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HASKAYNE SCHOOL OF BUSINESS

Corporate Finance

Capital Structure (theory)

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Agenda

The question of the optimal capital structure

- The Modigliani-Miller theorem
- Assumptions

MM Propositions 1 and 2 (without taxes)

MM Propositions 1 and 2 (with taxes)

Contributions of the MM theory

Chapter 16 of the textbook

The question of the optimal capital structure

$$Firm\ Value\ (V) = Market\ Value\ of\ Debt + Market\ Value\ of\ Equity$$

Maximization of firm value is a key goal, and capital can be raised under the form of debt or equity.

- Could the choice of debt versus equity influence the firm value via its debt-to-equity ratio?
- If an optimal capital structure exists for a given firm, how to determine it?

Franco Modigliani and Merton Miller provided the **baseline analysis** for capital structure (AER 1958 and 1963), known as the MM theorem under the form of two propositions (without and with taxes).

- Assume complete and perfect capital markets (no taxes, no bankruptcy costs, no agency costs...)
  - P1: The value of the levered firm is the same as the value of the unlevered firm $V_L = V_U$ (i.e. the capital structure is irrelevant, aka the capital structure irrelevance principle)
  - P2: The expected return to shareholders and risk increases as leverage increases (shareholders are no better or worse off by leverage on a risk-adjusted basis!)
- Taxes exist $\rightarrow$ need to consider tax shield provided by debt as its interest is tax-deductible
  - P1: $V_L = V_U + T_c D$ (i.e. the present value of lower taxes being paid equals $T_c D$)
  - P2: The value of the tax shield benefits shareholders, their expected return increases at a slower pace than risk as leverage increases (and delivers an increasingly large tax shield)

Complete and perfect capital markets: No frictions

Assumptions used by Modigliani and Miller (AER 1958)

- Taxes do not exist
- Transactions costs do not exist
- Individuals and corporations can borrow at the same rate
- Complete information
  - i.e. no asymmetric information and cost to principal for monitoring agent is zero
- The firm cash flows (CF) are perpetual and fixed
- No default risk
  - i.e. the cost of financial distress or bankruptcy is zero

In such theoretical approach, the idea is to ignore 'noise' (i.e. market imperfections) to identify and understand the core of the issue at hand (i.e. it provides a baseline analysis).

Then, by relaxing one or several assumptions, it is possible to identify and understand the interactions of the different factors (and get closer to practical prescriptions and managerial guidelines).

MM Proposition 1

Intuition of MM proposition 1 (the 'capital structure irrelevance principle')

- Whatever choice by management of leverage for a firm can be done or undone by shareholders on their own (i.e. by using the so-called homemade leverage).
- Therefore leverage has no influence over the value of the firm.

Proof of MM proposition 1 (by comparing the outcomes of strategies 'a' and 'b')

- V_U: value of the firm when 100% equity (unlevered)
- V_L: value of firm when both equity and debt are used (levered)

a) Buy 10% of V_U at cost of 10% of V_U, get payoff of **10% of CF**, or

b) Buy 10% of V_L (i.e. 10% of equity + 10% of debt outstanding), get equity payoff of 10% of CF minus 10% of cost of debt + 10% of cost of debt, for a net of **10% of CF**

Law of one price of same payoff: 10% of V_U = 10% of $V_L \rightarrow \boldsymbol{V_U = V_L}$

No frictions $\rightarrow$ firm value is unchanged by splitting the cash flows to capital anyway you want!

MM Proposition 2

Under MM proposition 1, **WACC is constant**: $r_{WACC} = r_0 = r_{EU} = {}^{CF}/_{V_U}$ (firm's CF are constant)

$$r_{EU} = \frac{D}{D+E} r_{Debt} + \frac{E}{D+E} r_{Equity} \leftrightarrow r_{EL} = r_{EU} + \frac{D}{E}\left(r_{EU} - r_D\right)$$

The required return for equity (r_{EL}) when the firm is levered is the unlevered equity return (r_{EU}) plus a risk premium ($r_{EU} - r_D$) multiplied by a risk measure, the debt to equity ratio ($\frac{D}{E}$).

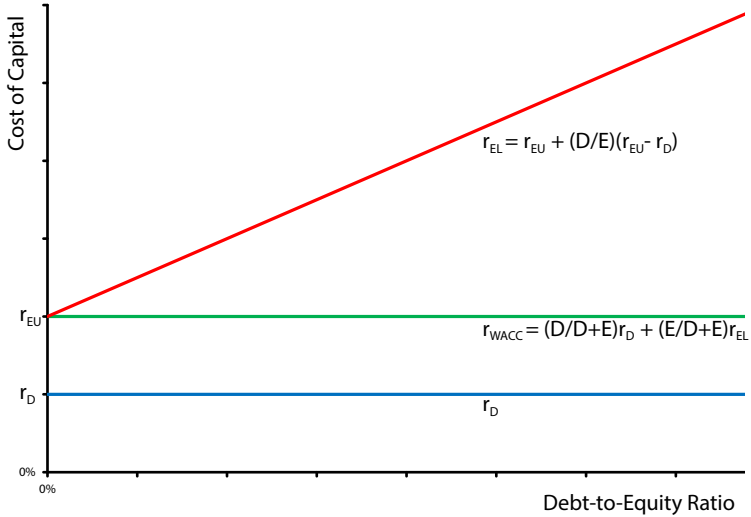
On a risk-adjusted basis, shareholders are no better or worse off, and therefore 'unaffected' by leverage.

- Since the levered beta is the same linear function of the debt to equity ratio as below illustrated.

$$\beta_{EU} = \frac{D}{D+E} \beta_{Debt} + \frac{E}{D+E} \beta_{Equity} \leftrightarrow \beta_{EL} = \beta_{EU} + \frac{D}{E}\left(\beta_{EU} - \beta_D\right)$$

Shareholders cannot be made better off on a risk-adjusted basis simply by replacing equity with debt.

MM Proposition 2 (graphical illustration)



MM Proposition 2 (example without taxes)

What happens when the debt to equity ratio goes from 0 to 1? (nothing created, nothing lost!)

- CF = \$1,000; $r_{EU} = 10\%$; $V_U = \frac{CF}{r_{EU}} = \$10{,}000$; 1,000 shares out while $\beta_U = 1$
- Firm issues \$5,000 in debt at 5%, buys back 500 shares at \$10 ($S = \frac{V_U}{Nb.\ shares} = \frac{\$10{,}000}{1{,}000} = \$10$)
- $CF_D = \$5{,}000 \times 0.05 = \$250$; $CF_E = CF - CF_D = \$1{,}000 - \$250 = \$750$

$$r_E = r_U + \frac{D}{E}(r_U - r_D) \rightarrow r_E = 0.10 + 1(0.10 - 0.05) = 0.15$$

$$\beta_E = \beta_U + \frac{D}{E}(\beta_U - \beta_D) \rightarrow \beta_E = 1 + 1(1) = 2$$

$$r_E = r_D + \beta_E(r_U - r_D) \rightarrow r_E = 0.05 + 2(0.05) = 0.15$$

$$V_U = V_D + V_E = \frac{\$250}{0.05} + \frac{\$750}{0.15} = \$5{,}000 + \$5{,}000 = \$10{,}000$$

Lets consider an example with corporate taxes (MM with taxes)

Tax is 40%, interest on debt is a tax deductible expense, $\beta_{UE} = 0 \rightarrow r_E = r_D = 10\%$, and D = 2,500

	Without taxes		With taxes	
	Unlevered	Levered	Unlevered	Levered
Base CF	1,000	1,000	1,000	1,000
CF to debt	-	250	-	250
Taxable CF	1,000	750	1,000	750
Taxes (40%)	-	-	400	300
CF to equity	1,000	750	600	450
CF to D and E	1,000	1,000	600	700
V at 10%	10,000	10,000	6,000	7,000
V_D at 10%	-	2,500	-	2,500
V_E at 10%	10,000	7,500	6,000	4,500

$$V_L = V_U + \frac{T_C\,(r_D \times D)}{r_D} = V_U + T_c \times D = 6{,}000 + 0.4 \times 2{,}500 = 6{,}000 + \mathbf{1{,}000} = 7{,}000$$

The value created by the debt-related tax shields (**1,000**) is entirely captured by the shareholders.

MM Propositions 1 and 2 with corporate taxes

Proposition 1 with corporate taxes

$$V_L = V_U + T_C D$$

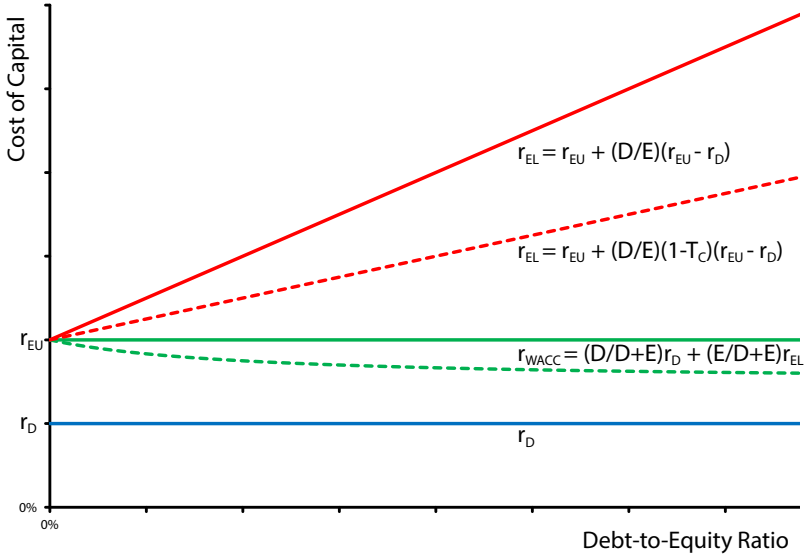
- The value of the firm is increasing with leverage (N.B. taxes negatively impact V_L to start with).

Proposition 2 with corporate taxes

$$r_E = r_U + \frac{D}{E}(1 - T_C)(r_U - r_D)$$

- The required rate of return for equity still increases as leverage ($\frac{D}{E}$) increases, but at a slower pace since equity now benefits from larger tax shields as leverage increases given $1 > T_C > 0 \leftrightarrow 0 < 1 - T_C < 1$.

MM Proposition 2 (with taxes graph)



Contributions of MM theory

The key contribution of Modigliani and Miller is that imperfections like taxes, financial distress costs, and behavioral biases are the important drivers of the actual capital structure of a firm as decided by management (explicitly or implicitly).

In addition to the above, some other drivers of capital structure might exist on a rational basis.

- One cost of taking on additional debt, as perceived by management, is a loss of future financial flexibility (i.e. borrowing now might decrease your ability to borrow in the future).
- An unconstrained ability to quickly seize business opportunity as they arise could therefore influence the decision making of management on a rational basis (a real option perspective).
- So, in a volatile industry or in an uncertain economic environment, the value of financial flexibility could be perceived to be high enough to justify using less debt than apparently optimal.

Chapter 16 of the textbook

Textbook sections covered

- 16.1 to 16.6

Worked examples

- Four worked examples are provided in chapter 16 of the textbook.

Exercises

- 30 exercises are provided in chapter 16 of the textbook.
- You should practice your Excel skills with a few of those.
- Suggest 16.8, 16.13 and 16.23
- Hints
  - 16.8: a) 550
  - 16.13: d) 10.04% and 9.08%
  - 16.23: a) same; b) 10.33%; c) 9.72%; d) 10.58%

16.8 Solution

$$Cash\ Flow = EPS \times Nb.\ Shares = \frac{\$33{,}000}{6{,}000} \times 100 = \$550\ (a)$$

$$Firm\ Value = Share\ Price \times Nb.\ Shares = \$58 \times 6{,}000 = \$348{,}000$$

$$New\ Debt = 0.35 \times \$348{,}000 = \$121{,}800$$

$$Shares\ Repurchased = \frac{\$121{,}800}{\$58} = 2{,}100$$

$$New\ Net\ Income = \$33{,}000 - 0.08 \times \$121{,}800 = \$23{,}256$$

$$New\ Cash\ Flow = EPS \times Nb.\ Shares = \frac{\$23{,}256}{6{,}000 - 2{,}100} \times 100 = \$596\ (b)$$

Sell 35% of shares owned and lend proceeds at 8%

$$\begin{aligned} Cash\ Flow &= Loan \times R_D + EPS \times Nb.\ Shares \\ &= 35 \times \$58 \times 0.08 + \frac{\$23{,}256}{6{,}000 - 2{,}100} \times 65 = \$550\ (c) \end{aligned}$$

16.13 Solution

$$WACC = 0.11 \; (a)$$

$$\begin{aligned} r_E &= r_U + \frac{D}{E}(1 - T_C)(r_U - r_D) \\ &= 0.11 + \frac{0.25}{0.75}(1 - 0.35)(0.11 - 0.08) = 0.1165 \; (b) \\ &= 0.11 + \frac{0.5}{0.5}(1 - 0.35)(0.11 - 0.08) = 0.1295 \; (c) \end{aligned}$$

$$\begin{aligned} WACC &= \frac{D}{D+E} r_{Debt}(1 - T_c) + \frac{E}{D+E} r_{Equity} \\ &= 0.25 \times 0.08(1 - 0.35) + 0.75 \times 0.1165 = 0.1004 \; (d) \\ &= 0.5 \times 0.08(1 - 0.35) + 0.5 \times 0.1295 = 0.0908 \; (d) \end{aligned}$$

16.23 Solution

$$0.35 = \frac{\$3{,}600{,}000}{E} \rightarrow E = \frac{\$3{,}600{,}000}{0.35} = \$10{,}285{,}714$$
$$V = V_D + V_E = \$3{,}600{,}000 + \$13{,}885{,}714 = \ (a)$$

No change in market value before and after the repurchase announcement.

$$ROE = \frac{\$1{,}350{,}000 - (0.08 \times \$3{,}600{,}000)}{\$10{,}285{,}714} = 0.1033\ (b)$$
$$r_{EL} = r_{EU} + \frac{D}{E}(r_{EU} - r_D) \rightarrow 0.1033 = r_{EU} + 0.35\,(r_{EU} - 0.08)$$
$$\rightarrow r_{EU} = 0.0972\ (c)$$
$$r_{EL} = r_{EU} + \frac{D}{E}(r_{EU} - r_D) = 0.0972 + 0.5\,(0.0972 - 0.08) = 0.1058\ (d)$$