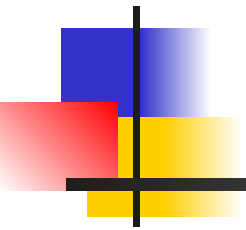


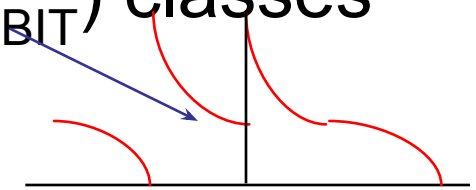
Modigliani & Miller + WACC

M&M: The Starting Point

- A number of restrictive assumptions apply
- Use the additivity principle
- Derive propositions re: valuation and cost of capital
  - Derived in both the “no tax” and “tax” cases.

The M&M Assumptions

- Homogeneous expectations
- Homogeneous business risk (σ_{EBIT}) classes



- Perpetual no-growth cash flows
- Perfect capital markets:
  - Perfect competition; i.e., everyone is a price taker
  - Firms and investors borrow and lend at the same rate
  - Equal access to all relevant information
  - No transaction costs (no taxes or bankruptcy costs).

Business Risk

- Business risk:
  - Risk surrounding expected operating cash flows
- Factors causing high business risk:
  - High correlation between the firm and the economy
  - Firm has small market share in competitive market
  - Firm is small relative to competitors
  - Firm is not well diversified
  - Firm has high fixed operating costs.

Principle of Additivity

- Allows you to value the cash flows in any way that you like
  - Either value each individual component at its own risk adjusted discount rate (RADR)
  - Or value the sum of the components at the RADR that is appropriate to the sum
- The concept:

  PV[*A* + *B at RADR appropriate to (A* + *B*)]

  = PV(*A at RADR appropriate to A*)

  + PV(*B at RADR appropriate to B*).

Additivity Example

Asset	1-Period E(payoff)	Beta
A	$100	1
B	$150	2

Market risk premium = 8%; risk-free rate = 6%

RADR of A = 6% + 1 * 8% = 14%

RADR of B = 6% + 2 * 8% = 22%

Value of A = $100 / 1.14 = $87.72

Value of B = $150 / 1.22 = $122.95

Portfolio = $87.72 + $122.95 = $210.67

Verify the answer from a portfolio perspective.

M&M Capital Structure Propositions (No Taxes)

- *M&M Proposition I:*

  Value of unlevered firm = value of levered firm

- *M&M Proposition II:*

$$r_e = r_u + (r_u - r_b)\, B / S$$

Also, defined as return on assets

r_b = cost of debt

r_e = cost of equity

r_u = cost of capital for all-equity firms in this risk class

B = value of debt

S = value of stock or equity.

M&M Propositions I & II (No Taxes)

Investment Alternative Initial investment = $5,000

EBIT = $1,000 forever

r_u = 10%

= Required return on unlevered equity

Financing Alternatives

	Unlevered	*Levered*
Equity	$5,000	$4,000
Debt (r_b = 5%)		$1,000
Cash Flows		
EBIT	$1,000	$1,000
– Interest		–50 = (.05)1,000
EBT	1,000	950
– Tax (0%)		
Net income	1,000	950
→ Cash flows debt + equity	$1,000	$1,000

M&M Propositions I & II (No Taxes)

- *Proposition I: $V_L = V_U$*

  V_U = S = (EBIT) / r_u = \$1,000 / .1 = \$10,000

  V_L = B + S = [Int + (EBIT - Int)] / r_u = \$1,000 / .1 = \$10,000

  $\Rightarrow$ S = V_L – B = \$10,000 – \$1,000 = \$9,000

  $\Rightarrow$ Capital structure: irrelevant without corporate taxes

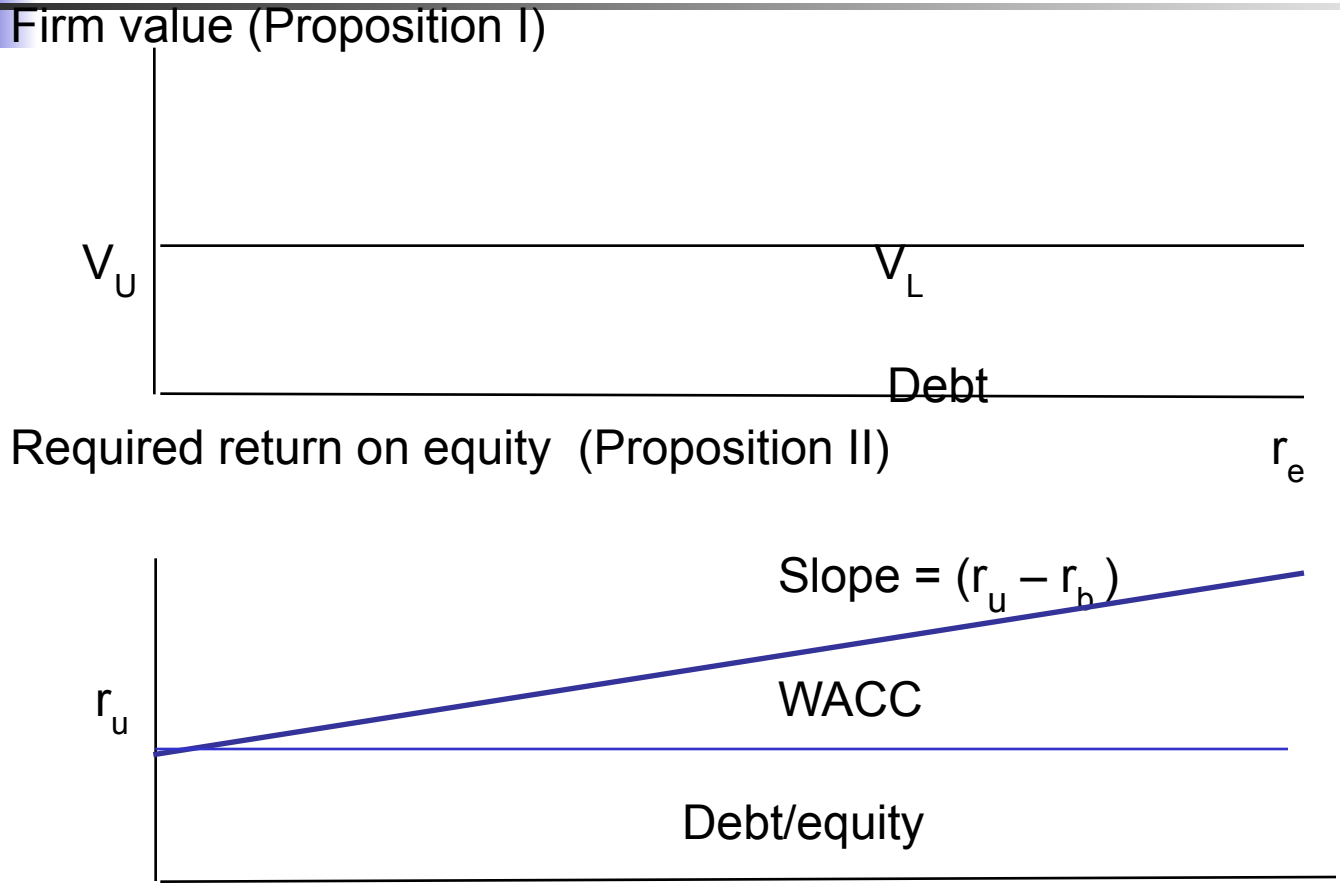
- *Proposition II: $r_e = r_u + (B/S)(r_u - r_b)$*

  r_u = .10 + (\$0 / \$10,000) (.10 – .05) = 10%

  r_e = .10 + (\$1,000 / \$9,000) (.10 – .05) = 10.556%

- WACC = 10.556% * 90% + 5% * 10% = 10%.

Graphing the M&M No-Tax Relationships



M&M Capital Structure Propositions (Corporate Taxes)

- *M&M Proposition I:*

$$V_L = V_U + \tau_C B$$

- *M&M Proposition II:*

$$r_e = r_u + (B / S)(1 - \tau_c)(r_u - r_b)$$

where

τ_c = Corporate tax rate

Other variables are as previously defined.

M&M Propositions I & II (Corporate Taxes)

Investment and financing alternatives - same as before

After-tax cost of capital for unlevered firm $r_u = 10\%$; $\tau_C = 34\%$

Cash Flows	*Unlevered*	*Levered*
EBIT	$1,000	$1,000
– Interest		–50 = (.05)1,000
EBT	1,000	950
– Tax (34%)		– 340
Net income		660
→ Cash flow debt + equity		$ 660

		– 323
		627
		$ 677

$17 difference = $50 interest x 34% tax rate

Tax Benefit of Debt Financing

- Debt interest is tax deductible
- For every $1 of interest expense:
  - Company pays $1 * (1 - τ)
  - Government pays $1 * τ
- Example:

  Income tax savings = Interest expense * τ

  = $50 * .34 = $17
- PV of gov't subsidy adds value to stock

  PV tax savings = Income tax savings / market rate

  = $17 / .05 = $340.

A Look at the Propositions

- *Proposition I:* $V_L = V_U + \tau_C B$

V_U = EBIT $(1 - \tau_C)$ / r_u = \$660 / .1 = \$6,600
$V_L = V_U + \tau_C B$ = \$6,600 + \$340 = \$6,940
$\Rightarrow$ $S = V_L - B$ = \$5,940.

- *Proposition II:* $r_e = r_u + (B / S)(1 - \tau_c)(r_u - r_b)$

r_u = .10 + (\$0 / \$6,600) (1–.34) (.10 – .05) = 10%
r_e = .10 + (\$1,000 / \$5,940) (1 – .34) (.10 – .05) = 10.556%

WACC = $(B / V_L)(1 - \tau_c) r_b + (S / V_L) r_e$
= (\$1,000 / \$6,940) (1 – .34) (.05)
+ (\$5,940 / \$6,940) (.10556) = 9.51%.

Confirmation

$V_L = B + S$

$= r_b B / r_b + (EBIT - r_d B)(1 - \tau_c) / r_e$

$= \$50 / .05 + (\$1{,}000 - \$50)(1 - .34) / .10556$

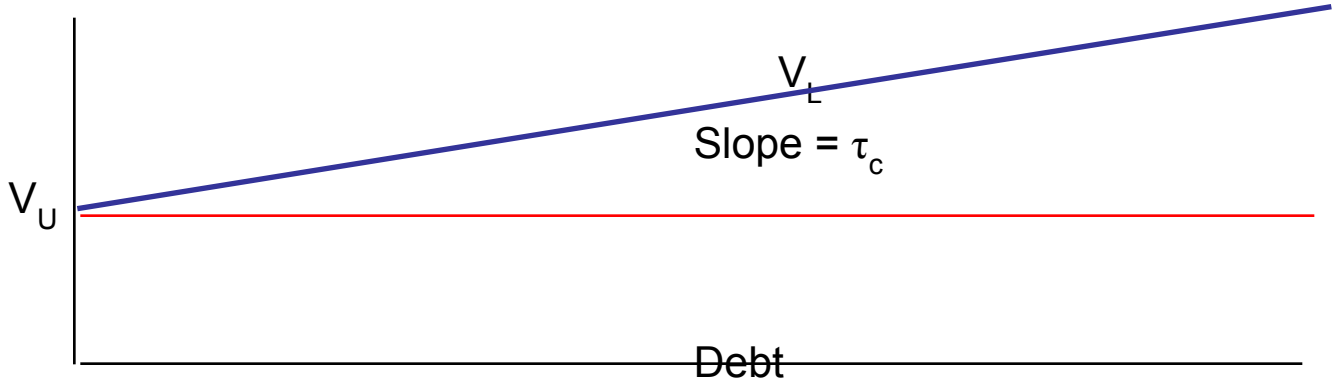
$= \$1{,}000 + \$5{,}940 = \$6{,}940$

$V_L = EBIT (1 - \tau_c) / WACC = \$660 / .0951$

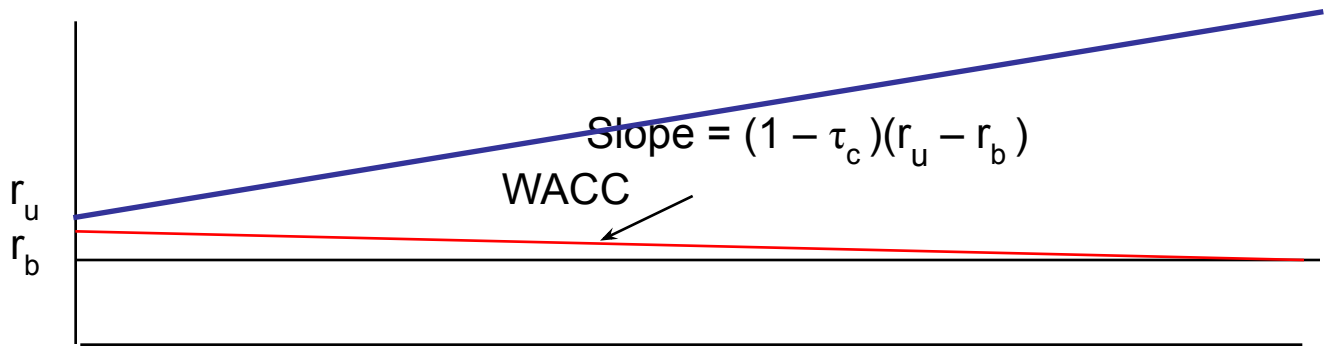
$= \$6{,}940.$

Graphing the M&M Relationships

Firm value (Proposition I)



Required return on equity (Proposition II)



Another Look with Corporate Taxes

Market Value Balance Sheet (All equity firm)

Physical assets = $1,000(1 – .34)/(.1) = $6,600 (1,000 shares at $6.60)	Equity = $6,600

Market Value Balance Sheet (Upon announcement of debt issue)

Physical assets $6,600 (1,000 shares at $6.94) Present value of tax shield = $T_C B$ = (.34) ($1,000) = $340 Total assets = $6,940	Equity = $6,940

Market Value Balance Sheet (After exchange has taken place)

Physical assets $6,600 (855.91 shares at $6.94) Present value of tax shield = $T_C B$ = (.34) ($1,000) = $340 Total assets = $6,940 = $6,940	Equity = $5,940 Debt = $1,000 Debt plus equity

An Aside: Introducing Personal Taxes

- Miller (1977) suggests that debt has both tax advantages and disadvantages
  - *Advantages* derive from the tax deductibility of interest at the corporate level
  - *Disadvantages* because personal taxes levied on interest income usually exceed those levied on equity income
    - Why?
      - Easy to defer equity income
        - Non-dividend paying stocks
        - Push capital gains into the future
- What is the effect on firm value?

Miller's Argument

- $V_L = V_U + [1 - (1 - \tau_c)(1 - \tau_s) / (1 - \tau_b)] B$
- If $(1 - \tau_c)(1 - \tau_s) / (1 - \tau_b) > 1$
  - It is less costly to pay the dollar to shareholders than to debt holders
    - Assume a constant corporate income tax rate
    - Need $\tau_s < \tau_b$
- If $(1 - \tau_c)(1 - \tau_s) / (1 - \tau_b) < 1$
  - It is more costly to pay the dollar to shareholders than to debt holders.

Net Tax Advantage

- PV of net tax advantage (NTA) of perpetual debt:

  $NTA = 1 - (1 - \tau_c)(1 - \tau_s) / (1 - \tau_b)$

- How large is the net tax effect of debt?
- Assume: $\tau_c = 34\%$; $\tau_s = 28\%$; $\tau_b = 39.5\%$
- NTA= 1 - (1 - .34)(1 - .28) / (1 - .395) = 21.45%
- If $\tau_s = \tau_b$, the NTA = _____
- Conclusion:
  - Debt may have less impact than the M&M position.

Changing the Rates

- Suppose shareholders can defer taxes, thereby lowering the effective rate from 28% to 15%
  - NTA = $1 - (1 - \tau_c)(1 - \tau_s) / (1 - \tau_b)$
  - Then NTA = 7.3%
- Suppose τ_c = 27.2%, τ_s = 15%, τ_b = 39.5%
  - Then NTA = -2.3%
- Empirical evidence suggests that NTA < τ_c.

How Does NTA Affect M&M Model?

- M&M:

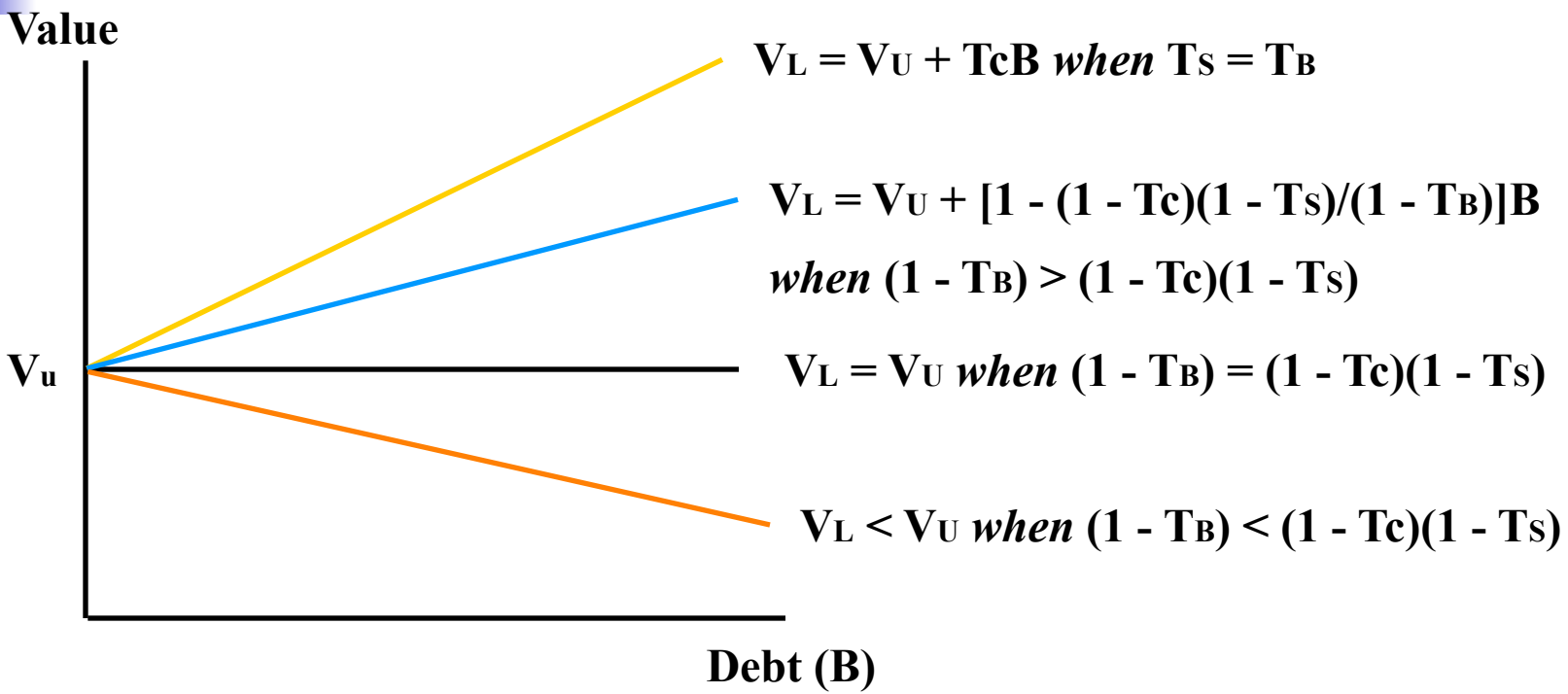
  $V_L = V_U + \tau_c B$

- Miller:

  $V_L = V_U + [1 - (1 - \tau_c)(1 - \tau_s) / (1 - \tau_b)] B$

- If $\tau_s = \tau_b$ in the Miller model, then the Miller model reduces to the M&M model.

A Graphical View of Miller



Tc = corporate tax rate
TB = personal tax rate on interest
TS = personal tax rate on dividends & other equity distributions.

Relationship Between Firm Value and WACC

- Value of firm = Value of debt + value of equity
- Δ(Value) / Δ(Investment)

  = Marginal cost of capital to maintain firm value
- $\Delta V / \Delta I = r_u (1 - \tau_c dB / dI) = WACC$
  - See *slide #14*

    $WACC = r_u (1 - \tau_c B / S)$

    $= .10 (1 - .34 * 1000 / 6940) = 9.51\%$

Assumes $\tau s = \tau b$

- Derive WACC from firm value — not vice versa
  - Earnings perspective
  - Financing perspective.

WACC: An Earning Power View

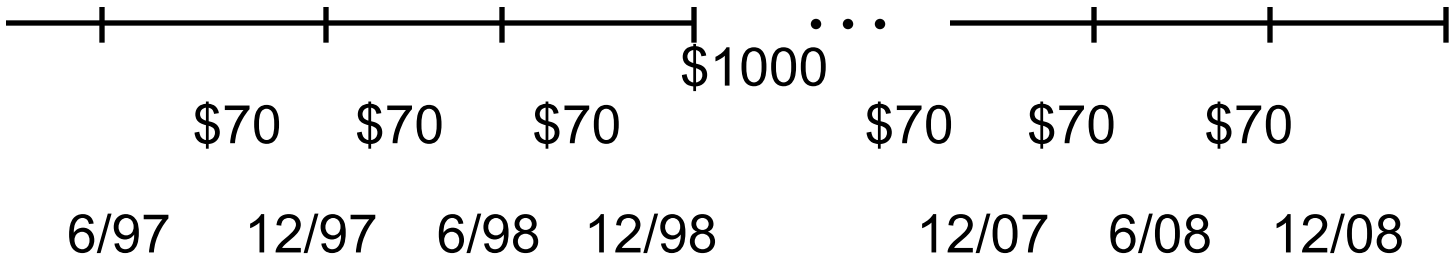
- Assumptions:
  - Maintain current level of production and efficiency
  - All cash flows paid as dividends to shareholders
- WACC
  $$= \frac{\text{Constant cash operating profits} * (1 - \tau_c)}{\text{Market value of } \textit{unlevered} \text{ firm}}$$
  = \$660 / \$6,600 = 10% (see *slide #9*)
- WACC
  $$= \frac{\text{Constant cash operating profits} * (1 - \tau_c)}{\text{Market value of } \textit{levered} \text{ firm}}$$
  = \$660 / \$6,940 = 9.51% (see *slide #14*).

WACC: A Financing View

- Calculate the cost of:
  - Debt
  - Preferred stock
  - Common stock
- Combine the different forms of capital into a weighted average cost of capital — WACC.

Debt's Yield to Maturity

Example: 14s of December 2014 selling for 110 on July 1, 2003



$$\$1{,}100 = \$70/(1 + r) + \$70/(1 + r)^2 + \$70/(1 + r)^3 + \ldots + \$1{,}070/(1 + r)^{23}$$

where r is a semiannual rate of interest

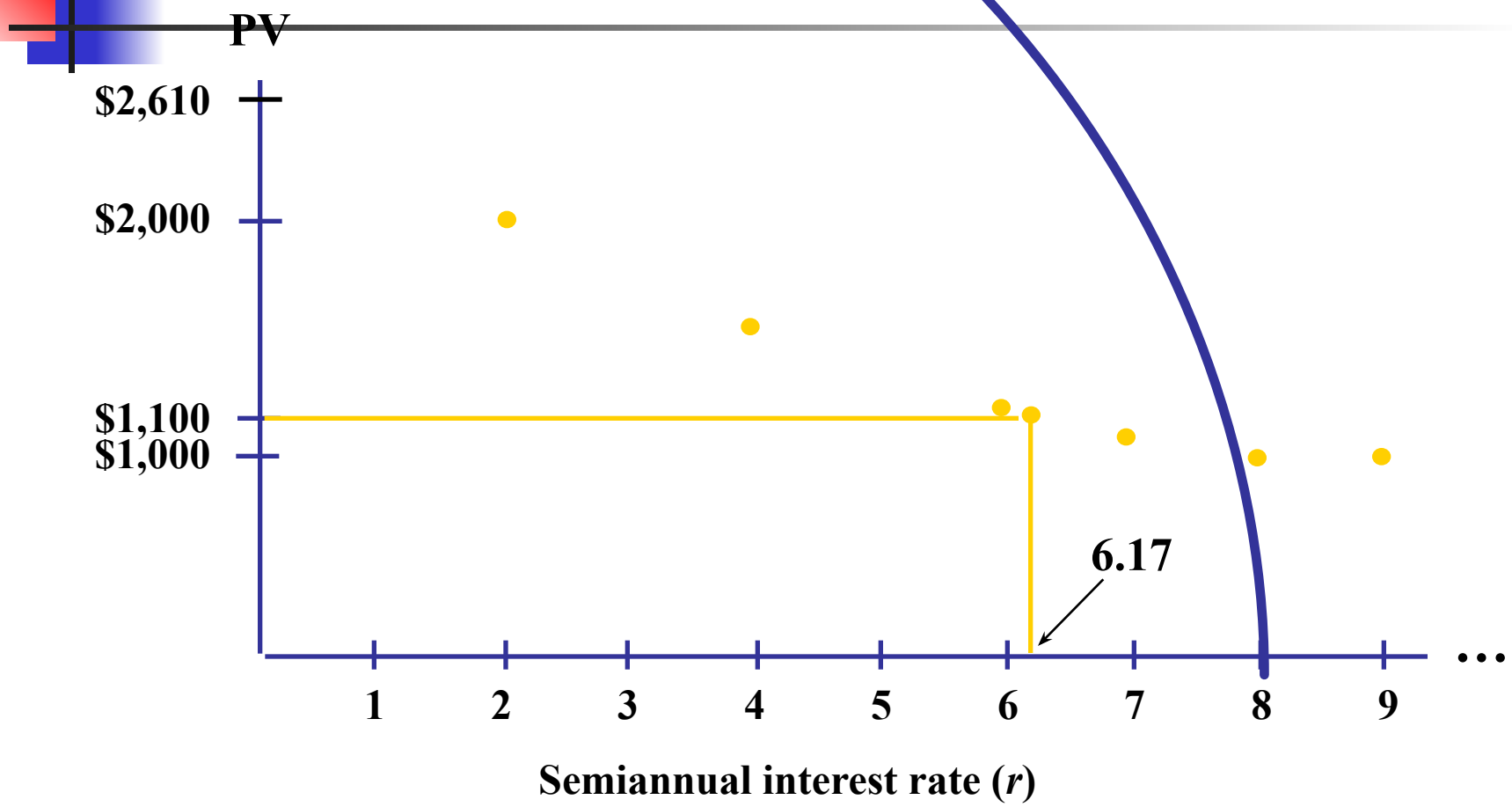
Find the YTM?

At r = 0%, PV = ($70)(23) + $1,000 = $2,610
At r = Infinity, PV = $0

How much is the coupon rate?

Is r greater than the coupon rate? Less than? Equal to?

A Graphical View: YTM



Cost of Debt

- Cost of debt to the firm is the YTM to investors adjusted for corporate taxes
  - Cost of debt = YTM * (1 - τ_c)
- Example:

  A firm's debt trades in the market to provide a YTM of 5%. If the firm's tax rate is 34%, how much is the after-tax cost of debt?

  Answer: 5% * (1 - .34) = 3.30%.

Cost of Debt = YTM * (1 - τ_c)

- Represents a good approximation if shareholders don't default on debt service obligations
  - It is the rate shareholders *promise* the debt holders
  - Thus, bondholders' expected return < YTM
  - See Exhibit 10.1, page 211 of text.

Cost of Preferred Stock

- Preferred stock dividend is not tax deductible
- Cost is the market return earned by investors:

  Dividend / market price of preferred stock

- Example:

  A preferred stock (par = $20) pays a $3 dividend annually. It currently trades in the market for $24. How much is the cost of the stock from the firm's perspective?

  Answer: $3 / $24 = 12.5%.

Cost of Equity

- Cost of equity is more difficult to calculate than either the cost of debt or the cost of preferred stock
- Methods commonly used:
  - M&M model
  - Dividend growth model (Gordon model)
  - Inverted price-earnings ratio
  - Security market line
  - Build-up approach

Using Historic Returns

- Estimating cost of capital using past returns is justified by *"rational expectations"* theory
  - Investors' expectations for returns that compensate them for risk can't be systematically off target
  - The average of past returns is the return that investors expect to receive
    - Sometimes the return is higher; other times lower
    - However, errors are not systematic.

Dividend Growth Model

$$r_e = D_1 / P_0 + g = D_0 (1 + g) / P_0 + g$$

- Assumes the term structure of RADR is flat
- Dividends grow at expected rate *g* in perpetuity
  - *g* represents sustainable growth
  - Use average or geometric rate?
  - Use real or nominal dividend growth?

$$1 + r_{real} = (1 + r_{nominal}) / (1 + inflation)$$

  - Measure inflation by CPI.

Growth Rate

- Arithmetic return:
  - Simple average of historical returns
- Geometric return:
  - $[(1 + r_1)(1 + r_2) \ldots (1 + r_n)]^{1/n} - 1$
- With historical data, the arithmetic average:
  - Provides expected annual return as a draw from the distribution of possible annual returns
  - Geometric average is an estimate of compound rate of return
    - Downward bias estimate of the average return.

Equity Cost Using the Dividend Growth Model

- Price = $\frac{\text{Expected dividend next year}}{\text{Required market rate - growth rate}}$.

Rearrange:

Required market rate = $D_1 / P_0 + g$

- Example:

  A firm's stock currently sells for $25 per share. The forecast for next year's dividend is $1 and this dividend is expected to grow 10% annually.

  Answer: $1 / $25 + .10 = .14 or 14%.

P/E and Cost of Equity

- Dividend growth model:

  $r_e = D_1 / P_0 + g$

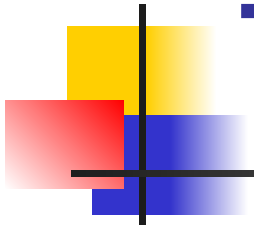
- Assume:
  - Firm has a fixed dividend payout policy, b
  - Earnings grow at a fixed rate, g
- Revised dividend growth model:

  $r_e = D_1 / P_0 + g = b * EPS_1 / P_0 + g$

  $= b * EPS_0 (1 + g) / P_0 + g = [b (1 + g) / PE_0] + g.$

Problem with Dividend Model

- Says nothing about risk!
- Returns should be based on perceived risk
- But not total risk
  - Investors able to diversify away some risk
  - Market only compensates for non-diversifiable or systematic risk.



The End