49	2.81	3.18	3.37	3.57	3.78
Plowback	167%	167%	167%	167%	108%	108%	50%	50%	50%	50%
Net investment ($Mn)	2.00	2.40	2.88	3.46	2.70	3.05	1.59	1.68	1.79	1.89
Free cash flows ($Mn)	-0.80	-0.96	-1.15	-1.38	-0.21	-0.23	1.59	1.68	1.79	1.89

A simple example of business valuation

- There are two components to this value
- Pre-steady state growth period value: $\mathbf{PV\ (cash\ flows\ )} = -\frac{\mathbf{0.80}}{\mathbf{1.10}} - \frac{\mathbf{0.96}}{\mathbf{(1.10)^2}} - \frac{\mathbf{1.15}}{\mathbf{(1.10)^3}} - \frac{\mathbf{1.38}}{\mathbf{(1.10)^4}} - \frac{\mathbf{0.21}}{\mathbf{(1.10)^5}} - \frac{\mathbf{0.23}}{\mathbf{(1.1)^6}}$ =-3.59
- Steady state growth period value or horizon value: $PV\ (Horizon\ value\ ) = \frac{1.59}{(0.10-0.06)} * \frac{1}{(1.1)^6}$ =22.42
- Total value= -3.59+22.42=$18.83 Mn.
- If you observe in financial markets that the average PE ratio for a mature business with similar profile is 11
- $PV\ (Horizon\ value\ ) = 11 * 3.18 * \frac{1}{(1.1)^6}$ =19.75
- If you observe that average market to book asset values for the similar mature companies is 1.4
- $PV\ (Horizon\ value\ ) = 1.4 * 26.48 * \frac{1}{(1.1)^6}$ =20.93

Summary and concluding remarks

- The value of stock is equal to the discounted dividend payments expected to be received in perpetuity
- $PV = \sum_{t=1}^{\infty} \frac{DIV_t}{(1+r)^t}$
- However, investors often do not plan to hold the stock for eternity and have finite investment horizons
- These investment horizons involve returns in the form of dividends and capital gains
- The value of the stocks with infinite stream of growing dividends: $P_0 = \frac{DIV_1}{r-g}$
- Price in terms of capitalized value of earnings and PVGO and $P_0 = \frac{EPS_1}{r} + PVGO$

Thanks!