Topics in Corporate Finance

Chapter 3 (updated) : Firm's Capital Structure: Debt Equity and the Modigliani and Miller Theorem

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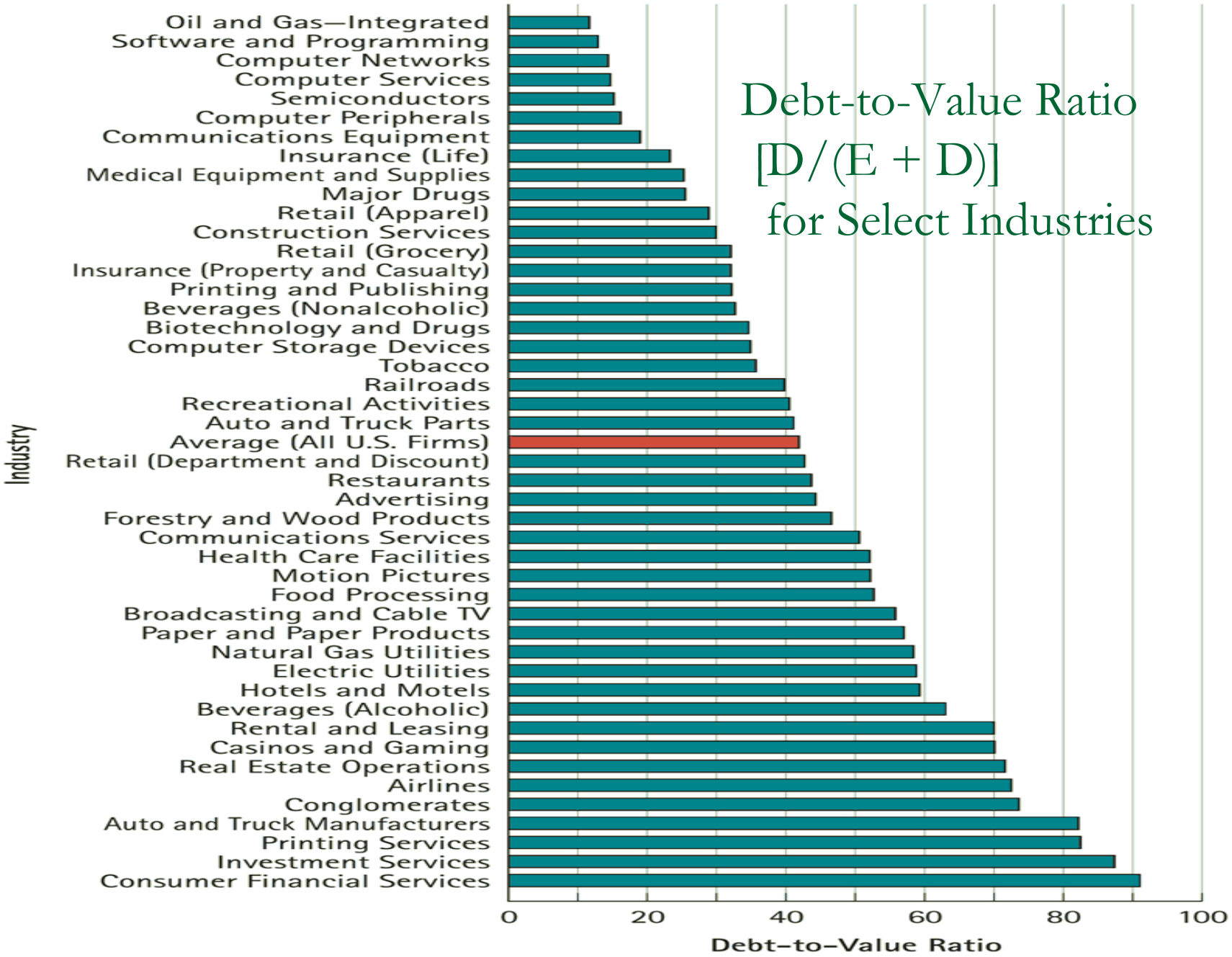
Financing Decision

- How are we going to pay for any investment?
  - Internal capital: retain earnings generated
  - External capital: Debt or equity?
    - Debt holder claims must be paid in full before the claims of equity holders can be paid
    - Equity holders elect the board of directors and thus ultimately control the firm
    - Equity holders receive cash in the form of dividends, which are not tax-deductible, while the interest payments of debt are a tax-deductible expense

Firm's Capital Structure

- The collection of securities a firm issues to raise capital from investors is called the **firm's capital structure**.
- In short "the firm's mix of debt and equity financing"

- When raising funds from outside investors, a firm must choose what type of security to issue and what capital structure to have.


Debt-to-Value Ratio
[D/(E + D)]
for Select Industries
Industry
Oil and Gas—Integrated
Software and Programming
Computer Networks
Computer Services
Semiconductors
Computer Peripherals
Communications Equipment
Insurance (Life)
Medical Equipment and Supplies
Major Drugs
Retail (Apparel)
Construction Services
Retail (Grocery)
Insurance (Property and Casualty)
Printing and Publishing
Beverages (Nonalcoholic)
Biotechnology and Drugs
Computer Storage Devices
Tobacco
Railroads
Recreational Activities
Auto and Truck Parts
Average (All U.S. Firms)
Retail (Department and Discount)
Restaurants
Advertising
Forestry and Wood Products
Communications Services
Health Care Facilities
Motion Pictures
Food Processing
Broadcasting and Cable TV
Paper and Paper Products
Natural Gas Utilities
Electric Utilities
Hotels and Motels
Beverages (Alcoholic)
Rental and Leasing
Casinos and Gaming
Real Estate Operations
Airlines
Conglomerates
Auto and Truck Manufacturers
Printing Services
Investment Services
Consumer Financial Services
0
20
40
60
80
100
Debt–to–Value Ratio

Financing with equity?

- Project:
  - Initial investment: £800m
  - Cash flows: £1400m (strong economy) or £900 (weak economy) next year
  - Each scenario is equally likely
  - Due to project risk, investors ask for an additional 10% over the 5% risk-free rate interest rate
  - NPV=?
- If project financed with equity, what is/are…
  - Market value of the firm's (unlevered) equity today?
  - Equity returns in each scenario?
  - Expected returns?

Financing with debt and equity?

- Suppose firm also borrows £500 initially,
  - What should the interest rate be?
  - How much would the firm owe in a year?
- What should now be the…
  - Market value of equity?
  - Equity returns if £500 in (levered) equity is raised?
  - Expected returns?
- What is the firm's average cost of capital?

Modigliani-Miller theorem

Proposition 1: Capital structure of the firm is irrelevant (total value of the firm is independent of the capital structure) in the absence of…

- Arbitrage opportunities
- Taxes
- Costs of bankruptcy
- Information problems
- Transaction costs

} Sum of cash flows to debt and equity holders is constant

Proof (1)

- Take two identical firms, U and L, except for their capital structure

  They exist for a year and produce identical pretax profits X at the end of the year

  One is unleveraged (no debt) and the other is leveraged (has some debt)

  Assume that its debt is riskless, at the interest rate r_D

  Total and split cash flows are…

Proof (2): Cash Flows

	Company U		Company L	
	Future Cash Flow	Current Cash Flow	Future Cash Flow	Current Cash Flow
Debt	0	0	$(1+ r_D)D$	D
Equity	X	V_U	$X- (1+ r_D)D$	E
Total	X	V_U	X	$V_L=D+E$

Proof (3): What if $V_L < V_U$?

- What if U has \$100m worth of equity (V_U) and L has \$60m of equity (E) and \$30m of debt (D)?
  - Buy 10% of equity of L (\$6m) and 10% of debt of L (\$3m)
  - Sell short 10% of equity of U (\$10m)
  - Cash inflow of \$1m at the beginning of the year
  - At the end of the year…
    - Receive: $.1[X-(1+r_D)D]+.1(1+r_D)D$
    - Pay: .1X
    - In total: 0!!
  - Arbitrage opportunity!
- Similarly, arbitrage opportunity if $V_L > V_U$
- Therefore $V_L = V_U$

Homemade leverage

Example: Stanley and Elco (before)

Elco	
Number of shares	1000
Price per share	$100
Market Value of Shares	$100,000
Market value of debt	$10,000

Stanley	
Number of shares	100
Payoff	$.1[X-(1+r_D)10{,}000]=.1X-(1+r_D)1{,}000$

Repurchasing Shares (leveraged recapitalisation)

- Firm wants to repurchase 500 shares
- Needs to raise $50,000 in debt

Elco (after)	
Number of shares	500
Price per share	$100
Market Value of Shares	$ 50,000
Market value of debt	$ 60,000

Undoing the capital structure change

- Stanley can opt for not selling shares (option a) or he can sell half of his shares (option b)

Stanley

Alternative A : Number of shares	100
Payoff	$.2[X-(1+r_D)60{,}000]=.2X-(1+r_D)12{,}000$
Alternative B : Number of shares	50
Payoff	$.1[X-(1+r_D)60{,}000]+(1+r_D)5{,}000=.1X-(1+r_D)1{,}000$

- If firm doesn't change capital structure, can Stanley get the payoff structure in alternative (A) (even with capital structure "before")?
- Shareholders can undo the effect of a change
- Shareholder is indifferent to changes in the firm's capital structure

What if debt may not be repaid?

Example: Suppose that the ownership can costlessly move from shareholders to debt holders

Elco

Number of shares	1000
Price per share	$100
Market Value of Shares	$100,000
Market value of debt	$10,000

Stanley

Number of shares	100
Payoff	$.1[X-(1+r_{DS})10{,}000]=.1X-(1+r_{DS})1{,}000$
	(*if* this amount is positive!)
	(*DS* stands for senior debholders, "or paid first")

Suppose new debt is junior (subordinated)

Example: Elco issues again new debt and Stanley buys

	Scenario A: cash flow exceeds all obligations	Scenario B: cash flow exceeds sr but not jr debt obligations	Scenario C: cash flow does not exceed sr debt obligations
50 shares of stock	$.1[X-(1+r_{DS})10,000-(1+r_{DJ})50,000]$	0	0
5000 of new debt	$(1+r_{DJ})5,000$	$.1[X-(1+r_{DS})10,000]$	0
Total	$.1[X-(1+r_{DS})10,000]$	$.1[X-(1+r_{DS})10,000]$	0

What if new debt is not subordinated?

- *Think about it as an exercise!*
- *You should get:*
  - Transfer of wealth from existing debt holders to shareholders:
    - If new debt has the same seniority then the existing debt holders are worse off
    - In scenarios B and C, shareholders are better off
  - Still, total value is unaltered: M&M still holds

Proposition 2: Cost of equity capital

- Proposition 1 states that (A is market value of assets):

$$E + D = U = \mathrm{A}$$

- By holding a portfolio of debt and equity, we can replicate the cash flows from holding unlevered equity,

$$\frac{E}{E+D} R_E + \frac{D}{E+D} R_D = R_U$$

(where R denotes returns) or

$$R_E = R_U + \frac{D}{E}(R_U - R_D)$$

- Therefore, in expected terms:

$$r_E = r_U + \frac{D}{E}(r_U - r_D)$$

Back to Capital Budgeting

- In an unlevered firm, cash flows of its assets are paid out to its equity holders
- Therefore, the cost of capital for the firm's assets is

$$r_A = r_U$$

- Projects should be discounted at their appropriate risk
- If we can find a comparison firm with assets having same risk as the project evaluated, and this firm is unlevered, then we can use its equity cost of capital as the cost of capital for the project

What if the firm is levered?

- For a levered firm, the equity cost of capital is higher than the cost of capital of the assets, and therefore of the project
- But we can compute the returns of the assets by

$$r_A = r_U = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D \equiv r_{wacc}$$

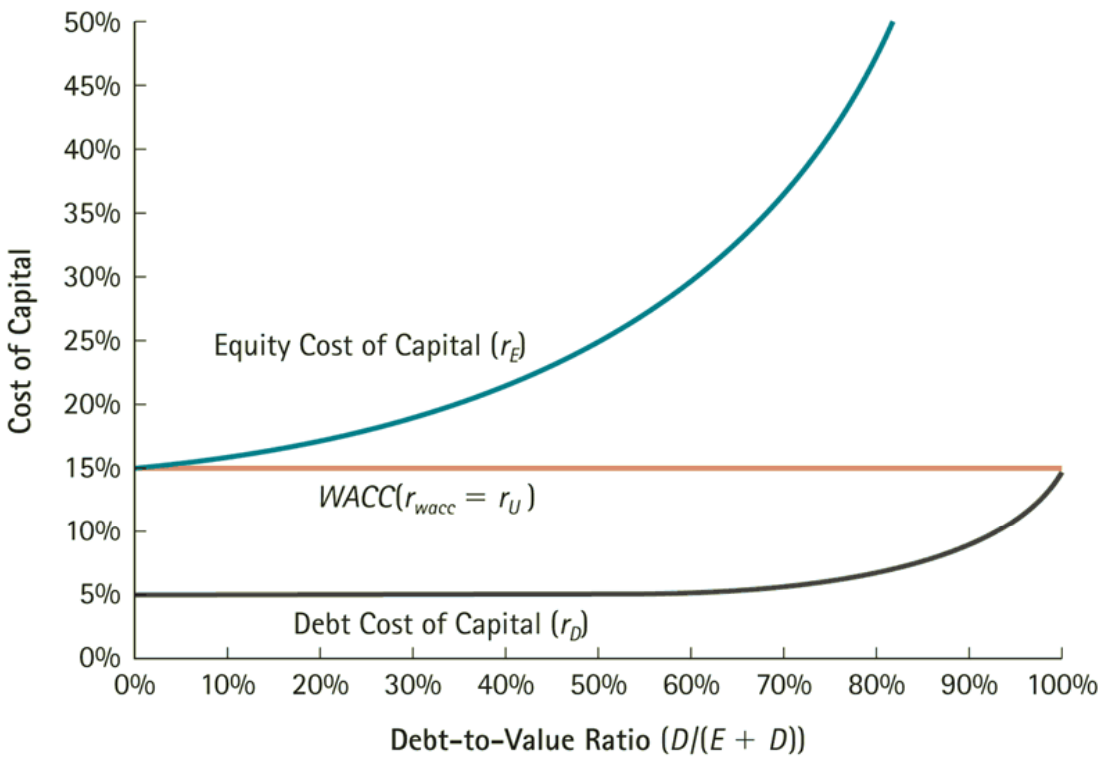
- The firm's WACC is independent of the capital structure

FIGURE 15.5

WACC and Leverage with Perfect Capital Markets

Panel (a) represents the data in panel (b) for the coffee shop example. As the fraction of the firm financed with debt increases, both the equity and the debt become riskier and their cost of capital rises. Yet because more weight is put on the lower-cost debt, the weighted average cost of capital remains constant.

Panel (a) Equity, Debt, and WACC for Different Amounts of Leverage



Panel (b) WACC Data for Alternative Capital Structures

E	D	r_E	r_D	$r_E\frac{E}{E+D} + r_D\frac{D}{E+D}$	$= r_{wacc}$
30,000	0	15.0%	5.0%	15.0% × 1.0 + 5.0% × 0.0	= 15%
24,000	6,000	17.5%	5.0%	17.5% × 0.8 + 5.0% × 0.2	= 15%
15,000	15,000	25.0%	5.0%	25.0% × 0.5 + 5.0% × 0.5	= 15%
3,000	27,000	75.0%	8.3%	75.0% × 0.1 + 8.3% × 0.9	= 15%

Reading

See Journal of Economic Perspectives special issue vol. 2, issue 4, (1988) including…

Battacharya (1988): "Corporate Finance and the Legacy of Modigliani and Miller"

Modigliani (1988) "MM -Past, Present, Future"

- Optional:

"The cost of capital, corporation finance and the theory of investment", American Economic Review, 1958