

# **Financing Policy I: The Modigliani-Miller Theorem and the Effects of Corporate/Personal Taxes on Leverage**

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## Outline

- The concept of capital structure
- The Modigliani-Miller theorem
- “Undoing” a firm’s capital structure choice
- The effects of corporate taxes
- The effects of personal taxes

## Capital Structure: Concept

- A firm's mix of different sources of capital is called capital structure or leverage
- Common measures of leverage

Measure	What is measured
$\frac{\text{Debt}}{\text{Debt} + \text{Market value of equity}}$	Long term ability to meet interest payments
$\frac{\text{Debt}}{\text{Total book assets}}$	Historical financing of investments
$\frac{\text{EBITDA}}{\text{Interest}}$	Ability to meet current interest payments

EBITDA: Earnings before interest, taxes, depreciation, and amortization

- Exhibit IV.2: Financial ratios of selected U.S. corporations, 1993

## Exhibit IV.2: Financial Ratios of Selected U.S. Corporation, 1993

<i>Company Name</i>	<i>Debt</i> <i>Debt + Mkt Equity</i>	<i>Debt</i> <i>Total Book Assets</i>	<i>EBITDA</i> <i>Interest</i>
AT&T	20%	29%	16.36
Boeing	15	13	14.37
Boston Edison	49	42	3.49
John Deere	40	37	2.47
Delta Air Lines	53	32	1.08
Disney	9	20	14.09
General Motors	61	37	2.98
Hewlett-Packard	13	17	21.67
McDonalds	15	31	7.18
3M	6	12	59.70
Philip Morris	27	35	6.72
Raytheon	9	12	37.88
Safeway Stores	55	53	3.06
Texaco	27	26	4.70
Wal-Mart	14	36	7.54

Source: Standard and Poor's Compustat Data 1994.

**Mark Grinblatt**                      **Sheridan Titman**  
**Financial Markets and Corporate Strategy, 2/e**

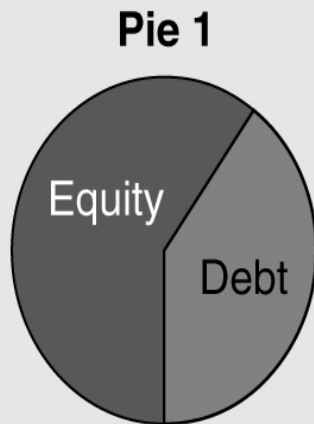
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## The Modigliani-Miller Theorem

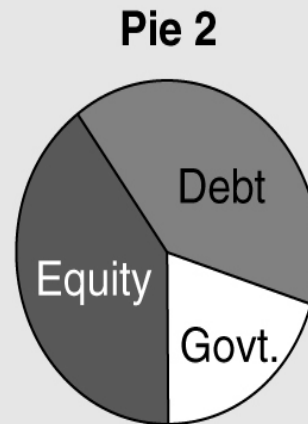
- Exhibit 14.1: Slicing the cash flows of the firm
- Proof of the MM theorem
- Consider two firms, exist for one year, identical pretax cash flows  $\tilde{X}$ , unleveraged company U, leveraged company L
- Exhibit 14.2: Liability and cash flow for two firms with different leverage ratios
- No-arbitrage: Because U's and L's future cash flows are identical,

$$V_U = V_L = D + E_L$$

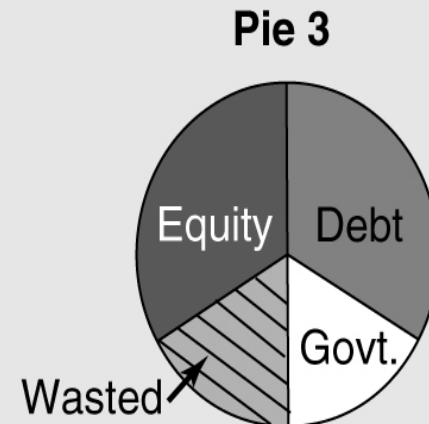
## Exhibit 14.1: Slicing the Cash Flows of the Firm



Slicing the pie doesn't affect the total amount available to debt holders and equity holders.



The size of the debt slice can affect the size of the slice going to government.



The size of the debt slice can affect the size of the wasted slice.

**Exhibit 14.2: Liability Cash Flows and Their Market Values for Two Firms with Different Capital Structures**

	<b>Company U</b>		<b>Company L</b>	
	<i>Future Cash Flow</i>	<i>Current Value</i>	<i>Future Cash Flow</i>	<i>Current Value</i>
Debt	0	0	$(1 + r_D)D$	$D$
Equity	$\bar{X}$	$V_U$	$\bar{X} - (1 + r_D)D$	$E_L$
Total	$\bar{X}$	$V_U$	$\bar{X}$	$V_L = D + E_L$

- Example 14.1 — An arbitrage opportunity if the MM theorem fails to hold
- Assume company U is totally equity financed, and worth \$100 million
- An otherwise identical company L is financed with \$40 million equity and \$50 million riskless debt with a 10% interest rate
- The bonds pay \$55 million at the end of the year
- If the economy is weak, cash flows for both firms will be \$80 million; If the economy is strong, \$200 million
- Company U's value \$100 mil > company L's (\$40 + \$50 mil), arbitrage!
- Buy cheap, sell high, say, buy 10% of company L and sell 10% of U

- Cash flow to the arbitrageur in \$ million:

	now	yearend (weak economy)	yearend (strong economy)
short sale of L equity	\$10	-\$8	-\$10
purchase of L equity	-4	2.5	14.5
purchase of L debt	-5	5.5	5.5
net cash flow	\$1	0	0

- The Modigliani-Miller Theorem:

Assume (1) a firm's total cash flows to its debt and equity holders are unaffected by how it is financed; (2) no transaction/bankruptcy costs, and (3) no arbitrage.

Then the market value of the firm is unaffected by its leverage

- The MM theorem gives the determinants of optimal leverage: (1) leverage can affect future cash flows via, e.g., tax; (2) transaction costs limit the extend of arbitrage; (3) limits to arbitrage

## Undoing Capital Structure Change

- An alternative interpretation of the MM theorem: Under its assumptions, shareholders are indifferent to a change in the firm's capital structure
- Example 14.2: Undoing Elco's capital structure change
- Elco has 1,000 shares outstanding with \$100 per share, also financed with riskless zero-coupon one-year bond with a market value of \$10,000
- Stan owns 10% of Elco's equity, 100 shares, without a capital structure change, Stan's payoff next year is  $.1[\tilde{X} - (1 + r_D)\$10,000] = .1\tilde{X} - (1 + r_D)\$1,000$

- Elco plans to repurchase 500 shares for \$50,000 and finance the repurchase by issuing \$50,000 in riskless debt
- If Stan chooses not to alter his portfolio, he would own 20% of Elco's shares (100/500), his share of Elco's cash flow is  $.2[\tilde{X} - (1 + r_D)\$60,000]$
- However, Stan can sell 50 shares and use the proceeds to buy \$5,000 in bonds, he will again own 10% of Elco's shares (50/500). His share of cash flow is

$$.1[\tilde{X} - (1 + r_D)\$60,000] + (1 + r_D)\$5,000 = .1\tilde{X} - (1 + r_D)\$1,000$$

- Punchline: The shareholder can achieve the same cash flow and control the same percent of shares outstanding in the presence of a capital structure change. Without transaction costs, the shareholder is indifferent to leverage changes

## Corporate Taxes

- Graham and Harvey (2001): 45% surveyed 392 CFOs agree that tax considerations are important in their capital structure choices
- In the absence of other frictions, minimizing the amount paid in taxes maximizes the cash flow to equity and bond holders, thus maximizing firm value
- In the U.S., interest is tax-deductible corporate expense. Dividends are not because they are viewed as distributions of profits, not expenses of operations
- How debt affects after-tax cash flows?

- Notations

$T_c$	corporate tax rate
$\tilde{X}$	pretax cash flow
$r_D D$	interests payment
$\tilde{X} - r_D D$	taxable income
$(\tilde{X} - r_D D)T_c$	corporate tax

- Cash flows after corporate taxes,

$$\begin{aligned}
 \tilde{C}_t &= \underbrace{(\tilde{X}_t - r_D D)(1 - T_c)}_{\text{to equity holder}} + \underbrace{r_D D}_{\text{to bond holder}} \\
 &= \underbrace{\tilde{X}_t(1 - T_c)}_{\text{unlevered cash flows}} + \underbrace{r_D D T_c}_{\text{tax gain of debt}}
 \end{aligned}$$

- How debt affects the firm value?

- Let  $V_U$  be the present value of  $\tilde{X}_t(1 - T_c)$

- The present value of a perpetuity tax savings  $r_D T_c D$  is  $T_c D$

- Result 14.4: Assume that the pretax cash flows of the firm are unaffected by a change in a firm's capital structure, and that there are no transaction costs or arbitrage. With corporate taxes at the rate  $T_c$ , but no personal taxes, the value of a levered firm with static, riskless perpetual debt is the value of an otherwise all-equity firm plus  $T_c D$ , i.e.,  $V_L = V_U + T_c D$
- Example 14.3: Recompute Stan's cash flows in Example 14.2 but with corporate tax at the rate of  $T_c$ . The cash flow in the initial low leverage is  $\tilde{C}_{\text{low lev}} = .1[\tilde{X} - r_D \$10,000](1 - T_c)$ . A leverage increase of \$50,000 offset by a change in Stan's portfolio yields

$$\begin{aligned}\tilde{C}_{\text{high lev}} &= .1[\tilde{X} - r_D \$60,000](1 - T_c) + r_D \$5,000 \\ &= .1[\tilde{X} - r_D \$10,000](1 - T_c) + r_D T_c \$5,000\end{aligned}$$

## Personal Taxes

- Tax-exempt shareholders prefer firms to have high leverage to exploit the tax advantage of debt (so that the slice of pie going to the government is minimized)
- But investors who pay personal taxes prefer to receive income in the form of capital gains (deferrable, lower tax rate than interest/dividend income rate)
- The average tax rate on stock income  $T_E <$  the average tax rate on debt income  $T_D$ , taxable shareholders prefer less leverage
- The effects of personal taxes on debt and equity rates of return

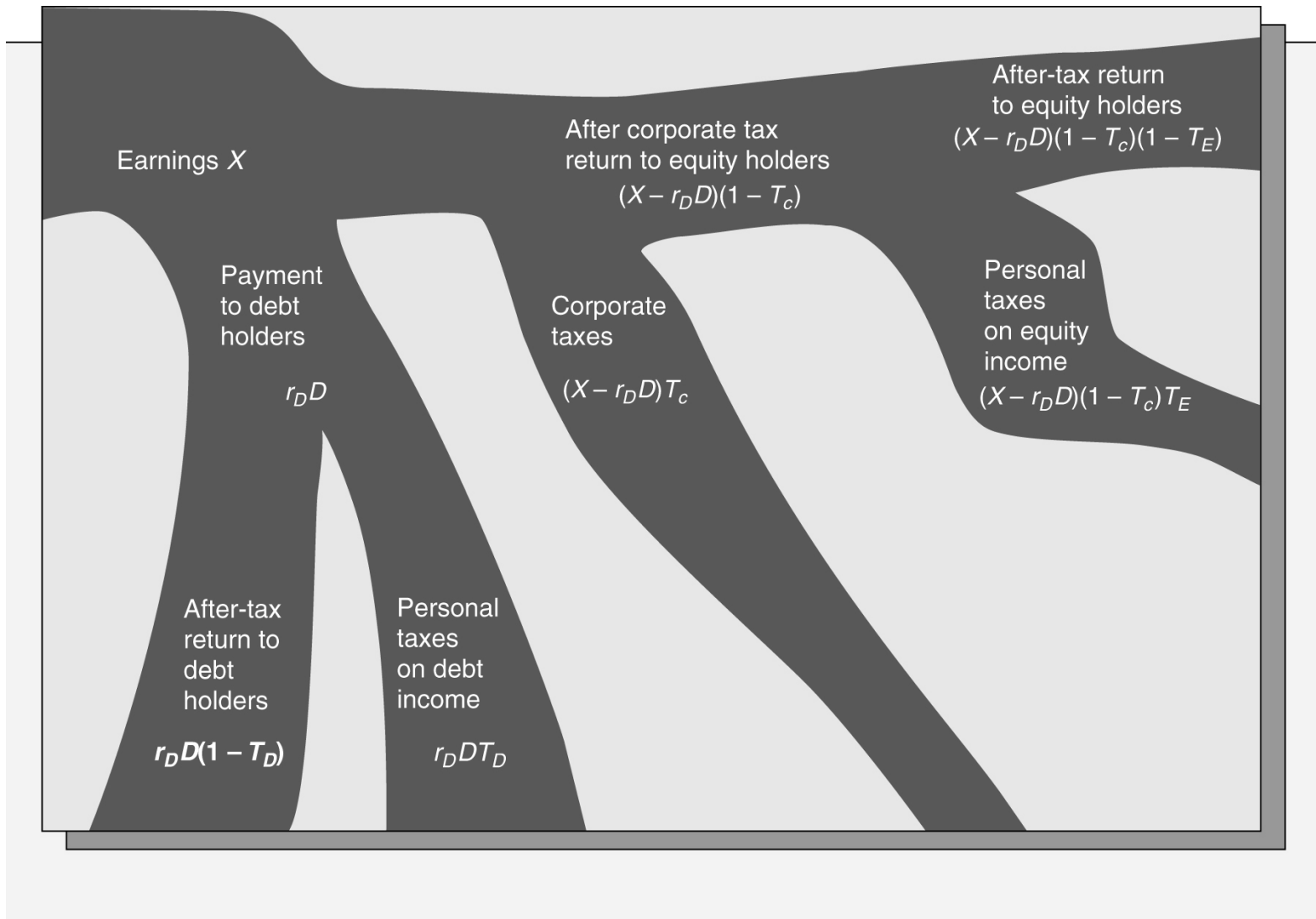
- Assume debt is riskless with a return of  $r_D$ , risk-adjusted expected return of equity,  $\bar{r}_E$ , differs from  $r_D$  only through taxes
- Then investors will be indifferent between holding debt and equity, if

$$r_D(1 - T_D) = \bar{r}_E(1 - T_E)$$

if ' $>$ ', investors prefer debt to equity, and vice versa

- How personal taxes affect the choice between issuing debt and equity?
- Assume  $T_D$  and  $T_E$  do not differ across investors
- Exhibit 14.4: The earnings stream (assume payout ratio = 1 and  $\text{EBIT} > r_D D$ )

## Exhibit 14.4: The Earnings Stream



- The total after-tax cash flow accruing to the debt and equity holders:

$$\begin{aligned}
 C &= (X - r_D D)(1 - T_c)(1 - T_E) + r_D D(1 - T_D) \\
 &= \underbrace{X(1 - T_c)(1 - T_E)}_{\text{unlevered cash flow}} + \underbrace{r_D D[(1 - T_D) - (1 - T_c)(1 - T_E)]}_{\text{tax gain of debt}}
 \end{aligned}$$

- Discount the perpetuity tax gain of debt at the after personal tax return of debt  $r_D(1 - T_D)$  or equivalent the after personal tax return of equity  $\bar{r}_E(1 - T_E)$
- The present value of tax gain of debt is  $T_g D$  where

$$T_g = 1 - \left[ \frac{(1 - T_c)(1 - T_E)}{1 - T_D} \right]$$

- Result 14.6: Assume the pretax cash flows of the firm are unaffected by a capital structure change, and there are no transaction costs or arbitrage. If investors all have personal tax rates on debt and equity of  $T_D$  and  $T_E$ , respectively, and the corporate tax rate is  $T_c$ , then  $V_L = V_U + T_g D$
- If  $T_g > 0$ , firms will issue enough debt to eliminate their tax liability; if  $T_g < 0$ , firms will use no debt; and if  $T_g = 0$ , capital structure is indeterminant.
- Example 14.6 In 2000, the maximum personal income tax rate is 40%, the maximum corporate tax rate is 35%, and the tax rate on capital gain is 20%. What is the tax gain from debt?
- $T_g = 1 - (1 - .35)(1 - .20)/(1 - .40) = .133$

- Practical tips: Firms that generate substantial taxable EBIT should use a substantial amount of debt financing; firms with substantial amounts of other tax shields such as depreciation deductions and R&D expenses tend to have lower taxable EBIT and should choose lower debt-equity ratios