

UNIVERSITY OF PENNSYLVANIA
The Wharton School

FNCE 100

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PROBLEM SET #6

Fall Term 2005

CAPITAL STRUCTURE

1. The XYZ Co. is assessing its current capital structure and its implications for the welfare of its security holders. XYZ currently is financed *entirely* with common stock, of which 1,000 shares are outstanding. Given the risk of the underlying cash flows (EBIT) generated by XYZ, investors currently require a 20% return on the XYZ common. The company pays out *all* expected earnings as dividends to common stockholders, and these expected earnings are based on the expected operating earnings (EBIT) generated by the firm's assets. XYZ estimates that operating income may be either 1,000, 2,000 or 4,200 with respective probabilities of .1, .4 and .5 depending on future economic conditions. Further, the firm expects to produce a level stream of EBIT in perpetuity. Assume that the corporate and personal tax rate is equal to zero.
 - (a) Given the above facts, compute
 - i. the value of the firm,
 - ii. the market value of a common share,
 - iii. the expected earnings per share of common,
 - iv. the return on the common shares under each economic scenario, and
 - v. the firm's average cost of capital.
 - (b) The president of XYZ has come to the conclusion that shareholders would be better off if the company had equal proportions of debt and equity. He therefore proposes to issue \$7,500 of debt at an interest rate of 10% and use the proceeds to repurchase 500 shares of common. Using the arguments of *Modigliani and Miller* (MM) analyze this proposition by computing
 - i. the new value of the firm,
 - ii. the value of debt,
 - iii. the value of equity,
 - iv. the price of one common share,
 - v. the required rate of return on equity (\bar{r}_e), and
 - vi. the firm's average cost of capital.

Be sure to give (brief) supporting explanations for your answers for parts (i), (v) and (vi).

- (c) Using the arguments proposed in the *Traditional* view, explain (without numbers) the effect of the increased debt in (b) on
- i. firm value and
 - ii. stock price.

What effect, according to the Traditionalists, would the increased debt have on the required return on the common stock? What impact would this have on average cost of capital.

- (d) Graph:
- i. the relationship between market value of the firm and the firm's debt-equity ratio, and
 - ii. the relationship between average cost of capital and the firm's debt-equity ratio for both the Traditional and the MM case.
- (e) What does MM's Proposition II say about the required rate of return on equity? What does the Traditional viewpoints have to say? Graph both of these viewpoints and briefly explain why they are consistent with the graphs in Questions (d.ii).
- (f) Lift the assumption of no corporate taxes and now assume that the corporate income tax rate is 40%. Using the "corrected" Modigliani-Miller framework, how does the existence of a corporate income tax affect the market value of the firm as computed in Question (b)? In particular, if we assume no risk of bankruptcy for a debt-equity ratio less than one, what would the new market value of XYZ be with the presence of \$7,500 of debt in the capital structure? If bankruptcy risks were a concern with this level of debt, how would this (qualitatively) affect your answer?
- (g) Now lift the assumption that personal taxes are zero. Suppose that returns to equity holders are effectively not taxed but that interest is taxed at the personal level. If the recipients of interest on the firm's debt are in the 30% personal income tax bracket how will your answer to part (f) change qualitatively? What if the bondholders are in the 40% bracket? The 50% bracket?

2. Ignore for this problem: taxes, transaction costs, and costs of financial distress. Are the following statements true, false, or uncertain? Explain your answer:

- (a) "If a firm issues equity in order to repurchase some of its debt, the price of the remaining shares will go up because they are less risky."
- (b) "Moderate borrowing doesn't significantly affect the probability of financial distress or bankruptcy. Hence, moderate borrowing won't increase the required return or risk of equity."

3. The market value of a firm which has \$500,000 in debt is \$1,700,000. The expected value of EBIT is constant over time. The interest rate on debt (pre-tax) is 10%. The company is subject to a 40% tax rate. If the company were 100% equity financed, the equity holders would have a 20% required return. What is the net income of the firm? What would be the market value of the firm if it were 100% equity financed?
4. A non-growth firm has interest expense on debt of \$200,000. The before tax cost of debt is 8%, the cost of equity is 12%. Earnings before interest and taxes are \$1,200,000 and the corporate tax rate is 40 percent. What is the total value of the firm?
5. The Veblen Company and the Knight Company comprise a single risk class. These firms are identical in every respect except that the Veblen Company is not levered, while the Knight Company has \$1 million in 6% bonds outstanding. (Assume that neither company pays any taxes.) The valuation of the two firms is assumed to be the following:

		Veblen	Knight
<i>I</i>	Net operating income	\$ 300,000	\$ 300,000
<i>F</i>	Interest on debt	—	60,000
<i>E</i>	Earnings to common	<u>\$ 300,000</u>	<u>\$ 240,000</u>
\bar{r}_e	Equity-capitalization rate	<u>.125</u>	<u>.140</u>
<i>E</i>	Market value of stock	\$2,400,000	\$1,714,000
<i>D</i>	Market value of debt	—	1,000,000
<i>V</i>	Total value of firm	<u>\$2,400,000</u>	<u>\$2,714,000</u>
\bar{r}_A	Implied overall capitalization rate	12.5%	11.0%
<i>D/E</i>	Debt/equity ratio	0	58.4%

- (a) An investor owns \$10,000 worth of Knight stock. Show the process and the amount by which he could increase his net return through use of arbitrage. (Assume he can borrow at 6%.)
 - (b) According to Modigliani and Miller, when will this arbitrage process cease?
6. Imagine it is August 1983.

Chrysler's financial structure is as follows on August 28, 1983:

security	amount outstanding	market price	market value
common stock	115,000,000 shares	\$ 26.00/share	\$2,990,000,000
preferred stock	10,000,000 shares	\$ 32.50/share	\$ 325,000,000
warrants	14,400,000 warrants	\$ 13.50/warrant	\$ 194,000,000
bonds	2,000,000 bonds	\$650.00/bond	\$1,300,000,000
total market value			\$4,800,000,000

Because of the large losses incurred in 1978–81, Chrysler has \$2,000,000,000 in tax-loss carry-forwards: the next \$2,000,000,000 of income is free from corporate income taxes. The consensus among security analysts is that Chrysler’s cumulative profits over the next 5 years are likely to be less than \$2,000,000,000.

Most of the preferred stock is held by banks, and Chrysler has agreed to retire the preferred within the next few years. Chrysler must decide to issue either debt or common equity to retire the preferred stock. If you were Lee Iacocca, what would you do? Why?

7. “A firm’s stockholders will never want the firm to invest in negative NPV projects.” Do you agree or disagree? Explain.
8. Acetate, Inc., has common stock with a market value of \$20 million and a debt of \$10 million. The current Treasury bill rate is 10 percent and the expected market risk premium is also 10 percent. A plot of the returns on the stock against the market returns shows a scatter of points through which a line can be fitted with a slope of 45 degrees.
 - (a) What is Acetate’s debt/value ratio?
 - (b) What is its expected return under the CAPM?
 - (c) What would be the required expected return on a project with a similar risk as the firm’s current assets?
9. An all equity firm is subject to a 30% tax rate and its equity holders require a 20% return. Its total market value is initially \$3,500,000. There are 175,000 shares outstanding. It then issues \$1 million worth of bonds at 10% interest and uses the proceeds to buy back common stock. (Assume no change in costs of financial distress.)

According to MM what is the new market value of the equity of the firm on a per share basis? What is the change?

10. You are given the following information about the XYZ corporation:

Stock price: \$100

shares outstanding: 1 million

Market value debt: \$25 million

The corporation is about to make *all* of the following pre-announced changes:

- i) A two for one stock split.
- ii) A \$1 dividend payment (per new share).
- iii) Issuing \$5 m of new debt.
- iv) Repurchase \$3 m worth of stock (ex-dividend).

Ignoring taxes, transaction costs, and costs of financial distress, how do the values of the following change (just before to just after the combined changes i)–iv)?

- (a) Market value of debt.
- (b) Number of common stock shares outstanding.
- (c) Price per share.
- (d) Market value of equity.
- (e) Market value of firm.

How would the original equity holders feel about these changes?

11. The equity of company ABC has a current market value of \$1500 million. It has no debt outstanding and 15 million shares of stock outstanding. The company currently has a surplus of cash of \$15 million, and is considering ways to distribute it. One possibility is to increase its dividend by \$1 per share for one time only. The other possibility is to repurchase shares at the current market price.

- (a) Assume that there are no personal taxes. For each possibility calculate:
 - i. The per share stock price after the policy is enacted.
 - ii. The market value of equity after the policy is enacted.
 - iii. The total wealth of the old shareholders after the policy.
- (b) You work for an institutional investor that owns 1 million shares of company ABC. You were counting on receiving the \$1 dividend. If ABC instead repurchases the shares (and pays no dividend), what additional steps could you undertake that would leave you in exactly the same position as you would have been in had the company paid the dividend?
- (c) Which policy would the shareholders prefer? Why?
- (d) How would your answer to (c) change if instead of distributing funds the company needed to raise \$15 m in new funds, and was considering doing so with either a one time \$1 cut in dividends or a new issue of stock?

- (e) Now assume that dividends are taxed at 50%, and that capital gains are only taxed at 20%. How do your answers to (a) and (c) change? (Assume that the stock was purchased for \$90 per share.)
- (f) Under the new tax law, dividends and realized capital gains will be taxed at the same rate. The capital gains tax is not collected, however, until the stock is sold (i.e. until the gains are realized.) How will this affect your answers to (a) and (c) above?

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Solutions to PROBLEM SET #6

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CAPITAL STRUCTURE

1. (a) All Equity

$$N = 1000 \text{ shares} \quad \bar{r}_A = \bar{r}_E = .20 \quad \tau_c = \tau_p = 0$$

State	Prob	X	$\text{EPS} = X/N$	r_E	$r_D D$	$X - r_D D$
1	.1	1000	1	.067	750	250
2	.4	2000	2	.133	750	1250
3	.5	4200	4.2	.280	750	3450

$$\bar{X} = .1(1000) + .4(2000) + .5(4200) = \$3000$$

i. $V_U = E_U = \frac{\bar{X}}{\bar{r}_E} = \frac{3000}{.2} = \$15,000$

ii. $P_0 = E_0/N = 15,000/1000 = \$15/\text{share}$

iii. $\bar{\text{EPS}} = 3000/1000 = \$3/\text{share}$

iv. See column r_E above

v. $\bar{r}_A = \bar{r}_E = .20$

(b) Firm issues \$7,500 of debt at $r_D = .10$

Number of outstanding shares of common = $\underline{500} = N_L$

i. use the simple arbitrage proof: buy the shares of the levered firm and undo the leverage by lending D_L .

	Buy unleveraged shares	Buy leveraged shares & lend D_L .
Investment	E_u	$E_L + D_L$
Return	\bar{X}	$\bar{X} - r_D D_L + r_D D_L = \bar{X}$

Therefore $E_U = E_L + D_L \implies E_L = E_u - D_L = \$15\text{K} - 7.5\text{K} = 7.5\text{K}$

So, $V_L = E_L + D_L = 7.5 + 7.5 = \15K

- ii. \$7.5K
- iii. \$7.5K (see (i))
- iv. $p_0 = E_L/N_L = 7500/500 = \$15/\text{share}$
- v. $\bar{r}_E(\bar{X} - r_D D_L)/E_L = 2.25/7.5 = 0.3$
- vi. $\bar{r}_a = \left(\frac{D}{V}\right) r_D + \left(\frac{E}{V}\right) r_E = .5(.1) + .5(.3) = .05 + .15 = .20$

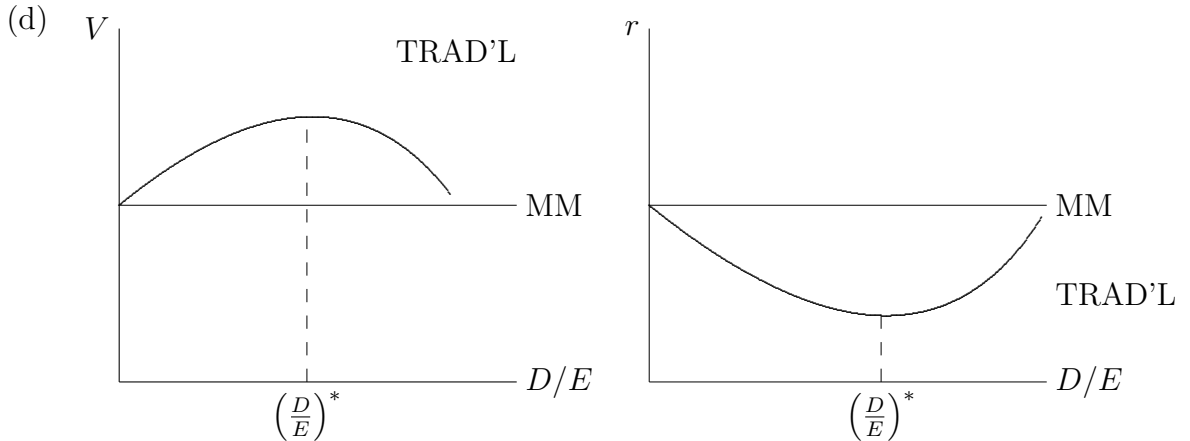
Notice that the value of the firm is unaffected by the increase in debt. This is because the reshuffling of claims to the cash flows generated by the firm's assets had *not* changed (a) the cash flows generated by the firm's assets (still equal to \$3000 not split up as dividends or \$2250 and interest of \$750) nor (b) the riskiness of those cash flows \implies the discount rate applicable has not changed. Therefore, the firm's cost of capital remains unchanged.

The required return on common is now

$$\begin{aligned}\bar{r}_E &= r_A + (D/E)(r_A - r_D) \\ &= .20 + 1(.20 - .10) = .30\end{aligned}$$

Thus, the stockholders perceive higher financial risk and demand compensation for bearing that risk.

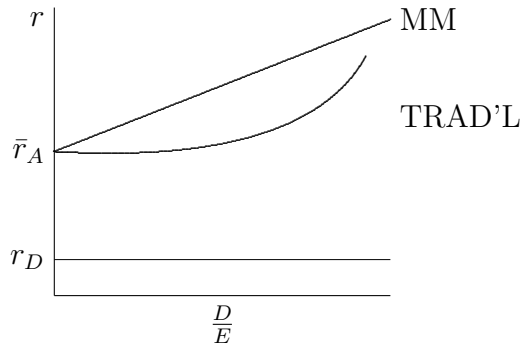
- (c) According to the traditional view, increased leverage would at first increase the value of the firm and the value per share. This occurs because the analysts believe the return that equity holders require will not increase as firms issue small amounts of debt. Therefore, the overall required rate of return on the firm's assets will fall as some debt is issued, allowing the value of the firm to increase.



- (e) See (c) above for traditional view of \bar{r}_E . MM argue that leverage will increase the systematic risk of the equity to the point where r_E increases fast enough to offset the cheaper cost of debt. More formally

$$\bar{r}_E = \bar{r}_A + \frac{D}{E}(\bar{r}_A - r_D) ;$$

and graphically



Note that if a firm can borrow at the risk-free rate, r_D , under MM this will not reduce \bar{r}_A because equity holders will raise required rate (\bar{r}_E) as financial risk rises. Since r_E does not rise as quickly under the traditional view, r_A will, in their opinion, rise more slowly with increasing D/E .

- (f) The value of the unlevered firm will change when we introduce corporate taxes. The after-tax cash flows generated by the assets of the firm will now be

$$\bar{X}(1 - \tau_c) = 3000(1 - .4) = \$1800.$$

Thus, the value of the unlevered firm is

$$V_U = \frac{\bar{X}(1 - \tau_c)}{r_E} = \frac{1800}{.2} = \$9000$$

The value of the levered firm is then

$$\begin{aligned} V_L &= V_U + \tau_c D \\ &= 9000 + .4(7500) = 9000 + 3000 = \$12,000 \end{aligned}$$

Obviously bankruptcy risks would reduce the amount by which the firm's value would increase due to leverage.

- (g) If $\tau_{pe} = 0$,

$$V_L - V_U = D_L \left[1 - \frac{1 - \tau_c}{1 - \tau_p} \right].$$

Thus for:

$$\begin{aligned} \tau_p = .3, \quad V_L - V_U &= 7500 \left[1 - \frac{1 - .4}{1 - .3} \right] = \$1071.43 \\ \tau_p = .4, \quad V_L - V_U &= 7500 \left[1 - \frac{1 - .4}{1 - .4} \right] = \$0.00 \\ \tau_p = .5, \quad V_L - V_U &= 7500 \left[1 - \frac{1 - .4}{1 - .5} \right] = -\$1500 \end{aligned}$$

2. (a) False. In the absence of taxes, transactions costs, and COFD, the stock price will not change. The decrease in financial leverage will decrease the risk of the cash flow to equity, but is offset by a lower required return on equity.

(b) Even risk-free debt creates financial leverage and financial risk for stockholders, so that r rises. Increased borrowing, even if it doesn't change the probability of bankruptcy at all, will still increase the financial risk of equity, and thus will raise the required return on equity: (See M&M prop II).

$$3. \quad \begin{aligned} D_L &= .5\text{m} & \tau &= .4 & NI &=? \\ V_L &= 1.7\text{m} & r_e^U &= .2 & V_U &=? \end{aligned}$$

Establish value of unlevered firm:

$$V_L = V_U + \tau D \quad 1.7\text{m} = V_u + (.4)(.5\text{m}) \implies V_u = 1.5\text{m}$$

Establish EBIT:

$$V_U = \overline{\text{EBIT}} \frac{(1 - \tau)}{r_e^U} \implies \overline{\text{EBIT}} = \frac{V_U r_e^U}{(1 - \tau)} = \frac{(1.5\text{m})(.2)}{.6} = .5\text{m}$$

CALCULATE NI:

$$\begin{aligned} \text{NI} &= [\text{EBIT} - rD](1 - \tau) \\ &= (.5\text{m} - (.10)(.5\text{m}))(0.6) \\ &= 270,000 \end{aligned}$$

4. Value is the sum of discounted after-tax cash flow to equity and debtholders.

$$\begin{aligned} \text{Debt:} \quad D &= \frac{r_D D}{r_D} = \frac{200,000}{.08} = 2.5\text{m} \\ \text{Equity:} \quad &\frac{[\text{EBIT} - r_D D](1 - \tau)}{r_e^L} = \frac{[1.2\text{m} - .2\text{m}](.6)}{.12} = 5\text{m} \\ \text{Value:} \quad &= 2.5\text{m} + 5\text{m} = 7.5\text{m} \end{aligned}$$

5. (a) The market value of the levered firm (Knight) is greater than that of the unlevered firm (Veblen) even though the underlying assets of both firms are identical. An investor would improve return by selling off the stock of the high priced (levered) firm, borrowing, and buying the stock of the lower priced (unlevered) firm. The investor is more cheaply creating leverage personally, rather than by buying stock in a levered firm.

Let α = the proportion of Knight shares he owns,

$$\alpha = \frac{10,000}{1,714,000} = .000583$$

		CASH FLOWS	
		PRESENT	FUTURE
(1)	Sell a proportion equal to α to the shares of Levered	$+\alpha E_L$	$-\alpha[\text{EBIT} - rD_L]$
(2)	Borrow $\alpha \frac{D_L}{E_L} E_L$	$+\alpha D_L$	$-\alpha r D_L$
(3)	Buy $(\alpha \times 100)\%$ of unlevered firm	$-\alpha V_u$	$+\alpha \text{EBIT}$
		$\alpha E_L + \alpha D_L - \alpha V_u$ $= \alpha(V_L - V_u)$	$-\alpha \text{EBIT} + \alpha r D_L - \alpha r D_L + \alpha \text{EBIT} = 0$

$$\begin{aligned} \alpha(V_L - V_u) &= \frac{10,000}{1,714,000}(2,714,000 - 2,400,000) = 1831.97 \\ &= \text{arbitrage profit} \end{aligned}$$

(b) Prices will adjust until $V_L = V_u$, arbitrage profit = 0.

6. Since Chrysler cannot make use of interest deductions over the next few years, equity is the preferred form of financing.
7. Disagree—When the firm is close to bankruptcy, the stockholders may feel they have little to lose; this may bring them into conflict with the bondholders, and lead them to make inefficient decisions. For example, if a project has a high variance, but a negative NPV, the shareholders might choose this project, because they get the upside gains but do not bear the downside losses. Taking this project would cause the value of the equity to rise, but the value of the firm (debt + equity) to fall.
8.

Equity = E = 20M	$\beta_{\text{Equity}} = 1.0$	— The β of Acetate's equity is
Debt = D = 10M		the slope of the regression
R_f = 10%		line relating returns on
$E(Rm) - R_f$ = 10%		Acetate's stock to returns
Assume $\beta_{\text{Debt}} = 0$		on the market

$$\begin{aligned} \beta_{\text{Assets}} &= \left(\frac{E}{D+E}\right)\beta_{\text{Equity}} + \left(\frac{D}{D+E}\right)\beta_{\text{Debt}} \\ &= (2/3)(1.0) + 0 = 2/3 \end{aligned}$$

(a) Their ratio of debt to total value equals

$$\frac{D}{D+E} = 10/(10+20) = 10/30 = 1/3$$

(b) Using the CAPM equation, $r_i = r_f + \beta_i(r_m - r_f)$,

$$r_{\text{Equity}} = .10 + (.10)\beta_{\text{Equity}} = (.10) + (.10)(1.0) = .20 = 20\%$$

(c) $r_{\text{Project}} = .10 + (.10)\beta_{\text{Assets}} = (.10) + (.10)(2/3) = .167 = 16.7\%$

9. If the market is efficient, the existing stockholders will reap the capital gain from the tax shields on the new debt. The initial price per share is $\$3,500,000/175,000$ shares = $\$20/\text{share}$. If the debt is perpetual, the bond issue of $\$1$ million implies a present value of the tax shield of $T_c D = .3 (\$1\text{M}) = \$300,000$. The swap therefore raises the value of the firm to $\$3.8$ million. The announcement of the swap therefore increases the share price to $3.8\text{M}/175,000 = \$21.71$. At this price, the bond proceeds can be used to retire $\$1\text{M}/\21.71 , or approximately, 46053 shares.

10. (e) First consider the market value of the firm's assets. The cash position of the firm changes due to each of the changes as follows:

stock split \implies no change

dividend \implies $-\$2$ m

debt issue \implies $+\$5$ m

equity repurchase \implies $-\$3$ m

Total effect \implies no change

The original value of the firm was $\$125$ m ($E = \$100\text{m}$, $D = \$25\text{m}$)

Since there is no change in claims by others on the firm (i.e. no change in taxes or COFD), the total value of the firm ($D + E$) will remain unchanged at $\$125$ m.

(a) MV debt = $\$25\text{m} + 5\text{m} = \30m

(d) MV equity (E) new = $V_{\text{new}} - D_{\text{new}} = 125\text{m} - 30\text{m} = \95m

(b) # shares outstanding (N_{new}) = $2 \times 1\text{m} - 3\text{m}/P_{\text{new}}$

(c) Price per share: $P_{\text{new}} = 95/N_{\text{new}}$

$$\implies P_{\text{new}} = 95\text{m}/(2\text{m} - 3\text{m}/P_{\text{new}})$$

$$\implies 2\text{m} \cdot P_{\text{new}} - 3\text{m} = 95\text{m}$$

$$P_{\text{new}} = 98\text{m}/2\text{m} = \$49$$

$$\implies N_{\text{new}} = (2 \cdot 1\text{m}) - 3\text{m}/49 = 1,938,775.51$$

The total wealth of the equity holders before changes was $\$100\text{m}$.

The total wealth of the equity holders after changes is:

stock holdings:	$\$49 \cdot 1,938,775.51 =$	$\$95\text{m}$
cash (from dividends):	$\$1 \cdot 2\text{m} =$	2m
cash (from sale of shares):	$\$3\text{m} =$	3m
		$\$100\text{m}$

The total wealth is the same before and after the changes, leaving the shareholders indifferent to the changes.

11. The present price per share is $\$1500\text{m}/15\text{m shares} = \$100/\text{share}$.

(a) Issue $\$1/\text{share}$ dividend:

- (ii) new MV equity = old MV equity – cash paid out = $\$1500 - 15 = \1485m
- (i) ex-dividend price = MV equity/shares outstanding = $1485/15 = \$99/\text{share}$
- (iii) total wealth of old shareholders = new MV equity + cash dividend = $\$1485 + 15 = \1500m

Repurchase $\$15\text{m}$ worth of shares at $\$100/\text{share} = 150,000$ shares.

- (ii) new MV equity = $\$1500 - 15 = \1485m
- (i) new price = $\$100/\text{share}$ (no change) = $\$1485\text{m}/14,850,000$ shares
- (iii) total wealth of old shareholders = new MV equity + payoff from sale of shares = $\$1485 + 15 = \1500m

(b) With the dividend, holdings are:

cash: $\$1\text{m}$ (from dividend)
ABC equity: $\$99\text{m}$ (ex-dividend price \cdot 1m shares).

Under repurchase, the institutional investor could sell 10,000 shares of stock and receive $\$1\text{m}$. The resulting position would be:

cash: $\$1\text{m}$ (from sale of shares)
ABC equity: $\$99\text{m}$ ($\$100 \times 990,000$ shares).

- (c) The shareholders are indifferent, because they are equally well off with respect to total wealth, as they could take steps (as in (b) above) so that their stock and cash positions would be identical under each policy.
- (d) The lower dividend/issuance of stock scenario is actually (a) in reverse, with respect to the outcomes. The shareholders, therefore, will be indifferent.
- (e) If the dividend is paid, the total wealth of old shareholders will be:

$$\begin{aligned} & \text{new MV equity} + \text{after-tax cash dividend} \\ & = \$1485\text{m} + 15\text{m} \cdot (1 - .5) = \$1492.5\text{m}. \end{aligned}$$

If the shares are repurchased the total wealth of old shareholders will be:

$$\begin{aligned} & \text{new MV equity} + \text{repurchase proceeds} - \text{capital gain tax} \\ & = \$1485\text{m} + \$15\text{m} - 150000 \cdot (100 - 90) \cdot (.2) \\ & = \$1499.7\text{m}. \end{aligned}$$

The shareholders are better off by $\$7.2\text{m}$ with the repurchase. However, under the repurchase alternative their future tax liability will be higher than under the dividends alternative. But since this higher tax liability will be less than $\$7.2\text{m}$ the shareholders would prefer the repurchase. (The extra tax liability would be $\$2.7\text{m}$ if all shares are sold now.)

- (f) If the shareholders plan to sell their shares and will thus realize the capital gains at the end of the year, they will be indifferent to the dividend vs. the share repurchase, since either will result in the same after-tax wealth. If, however, the shareholder plans to hold her shares, she will prefer the repurchase, because she will be able to defer the tax until the stock is sold and the capital gain is realized.