SUMMARY CHAPTER 5
RESIDUAL INCOME VALUATION

- Residual income is calculated as net income minus a deduction for the cost of equity capital. The deduction is called the equity charge, and is equal to equity capital multiplied by the required rate of return on equity (the cost of equity capital in percent).
- Economic value added (EVA) is a commercial implementation of the residual income concept. EVA = NOPAT - (C% X TC), where NOPAT is net operating profit after taxes, C% is the percent cost of equity capital, and TC equals total capital.
- Residual income models (including commercial implementations) are used not only for equity valuation but also to measure internal corporate performance and for determining executive compensation.
- We can forecast per-share residual income as forecasted earnings per share minus the required rate of return on equity multiplied by beginning book value per share. Alternatively, we can forecast per-share residual income as beginning book value per share multiplied by the difference between forecasted ROE and the required rate of return on equity.
- According to the residual income model, the intrinsic value of a share of common stock is the sum of book value per share and the present value of expected future per share residual income. According to the residual income model, equivalent mathematical expressions for intrinsic value of a common stock are

$$V_0 = B_0 + \sum_{t=1}^{\infty} \frac{RI_t}{(1+r)^t} = B_0 + \sum_{t=1}^{\infty} \frac{E_t - rB_{t-1}}{(1+r)^t} = B_0 + \sum_{t=1}^{\infty} \frac{(ROE_t - r)B_{t-1}}{(1+r)^t}$$

Where

V_0 = value of a share of stock today ($t = 0$)

B_0 = current per share book value of equity

B_t = expected per share book value of equity at any time t

r = required rate of return on equity (cost of equity)

E_t = expected earnings per share for period t

RI_t = expected per share residual income, equal to $E_t - rB_{t-1}$ or $(ROE - r)B_{t-1}$

- In most cases, value is recognized earlier in the residual income model compared with other present value models of stock value such as the dividend discount model.
- Strengths of the residual income model include the following:
  - Terminal values do not make up a large portion of the value relative to other models.
  - The models use readily available accounting data.
  - The models can be used in the absence of dividends and near-term positive free cash flows.
  - The models can be used when cash flows are unpredictable.
- Weaknesses of the residual income model include the following:

  - These models are based on accounting data that can be subject to manipulation by management.
  - Accounting data used as inputs may require significant adjustments.
  - The models require that the clean surplus relation holds, or that the analyst makes appropriate adjustments when the clean surplus relation does not hold.

The residual income model is most appropriate in the following cases:

  - a company is not paying dividends or if it exhibits an unpredictable dividend pattern.
  - a company has negative free cash flow many years out but is expected to generate positive cash flow at some point in the future.
  - there is a great deal of uncertainty in forecasting terminal values.

- The fundamental determinants or drivers of residual income are book value of equity and return on equity.
- Residual income valuation is most closely related to PIB. When the present value of expected future residual income is positive (negative), the justified PIB based on fundamentals is greater than (less than) 1.
- When fully consistent assumptions are used to forecast earnings, cash flow, dividends, book value, and residual income through a full set of pro forma (projected) financial statements, and the same required rate of return on equity is used as the discount rate, the same estimate of value should result from a residual income, dividend discount, or free cash flow valuation. In practice, however, analysts may find one model much easier to apply and possibly arrive at different valuations using the different models.
- The residual income model assumes the clean surplus relation

$$B_t = B_{t-1} + E_t - D_t$$

In other terms, the ending book value of equity equals the beginning book value plus earnings less dividends, apart from ownership transactions.

- In practice, to apply the residual income model most accurately, the analyst needs
  - to adjust book value of common equity for off-balance-sheet items; and
  - adjust reported net income to reflect clean surplus accounting, where necessary.
- Continuing residual income is residual income after the forecast horizon. Frequently, one of the following assumptions concerning continuing residual income is made:
  - Residual income continues indefinitely at a positive level.
  - Residual income is zero from the terminal year forward.
  - Residual income declines to zero as ROE reverts to the cost of equity over time.
  - Residual income declines to some mean level.

PROBLEMS

1. Based on the following information, determine whether Vertically Integrated Manufacturing (VIM) earned any residual income for its shareholders in 2001:

- VIM had total assets of $3,000,000, financed with twice as much debt capital as equity capital.
- VIM's pretax cost of debt is 6 percent and cost of equity capital is 10 percent.
- VIM had EBIT of $300,000 and was taxed at a rate of 40 percent.

2. Using the following information, estimate the intrinsic value of VIM's common stock using the residual income model:

- VIM had total assets of $3,000,000, financed with twice as much debt capital as equity capital.
- VIM's pretax cost of debt is 6 percent and cost of equity capital is 10 percent.
- VIM had EBIT of $300,000 and was taxed at a rate of 40 percent. EBIT is expected to continue at $300,000 indefinitely.
- VIM's book value per share is $20.
- VIM has 50,000 shares of common stock outstanding.

3. Palmetto Steel, Inc. (PSI) maintains a dividend payout ratio of 80 percent because of its limited opportunities for expansion. Its return on equity is 15 percent. The required rate of return on PSI equity is 12 percent, and its long-term growth rate is 3 percent. Compute the justified P/B based on forecasted fundamentals, consistent with the residual income model and a constant growth rate assumption.

4. Because NewMarket Products (NMP) markets consumer staples, it is able to make use of considerable debt in its capital structure; specifically, 90 percent of the company's total assets of $450,000,000 are financed with debt capital. Its cost of debt is 8 percent before taxes, and its cost of equity capital is 12 percent. NMP achieved a pretax income of $5.1 million in 2001 and had a tax rate of 40 percent. What was NMP's residual income for 2001?

5. In 2002, Smithson-Williams Investments (SWI) achieved an operating profit after taxes of €10 million on total assets of €100 million. Half of its assets were financed with debt with a pretax cost of 9 percent. Its cost of equity capital is 12 percent, and its tax rate is 40 percent. Did SWI achieve a positive residual income?

6. Calculate the economic value added (EVA) or residual income, as requested, for each of the following:

A. NOPAT = $100
Beginning book value of debt = $200
Beginning book value of equity = $300
WACC = 11 percent
Calculate EVA.

B. Net income = €5.00
Dividends = €1.00
Beginning book value of equity = €30.00
Required rate of return on equity = 11 percent
Calculate residual income.

C. Return on equity = 18 percent
Required rate of return on equity = 12 percent
Beginning book value of equity = €30.00
Calculate residual income.

7. (Adapted from 2000 CFA Level II exam) Jim Martin is using economic value added (EVA) and market value added (MVA) to measure the performance of Sundanci. Martin uses the fiscal 2000 information below for his analysis.

- Adjusted net operating profit after tax (NOPAT) is $100 million.
- Total capital is $700 million (no debt).
- Closing stock price is $26.
- Sundanci has 84 million shares outstanding.
- The cost of equity is 14 percent.

Calculate the following for Sundanci. Show your work.

A. EVA for fiscal 2000
B. MVA as of fiscal year-end 2000

8. Protected Steel Corporation (PSC) has a book value of $6 per share. PSC is expected to earn $0.60 per share forever and pays out all of its earnings as dividends. The required rate of return on PSC's equity is 12 percent. calculate the value of the stock using the following:

A. Dividend discount model
B. Residual income model

9. Notable Books (NB) is a family-controlled company that dominates the retail book market. NB has book value of $10 per share, is expected to earn $2.00 forever, and pays out all of its earnings as dividends. Its required return on equity is 12.5 percent. Place a value on the stock of NB using the following:

A. Dividend discount model

B. Residual income model

10. Simonson Investment Trust International (SITI) is expected to earn $4.00, $5.00, and $8.00 for the next three years. SITI will pay annual dividends of $2.00, $2.50, and 20.50 in each of these years. The last dividend includes the liquidating payment to shareholders at the end of Year 3 when the trust terminates. SITI's book value is $8 per share and its required return on equity is 10 percent.

A. What is the current value per share of SITI according to the dividend discount model?

B. Calculate per-share book value and residual income for SITI for each of the next 3 years and use those results to find the stock's value using the residual income model.

C. Calculate return on equity and use it as an input to the residual income model to calculate SITI's value.

11. Foodsco Incorporated (FI), a leading distributor of food products and materials to restaurants and other institutions, has a remarkably steady track record in terms of both return on equity and growth. At year-end 2000, FI had a book value of $30 per share. For the foreseeable future, you expect the company to achieve a ROE of 15 percent (on trailing book value) and to pay out one-third of its earnings in dividends. Your required return is 12 percent. Forecast FI's residual income for the year ending 31 December 2005.

12. Lendex Electronics (LE) has had a great deal of turnover of top management for several years and was not followed by analysts during this period of turmoil. Because the company's performance has been improving steadily for the past three years, technology analyst Steve Kent recently reinitiated coverage of LE. A meeting with management confirmed Kent's positive impression of LE's operations and strategic plan.
Kent decides LE merits further analysis.
Careful examination of LE's financial statements revealed that the company had negative other comprehensive income from changes in the value of available-for-sale securities in each of the past five years. How, if at all, should this observation about LE's other comprehensive income affect the figures that Kent uses for the company's ROE and book value for those years?

13. Retail fund manager Seymour Simms is considering the purchase of shares in upstart retailer Hot Topic Stores (HTS). The current book value of HTS is $20 per share, and its market price is $35. Simms expects long-term ROE to be 18 percent, long-term growth to be 10 percent, and cost of equity to be 14 percent. What conclusion would you expect Simms to arrive at if he uses a single-stage residual income model to value these shares?

14. Dayton Manufactured Homes (DMH) builds prefabricated homes and mobile homes. Both favorable demographics and the likelihood of slow, steady increases in market share should enable DMH to maintain its ROE of 15 percent and growth rate of 10 percent over time. DMH has a book value of $30 per share and the required rate of return on its equity is 12 percent. Compute the value of its equity using the single-stage residual income model.

15. Use the following inputs and the finite horizon form of the residual income model to compute the value of Southern Trust Bank (STB) shares as of 3 1 December 2001:

- ROE will continue at 15 percent for the next five years (and 10 percent thereafter) with all earnings reinvested (no dividends paid).
- Cost of Equity = 10 percent.
- B_0 = $10 per share (at year-end 2001).
- Premium over book value at the end of five years will be 20 percent.

For Problems 16 and 17, use the following data for Taiwan Semiconductor Manufacturing Ltd. (TSM). Refer to Equation 5-8 in the text.

- Current price = TWD8 1.
- Cost of equity = 14.33 percent.
- Five-year forecast of growth in book value = 22 percent.
- Book value per share = TWD16.47.
- Analyst EPS forecasts are TWD2.07 for 2002 and TWD4.81 for 2003.
- Analysts expect ROE to stabilize at 25 percent from 2002 through 201 1, and then decline to 20 percent through 2022 in Problem 16 and 2023 in Problem 17.
- As of the beginning of 2002, an analyst estimates the intrinsic value using the residual income model as TWD59.18 with the zero premium shown in Example 5-10.

16. In the above analysis, the analyst uses the multistage residual income model and assumes that TSM's ROE will fade toward the cost of equity capital after 2022. How would her conclusion about TSM's valuation change if she believed that the persistence parameter for this company should be 0.90 (rather than 0.60) because of patent protection for some of TSM's technology?

17. Having completed the revised analysis, which gives TSM greater credit for its patented technology, the analyst realizes that the changes warrant an additional adjustment.
Although she generally employs a 20-year time frame when implementing the multistage residual income model, she believes that the TSM's ROE will remain at 20 percent through 2023 before fading toward the cost of equity capital. (Recall she is now using a persistence parameter of 0.90.) How does this extension of the period with above-normal ROE alter her valuation of TSM?

18. Shunichi Kobayashi is valuing United Parcel Service (NYSE: UPS). Kobayashi has made the following assumptions:

- Book value per share is estimated at $9.62 on 3 1 December 2001.
- EPS will be 22 percent of the beginning book value per share for the next eight years.
- Cash dividends paid will be 30 percent of EPS.
- At the end of the eight-year period, the market price per share will be three times the book value per share.
- The beta for UPS is 0.60, the risk-free rate is 5.00 percent, and the equity risk premium is 5.50 percent.

The current market price of UPS is $59.38, which indicates a current PIB of 6.2.

A. Prepare a table showing the beginning and ending book values, net income, and cash dividends annually for the eight-year period.
B. Estimate the residual income and the present value of residual income for the eight years.
C. Estimate the value per share of UPS stock using the residual income model.
D. Estimate the value per share of UPS stock using the dividend discount model.How does this value compare with the estimate from the residual income model?

19. Boeing Company (NYSE: BA) has a current stock price of $49.86. It also has a PIB of 3.57 and book value per share of $13.97. Assume that the single-stage growth model is appropriate for valuing BA. Boeing's beta is 0.80, the risk-free rate is 5.00 percent, and the equity risk premium is 5.50 percent.
A. If the growth rate is 6 percent and the ROE is 20 percent, what is the justified P/B for Boeing?
B. If the growth rate is 6 percent, what ROE is required to yield Boeing's current P/B?
C. If the ROE is 20 percent, what growth rate is required for Boeing to have its current P/B?

Chapter 5 – Residual Income Valuation

Solutions

1. Yes, VIM earned a positive residual income:

EBIT	300,000
Interest	120,000 (2,000,000 × 6%)
Pretax income	180,000
Tax expense	72,000
Net income	108,000

Equity charge = Equity capital × Required return on equity
= (1/3)(3,000,000) × 0.10
= 1,000,000 × 0.10 = 100,000

Residual income = Net income – Equity charge
= 108,000 – 100,000 = 8,000

2. According to the residual income model, intrinsic value for a share of common stock equals book value per share plus the present value of expected future per-share residual income. Book value per share was given as \$20. Noting that debt is (2/3)(\$3,000,000) = \$2,000,000 so that interest is \$2,000,000 × 6% = \$120,000, we find that VIM has residual income of \$8,000 calculated (as in Problem 1) as follows:

Residual income = Net income – Equity charge
= [(EBIT – Interest)(1 – Tax rate)]
– [(Equity capital)(Required return on equity)]
= [(\$300,000 – \$120,000)(1 – 0.40)] – [(\$1,000,000)(0.10)]
= \$108,000 – \$100,000
= \$8,000

Therefore, residual income per share is \$8,000/50,000 shares = \$0.16 per share. Because EBIT is expected to continue at the current level indefinitely, we treat the expected per-share residual income of \$0.16 as a perpetuity. With a required return on equity of 10 percent, we have

Intrinsic value = \$20 + \$0.16/0.10 = \$20 + \$1.60 = \$21.60

3. With $g = b \times \text{ROE} = (1 - 0.80)(0.15) = (0.20)(0.15) = 0.03$,

P/B $= (\text{ROE} - g)/(r - g)$
$= (0.15 - 0.03)/(0.12 - 0.03)$
$= 0.12/0.09 = 1.33$
or
P/B $= 1 + (\text{ROE} - r)/(r - g)$

$= 1 + (0.15 - 0.12)/(0.12 - 0.03)$
$= 1.33$

4. In this problem, interest expense has already been deducted in arriving at NMP's pretax income of $5.1 million. Therefore,

Net income = Pretax income × (1 – Tax rate)
= $5.1 million × (1 – 0.4)
= $5.1 × 0.6 = $3.06 million

Equity charge: Total equity × Cost of equity capital
= (0.1 × $450 million) × 12%
= $45 million × 0.12 = $5,400,000

Residual income = Net income – Equity charge
= $3,060,000 – $5,400,000 = –$2,340,000

NMP had negative residual income of –$2,340,000 in 2001.

5. To achieve a positive residual income, a company's net operating profit after taxes as a percentage of its total assets can be compared with the weighted-average cost of its capital. For SWI:

NOPAT/Assets = 10 million/100 million = 10 percent
WACC = (0.5)(After-tax cost of debt) + (0.5)(Cost of equity)
= (0.5)(0.09) (0.6) + (0.5)(0.12)
= (0.5)(0.054) + (0.5)(0.12) = 0.027 + 0.06 = 0.087 = 8.7%

Therefore, SWI's residual income was positive. Specifically, residual income equals (0.10 – 0.087) × €100 million = €1.3 million.

6. A. EVA = NOPAT – WACC × (Beginning book value of assets)
= 100 – (11%) × (200 + 300) = 100 – (11%)(500) = $45

B. $RI_t = E_t - rB_{t-1}$
= 5.00 – (11%)(30.00) = 5.00 – 3.30 = €1.70

C. $RI_t = (ROE_t - r) \times B_{t-1}$
= (18% – 12%) × (30) = €1.80

7. A. Economic value added = Net operating profit after taxes – (Cost of capital × Total capital) = $100 million – (14% × $700 million) = $2 million. In the absence of information that would be required to calculate the weighted average cost of debt and equity, and given that Sundanci has no long-term debt, the only capital cost used is the required rate of return on equity of 14 percent.

B. Market value added = Market value of capital – Total capital
$26 stock price × 84 million shares – $700 million = $1.48 billion

8. A. Because the dividend is a perpetuity, the no-growth form of the DDM is applied as follows:

$V_0 = D/r$
$= \$0.60/0.12 = \$5$ per share

B. According to the residual income model, V_0 = Book value per share + Present value of expected future per-share residual income.
$RI_t = E - rB_{t-1}$
$= 0.60 - (0.12)(6) = -\$0.12$
Present value of perpetual stream of residual income equals
$RI_t/r = -\$0.12/0.12 = -\$1.00$
$V_0 = \$6.00 - \$1.00 = \$5.00$ per share

9. A. According to the DDM, $V_0 = D/r$ for a no-growth company.
$V_0 = \$2.00/0.125 = \$16$ per share

B. Under the residual income model, $V_0 = B_0$ + Present value of expected future per-share residual income:
$RI_t = E - rB_{t-1}$
$= \$2 - (0.125)(\$10) = \$0.75$
Present value of stream of residual income = RI_t/r
$= 0.75/0.125 = \$6$
$V_0 = \$10 + \$6 = \$16$ per share

10. A. V_0 = Present value of the future dividends
$= 2/1.10 + 2.50/(1.1)^2 + 20.50/(1.1)^3$
$= \$1.818 + \$2.066 + \$15.402 = \$19.286$

B. The book values and residual incomes for the next three years are:

Year	1	2	3
Beginning book value	8.00	10.00	12.50
Retained earnings (Net income – Dividends)	2.00	2.50	(12.50)
Ending book value	10.00	12.50	0.00
Net income	4.00	5.00	8.00
Less equity charge ($r \times$ Book value)	0.80	1.00	1.25
Residual income	3.20	4.00	6.75

$V_0 = 8.00 + 3.20/1.1 + 4.00/(1.1)^2 + 6.75/(1.1)^3$
$V_0 = 8.00 + 2.909 + 3.306 + 5.071 = \$19.286$

C.

Year	1	2	3
Net income	4.00	5.00	8.00
Beginning book value	8.00	10.00	12.50
Return on equity (ROE)	50%	50%	64%
ROE – r	40%	40%	54%
Residual income (ROE – r) × Book value	3.20	4.00	6.75

$V_0 = 8.00 + 3.20/1.1 + 4.00/(1.1)^2 + 6.75/(1.1)^3$
$V_0 = 8.00 + 2.909 + 3.306 + 5.071 = \$19.286$

Note: Because the residual incomes for each year are necessarily the same in Parts B and C, the results for stock valuation are identical.

11.

Year	2001	2002	2005
Beginning book value	30.00	33.00	43.92
Net income = ROE × Book value	4.50	4.95	6.59
Dividends	1.50	1.65	2.20
Equity charge (r × Book value)	3.60	3.96	5.27
Residual income	0.90	0.99	1.32
Ending book value	33.00	36.30	48.32

The table shows that residual income in Year 2001 is \$0.90, which equals Book value (beginning of year) × (ROE – r) = \$30 × (0.15 – 0.12) = \$0.90. By examining the Year 2002 column, one can see that residual income grew by 10 percent to \$0.99, which follows from the fact that growth in residual income relates directly to the growth in net income as this company is configured. When both net income and dividends are a function of book value and return on equity is constant, then growth can be predicted from g = (ROE)(1 – Dividend payout ratio). In this case, $g = 0.15 \times (1 - 0.333) = 0.10$ or 10 percent. Net income and residual income will grow by 10 percent annually.

Therefore, residual income in Year 2005 = (Residual income in Year 2001) × $(1.1)^4$. Residual income in Year 2005 = 0.90 × 1.4641 = \$1.32.

12. When items such as changes in the value of available-for-sale securities bypass the income statement, they are generally assumed to be non-operating items that will fluctuate from year to year, although averaging to zero over a period of years. The evidence suggests, however, that changes in the value of available-for-sale securities are not averaging to zero but are persistently negative. Furthermore, these losses are bypassing the income statement. It appears that the company is either making an inaccurate assumption or misleading investors in one way or another. Accordingly, Kent might adjust LE's income downward by the amount of loss for other comprehensive income for each of those years. ROE would then

decline commensurately. LE's book value would *not* be misstated because the decline in the value of these securities was already recognized.

13. $V_0 = B_0 + [(\text{ROE} - r)/(r - g)] \times B_0$
$= \$20 + [(0.18 - 0.14)/(0.14 - 0.10)] \times \$20$
$= \$20 + 1.0\ (\$20) = \$40$
Simms will probably conclude that the shares are somewhat undervalued.

14. $V_0 = B_0 + (\text{ROE} - r) \times B_0/(r - g)$
$= 30 + (0.15 - 0.12) \times 30/(0.12 - 0.10)$
$= 30 + 45 = \$75$ per share

15.

Year	Net Income (Projected)	Ending Book Value	ROE (%)	Equity Charge (in currency)	Residual Income	PV of RI
2001		10.00				
2002	1.50	11.50	15	1.00	0.50	0.45
2003	1.73	13.23	15	1.15	0.58	0.48
2004	1.99	15.22	15	1.32	0.67	0.50
2005	2.29	17.51	15	1.52	0.77	0.53
2006	2.63	20.14	15	1.75	0.88	0.55
						2.51

Using the finite horizon form of residual income valuation,
V_0 = B_0 + Sum of discounted RIs + Premium (also discounted to present)
$= \$10 + \$2.51 + (0.20)(20.14)/(1.10)^5$
$= \$10 + \$2.51 + \$2.50 = \$15.01$

16. The present value of the terminal value would then be
$\text{RI}_T/(1 + r - \omega)(1 + r)^{T-1} = 48.86/(1 + 0.1433 - 0.90)(1.1433)^{20} = 13.79$

Total value is 59.18 + 13.79 = TWD72.97. The analyst would again conclude that TSM's shares are overvalued.

17. The value of TSM for the forecast period would be

Year	Net Income (Projected)	Book Value	Forecast ROE (beg. equity, %)	Cost of Equity (%)	Equity charge TWD	Residual Income	PV of RI	Total
2001		16.47					16.47	62.11
2002	2.07	18.54	12.57	14.33	2.36	–0.29	(0.25)	
2003	4.81	23.35	25.94	14.33	2.66	2.15	1.65	
2004	5.84	29.19	25.00	14.33	3.35	2.49	1.67	
2005	7.30	36.48	25.00	14.33	4.18	3.11	1.82	
2006	9.12	45.61	25.00	14.33	5.23	3.89	1.99	
2007	11.40	57.01	25.00	14.33	6.54	4.87	2.18	
2008	14.25	71.26	25.00	14.33	8.17	6.08	2.38	
2009	17.81	89.07	25.00	14.33	10.21	7.60	2.60	
2010	22.27	111.34	25.00	14.33	12.76	9.50	2.85	
2011	27.84	139.18	25.00	14.33	15.96	11.88	3.11	
2012	27.84	167.01	20.00	14.33	19.94	7.89	1.81	
2013	33.40	200.41	20.00	14.33	23.93	9.47	1.90	
2014	40.08	240.50	20.00	14.33	28.72	11.36	1.99	
2015	48.10	288.60	20.00	14.33	34.46	13.64	2.09	
2016	57.72	346.32	20.00	14.33	41.36	16.36	2.20	
2017	69.26	415.58	20.00	14.33	49.63	19.64	2.30	
2018	83.12	498.70	20.00	14.33	59.55	23.56	2.42	
2019	99.74	598.43	20.00	14.33	71.46	28.28	2.54	
2020	119.69	718.12	20.00	14.33	85.76	33.93	2.66	
2021	143.62	861.75	20.00	14.33	102.91	40.72	2.80	
2022	172.35	1034.10	20.00	14.33	123.49	48.86	2.93	
2023	206.82	1240.91	20.00	14.33	148.19	58.63		

The present value of the terminal value would then be

$$RI_T/(1 + r - \omega)\,(1 + r)^{T-t} = 58.63/(1 + 0.1433 - 0.90)(1.1433)^{21} = 14.47$$

Total value is 62.11 + 14.47 = TWD76.58. The analyst would again conclude that TSM's shares are overvalued.

18. A. The table below shows calculations for book values, net income, and dividends.

Year	Beginning Book Value	Net Income	Dividends	Ending Book Value	Residual Income	PV of RI
1	9.620	2.116	0.635	11.101	1.318	1.217
2	11.101	2.442	0.733	12.811	1.521	1.297
3	12.811	2.818	0.846	14.784	1.755	1.382
4	14.784	3.252	0.976	17.061	2.025	1.472
5	17.061	3.753	1.126	19.688	2.337	1.569
6	19.688	4.331	1.299	22.720	2.697	1.672
7	22.720	4.998	1.500	26.219	3.113	1.781
8	26.219	5.768	1.730	30.257	3.592	1.898

For each year above, net income is 22 percent of beginning book value. Dividends are 30 percent of net income. The ending book value is the beginning book value plus net income minus dividends.

B. Residual income is Net income – Cost of equity (%) × Beginning book value. To find the cost of equity,

$r = R_F + \beta_i[E(R_M) - R_F] = 5\% + (0.60)(5.5\%) = 8.30\%$

For Year 1 in the table above,

Residual income = 2.116 – (8.30%)(9.62) = 2.116 – 0.798 = \$1.318

This same calculation is repeated for Years 2 through 8. The final column of the table gives the present value of the calculated residual income, discounted at 8.30 percent.

C. To find the stock value with the residual income method, we use the equation

$$V_0 = B_0 + \sum_{t=1}^{T} \frac{(E_t - rB_{t-1})}{(1+r)^t} + \frac{P_T - B_T}{(1+r)^T}$$

In this equation, B_0 is the current book value per share of \$9.62. The sum of the present values of the eight years' residual income is the sum of the present values of the residual incomes in the table above, \$12.288. We need to estimate the final term, the present value of the excess of the terminal stock price over the terminal book value. The terminal stock price is assumed to be 3.0 times the terminal book value, or $P_T = 3.0(30.257) =$ \$90.771. $P_T - B_T$ is 90.771 – 30.257 = \$60.514. The present value of this amount discounted at 8.30 percent for eight years is \$31.976. Adding these terms together gives a stock price of $V_0 = 9.62 + 12.288 + 31.976 =$ \$53.884.

D. The appropriate DDM expression is

$$V_0 = \sum_{t=1}^{T} \frac{D_t}{(1+r)^t} + \frac{P_T}{(1+r)^T}$$

We have calculated the dividends and terminal stock price above. Discounting them at 8.30 percent would give the value of the stock:

Year	Dividend	PV of Dividend
1	0.635	0.586
2	0.733	0.625
3	0.846	0.666
4	0.976	0.709
5	1.126	0.756
6	1.299	0.805
7	1.500	0.858
8	1.730	0.914
All		5.919

The present value of the eight dividends is \$5.92. The terminal stock price is assumed to be \$90.771, which is worth \$47.964 discounted at 8.30 percent for eight years. The value for the stock, the present value of the dividends plus the present value of the terminal stock price, is $V_0 = 5.92 + 47.964 = \$53.884$. The stock values estimated with the residual income model and the dividend discount model are identical. Because they are based on similar financial assumptions, this equivalency is expected. Even though the recognition of income differs between the two models, their final results are the same.

19. A. The justified P/B can be found with the following formula:

$$\frac{P_0}{B_0} = 1 + \frac{\text{ROE} - r}{r - g}$$

ROE is 20%, g is 6%, and $r = R_F + \beta_I[E(R_M) - R_F] = 5\% + (0.80)(5.5\%) = 9.4\%$. Substituting in the values gives a justified P/B of

$$\frac{P_0}{B_0} = 1 + \frac{0.20 - 0.094}{0.094 - 0.06} = 4.12$$

The assumed parameters give a justified P/B of 4.12, slightly above the current value of 3.57.

B. To find the ROE that would result in a P/B of 3.57, we substitute 3.57, r, and g into the following equation:

$$\frac{P_0}{B_0} = 1 + \frac{\text{ROE} - r}{r - g}$$

This yields

$$3.57 = 1 + \frac{\text{ROE} - 0.094}{0.094 - 0.06}$$

Solving for ROE, after several steps we finally derive a ROE of 0.18138 or 18.1 percent. This value of ROE is consistent with a P/B of 3.57.

C. To find the growth rate that would result in a P/B of 3.57, we use the expression given in Part B, solving for g instead of ROE:

$$\frac{P_0}{B_0} = 1 + \frac{\text{ROE} - r}{r - g}$$

Substituting in the values, we have

$$3.57 = 1 + \frac{0.20 - 0.094}{0.094 - g}$$

Solving for g, after several steps we obtain a growth rate of 0.05275 or 5.3 percent. Assuming that the single-stage growth model is applicable to Boeing, the current P/B and current market price can be justified with values for ROE or g that are not much different from our starting values of 20 percent and 6 percent, respectively.