15.415x Foundations of Modern Finance

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Lecture 18: Financing/Capital Structure II

Key Concepts

- Capital structure II: Extending MM
- Taxes
- Financial distress
- Cost of financial distress
- Trade-off theory of capital structure
- Personal taxes

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Capital structure: Extending MM

MM assumptions to relax first:

- Taxes:
  - Corporate taxes,
  - Personal taxes.
- Costs of financial distress.

In more advanced corporate finance topics, we will also consider:

- Transaction costs for issuing debt and equity,
- Asymmetric information about the firm's investments,
- Capital structure may influence managers' investment decisions.

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Capital structure with taxes

- Different financial transactions are taxed differently:
  - Interest payments are tax exempt for a firm (considered expense)
  - Dividends and retained earnings are not …

tax code varies substantially across countries

- Financing now matters because it affects a firm's tax bill.
- Assume for now that there are no personal taxes:
  - E.g., investors are pension funds …

charities, and tax-exempt foundations

Capital structure with taxes

Claim: Debt increases firm value by reducing its tax burden.

discount rate

Example. XYZ Inc. generates a safe $100M annual perpetuity. Assume risk-free rate of 10%. Tax rate is 35%. Compare:

- 100% debt: perpetual $100M interest,
- 100% equity: perpetual $100M dividend or capital gains.

	100% Debt	100% Equity
Income before tax	Interest Income $100M	Equity income $100M
Corporate tax rate 35%	0	-$35M
Income after tax	$100M	$65M
Firm value	$1,000M	$650M

discount rate: 10%

Since after the interest payment the firm has no income to report, it pays zero taxes.

Capital structure with taxes

It is fully determined by the firm's asset or its cash flow

- MM still holds: The pie before tax is unaffected by capital structure:

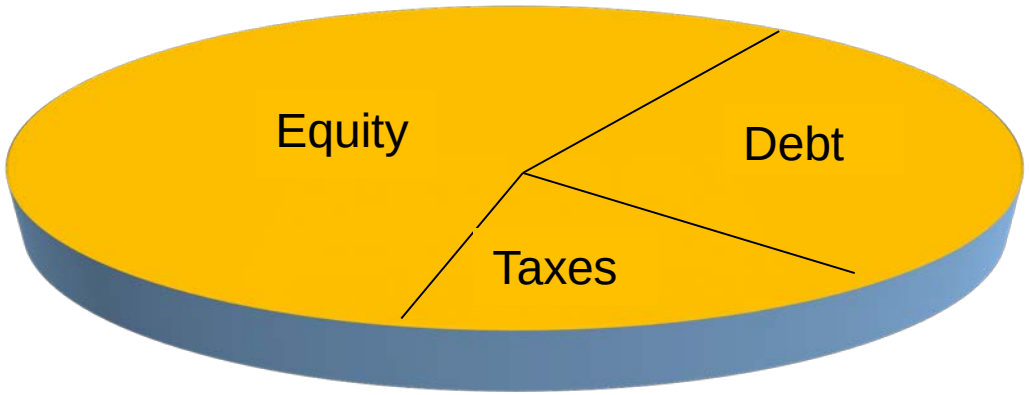
$$\text{Size of the pie before tax} = \text{PV of pre-tax cash flow}$$

- But the IRS gets a slice before investors.
- Financing policy affects the size of that slice.
- Interest payments being tax deductible, the PV of the IRS' slice can be reduced by using debt rather than equity.
- The after-tax value of the firm depends on capital structure.

total value of the firm: D plus E

increasing D will then decrease T, D+E will increase

Pie Theory (cont'd):



MM with taxes

Consider the following:

- Two firms, U and L, with identical assets.
- Assets yield a pre-tax, expected terminal cash flow X next period. nothing afterwards
- The required rate of return on the assets is r_A.
- Firm U is 100% equity financed.
- Firm L has a debt level D, which pays an expected interest r_D (plus the principal) next period. pay interest and principle
  - D is the market value of debt. current value of debt
- Corporate tax rate is τ.
- Ignore personal taxes.

MM with taxes

The expected terminal (next period) after-tax cash flows of the two firms are:

- Firm U: $(1-\tau)\,X$
- Firm L: $(1-\tau)\,(X - r_D D) \;+\; r_D D \;=\; (1-\tau)\,X \;+\; \tau\,(r_D D)$

Thus, the tax shield from debt is $\tau\,(r_D D)$, i.e., tax rate times interest payment.

The value of each firm:

$$V_U \;=\; \frac{(1-\tau)\,X}{1+r_A}$$

$$V_L \;=\; \frac{(1-\tau)\,X}{1+r_A} + \frac{\tau\, r_D D}{1+r_D} \;=\; V_U + \frac{\tau\, r_D D}{1+r_D}$$

tax shield

- Required rate of return on debt same as the interest rate on debt.

different discount rate

same as the expected interest rate on debt, because they have the same risk. But it not always true. If debt defaults, in the bad state, Tax Shield is not proportional to Debt value, even may be zero if principle defaults. In this case you can not discount TS with R_D, you have to use state price

MM with taxes

MM I with taxes. The value of a levered firm equals the value of the unlevered firm (with the same assets) plus the present value of the tax shield:

$$V_L = V_U + PV\,(\text{debt tax shield}) = V_U + PVTS$$

The face value is not interest. Only interest payments are tax-deductible.

- Tax shield of debt matters, potentially quite a bit.
- Pie theory gets us to ask the right question: How does financing choice affect the IRS' bite of the corporate pie?
- Caveats:
  - Not all firms face full marginal tax rate (e.g., non tax paying companies).
  - Personal taxes.

MM with taxes

- Raising debt itself does not create value -- can't create value by borrowing and sitting on the excess cash.

using debt — same amount of funds

- It creates value relative to raising the same amount in equity.
- Value can be created by the tax shield when:
  - finance an investment with debt rather than equity,
  - undertake a recapitalization, i.e., retire some equity with debt.
- Tax advantage of debt is substantial for firms.
- With personal taxes, the total effect is reduced for individuals (see later).
- If investors are mostly individuals, the tax shield is smaller.

Question: If debt adds value, why don't corporations simply lever up?

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The dark side of debt

Potential costs of debt:

- If taxes were the only issue, (most) companies would be 100% debt financed.
- Common sense suggests otherwise:
  - If the debt burden is too high, the company will have trouble paying;
  - The result: financial distress;
  - Financial distress involves costs …

The dark side of debt

If debt is risk-free, there will be no financial distress nor cost.

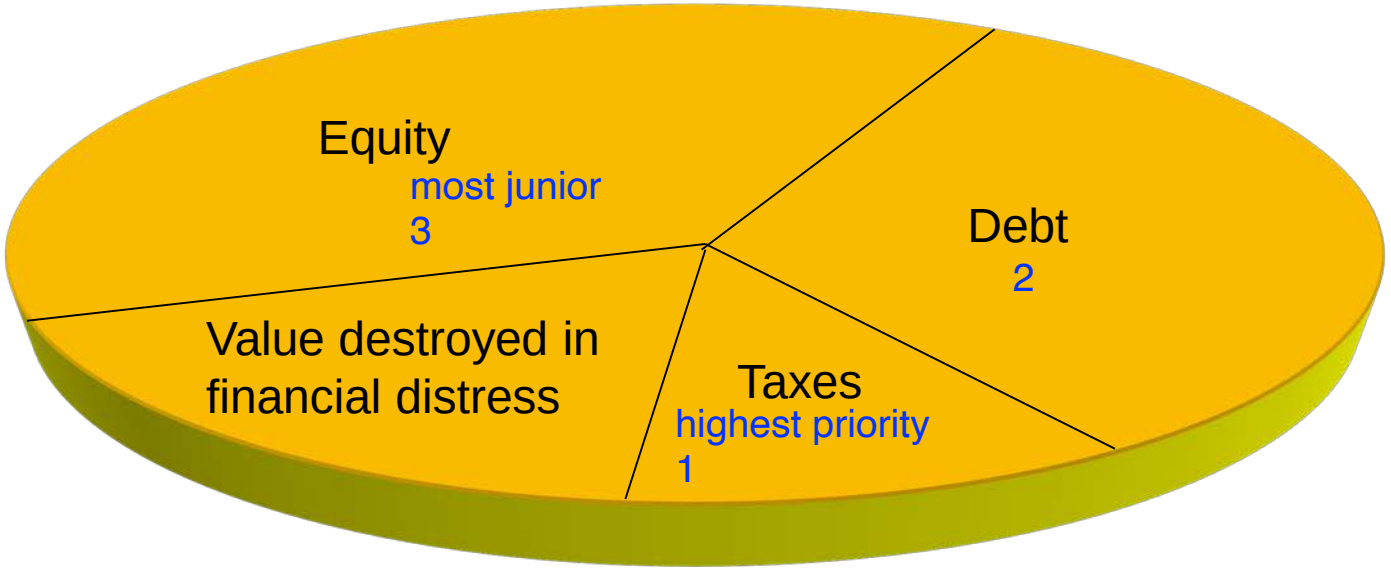
- Financial distress – Cash flow is not sufficient to cover current obligations, which starts a process of resolving the broken contract with creditors.
  - Private renegotiation or workout,
  - Bankruptcy, supervised by court.
- It is important not to confuse the causes and effects of financial distress when identifying the potential "costs of financial distress"!
- Only those costs that would not arise outside financial distress should be counted:
  - Firms in financial distress perform poorly: Cause or effect?

cause or effect?
it depends. Poor performance may have caused the financial distress in the first place. But financial distress can put additional pressure on the firm, leading to further deterioration of its performance.

Costs of financial distress

Pie Theory (cont'd)

The total pie is given by the value of the firm's asset, which is fixed.



For the firm stakeholders, the objective is to maximize the total value of the firm, which is debt plus equity.

increasing debt can reduce taxes and thus increase d plus e. However, the cost of financial distress also increases, which tends to offset the tax benefit of debt.

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Costs of financial distress

Direct costs of financial distress:

- Legal costs… time spent on dealing with distress

Indirect costs of financial distress:

- Scare off customers and suppliers.
- Agency costs.
- Debt overhang: Inability to raise funds to undertake good investments.
  - Pass up valuable investment projects,
  - Competitors may take this opportunity to be aggressive...

Costs of financial distress

- What are direct financial distress/bankruptcy costs?
  - Legal expenses, court costs, advisory fees…
  - Opportunity costs: time spent by dealing with creditors… distractions
- How important are direct bankruptcy costs?
  - 2~5% of total firm value for large firms and up to 20~25% for small firms.
  - But this needs to be weighted by the bankruptcy probability!
  - Overall, expected direct costs tend to be small.
    - It can be large for some firms…

the present value of bankruptcy costs should be expected value, using risk-neutral probabilities, not physical probabilities.

Costs of financial distress

Indirect cost 1: Losing customers and suppliers.

- Suppliers may demand cash payment.
  - This may put a firm into distress.
- Customers may choose another vendor.
  - Why is this true? That's because the relationship can be longer term.
  - For what types of firms is this not an important issue?
    - GM? longer term.
    - Market Basket? retail store for groceries short term

Costs of financial distress

Indirect cost 2: Agency costs.

managers take on actions that are not in the best interest of shareholders.

- Financial distress may motivate managers to act in value-destroying ways.
- Examples:
  - Cash-in-and-run: Take money out of the company
  - Excessive risk-taking (gambling for resurrection)
  - Delay of (efficient) liquidation...
- Why are these possibilities costly to shareholders?
  - Debt holders anticipate them and pay less for debt when issued.

Preventive measures: Covenants (more discussion later).

- covenants in the debt contract
- having collateral

Costs of financial distress

Indirect cost 3: Debt overhang.

debt issued before becomes too much of a burden on the firm, so that it will distort its decisions.

Example. XYZ's assets in place (with idiosyncratic risk) worth in year 1:

State	Probability	Asset ($M)
Good	1/2	100
Bad	1/2	10

discount rate: 0

Assume risk-free rate to be 0. XYZ has a new investment project:

- Today's investment outlay: $15M,
- Next year safe payoff: $20M,
- At 0% risk-free rate, XYZ should take this project:

NPV = - 15 + 20/1.0 = $5M

Costs of financial distress

including interest

- XYZ has debt with face value $40M due next year.

Without Project				
State	Probability	Asset ($M)	Debt ($M)	Equity ($M)
Good	1/2	100	40	100-40 = 60
Bad	1/2	10	10	0

With Project				
State	Probability	Assets ($M)	Debt ($M)	Equity ($M)
Good	1/2	100+20 = 120	40	120-40 = 80
Bad	1/2	10+20 = 30	30	0

- XYZ's shareholders will not fund the project because:

financed by equity holders

NPV for shareholders = -15 + [(1/2)(20) + (1/2)(0)]/1.0 = - $5M

- What's happening? assume that, in order to take the project, the equity holders will need to put up the initial investment of $15 million.

Costs of financial distress

- For shareholders:
  - Incur the full investment cost: - $15M,
  - Receive only part of the payoff (20 only in the good state).
- For existing debt holders:
  - Incur none of the investment cost,
  - Still receive part of the payoff (20 in the bad state).
- So, existing risky debt acts as a "tax on new investment." for equity holders

Thus,

- Shareholders of firms in financial distress are reluctant to fund valuable projects when most of the benefits go to the firm's existing debt holders.
- This effect becomes stronger as the debt becomes more risky and financial distress more likely.

The debt overhang problem shows the potential divergence in the interest of debt and equity holders under financial distress.

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Costs of financial distress (2)

Measures to overcome debt overhang ex post:

- Issue new debt? issue new debt to fund the project, as equity holders won't fund it.
  - Junior or senior debt.
- Financial restructuring?
  - Outside bankruptcy; in-court
  - Under a formal bankruptcy procedure. out-of-court

workout

Costs of financial distress (2)

Issue new debt:

- New debt with lower seniority than the existing debt.
  - Will not improve things: the “tax” on equity holders is unchanged.
- New debt with same seniority as existing debt.
  - Will mitigate but may not solve the problem: a (smaller) tax remains.
- New debt with higher seniority than existing debt.
  - Further reduces tax on investments (on equity holders) by getting a larger part of payoff.
  - Similar alternative: debt with shorter maturity (de facto senior).
  - However, this (issuing more senior debt) is often prohibited by covenants!

Costs of financial distress (2)

- Existing debt with face value $40M due next year.
- Without the project, existing debt value is $25M, equity value 30.
- Issue new junior debt to raise $15M for the project.

= 1/2 * 40 + 1/2 * 10

= 1/2 * 60 + 1/2 * 0

With the Project					
State	Prob.	Assets	Old Debt	New Debt	Equity
Good	1/2	100+20=120	40	30	120-40-30 = 50
Bad	1/2	10+20=30	30	0	0

- Existing debt value increases to (1/2)(40+~~20~~ 30) = $35M.
- Value of new (junior) debt is (1/2) (30+~~10~~ 0) = $15M.

new debt: (discount rate = 0)
current value = expected value
15 = 1/2 * 30 + 1/2 * 0

- Share holders will not take the project because:

NPV = change of equity

NPV for shareholders = [(1/2)(50) + (1/2)(0)]/1.0 - 30 = - $5M

but existing debt: +10M (35M -25M)

NPV = 0 + (1/2 * (50 - 60) + 1/2 * (0 - 0))

Costs of financial distress (2)

- Existing debt with face value $40M due next year.
- Without the project, existing debt value is $25M, equity value 30.
- Issue new debt of same seniority to raise $15M for the project.

1/2 * x + 1/2 * (30-x) = 15

With the Project					
State	Prob.	Assets	Old Debt	New Debt	Equity
Good	1/2	100+20=120	40	20 x	120-40-20 = 60
Bad	1/2	10+20=30	20	10 30-x	0

30 - (30-x) = x

- Existing debt value increases to $30M. 1/2 * 40 + 1/2 * 20 = 30
- Value of the new (equal seniority) debt is (1/2)(20+10) = $15M.
- Share holders are indifferent about taking the project because:

NPV = 0 + (1/2 * (60 - 60) + 1/2 * (0 - 0))

NPV for shareholders = [(1/2)(60) + (1/2)(0)]/1.0 - 30 = 0

With the same seniority, the old and new debt will be splitting the value of the asset propotional to their face values.

40/x = x/(30-x)

Costs of financial distress (2)

- Existing debt with face value $40M due next year.
- Without the project, existing debt value is $25M, equity value 30.
- Issue new debt of higher seniority to raise $15M for the project.

With the Project					
State	Prob.	Assets	Old Debt	New Debt	Equity
Good	1/2	100+20=120	40	15	120-40-15 = 65
Bad	1/2	10+20=30	15	15	0

senior, always get paid

- Existing debt value increases to $27.5M.
- Value of new senior debt is (1/2)(15+15) = $~~30~~M.

15

- Share holders will take the project because:

NPV = 0 + (1/2 * (65 - 60) + 1/2 * (0 - 0))

NPV for shareholders = [(1/2)(65) + (1/2)(0)]/1.0 - 30 = $2.5M

Will the existing debtholders agree to break the covenants?

covenants of the existing debt typically prohibits the issuing of more senior debt. Effectively, this will require a restructuring of the existing debt.

Costs of financial distress (2)

Financial restructuring:

- In principle, restructuring could avoid the inefficiency:
  - Debt for equity exchange,
  - Debt rescheduling. rescheduling and restructuring
- Basic idea:
  - Offer to give debt holders equity in return for canceling the firm's debt;
  - Debt holders become equity holders; and will have aligned interests
  - Once debt is reduced, it no longer imposes a "tax" on new investment!
  - Put differently: Overcome debt overhang by reducing debt.

Costs of financial distress (2)

based on forecasts rather than actual results

Measures to avoid debt overhang ex ante:

- Firms anticipating funding needs should avoid too much debt.
- Firms anticipating valuable investment opportunities should avoid too much debt.
- If cannot avoid leverage, at least structure liabilities so that they are easy to restructure if needed:
  - Active management of liabilities,
  - Bank debt,
  - Fewer banks.

reduce the number of debt claimer, which make restructure easier

using bank debt rather than bonds, which have diverse investors, dealing with fewer banks rather than many.

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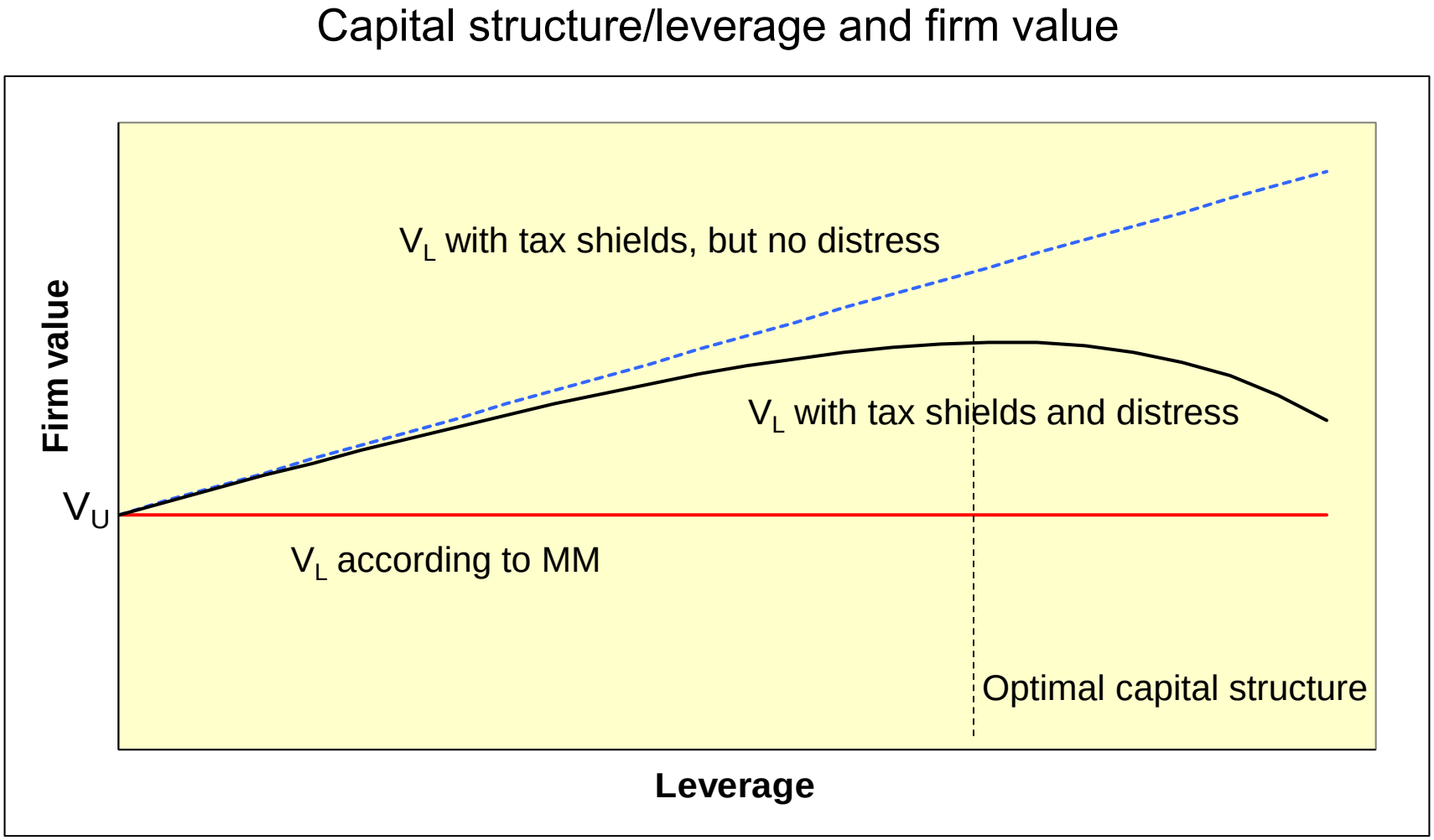
Trade-off theory

Putting things together:

1. Start with MM Irrelevance Theorem.
2. Add two ingredients that can change the size of the pie:
   - Taxes,
   - PV of distress costs.
3. Trading off the two gives the “static optimum” for capital structure.
   - “Static” as this theory views a firm’s debt level relatively stable over time.

Trade-off theory



Trade-off theory

Summarizing the Trade-off Theory:

Value of levered firm = Value of unlevered firm

\+ Adjustment for leverage effect:

- Tax benefit,
- Cost of financial distress.

Adjusted Present Value

$$V_L = V_U + PV\ (\text{tax shield of debt}) - PV(\text{cost of financial distress}) = APV$$

The optimal level of debt is chosen to maximize V_L (firm's total value) or APV (its adjusted PV).

Trade-off theory

Implications:

- Firms with “low” PV of distress costs should load up on debt to get tax benefits.
- Firms with “high” PV of distress costs should be more conservative in leverage.
- Thus, the key lies in having an idea of what industry and company traits lead to potentially high PV of distress costs.

PV distress costs = (Risk neutral probability of distress) × (Distress costs)

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Trade-off theory

Example. 415inc, a fintech company, is currently 100% equity financed. The value of its assets can be described by the following process:

$$100 \longrightarrow \begin{cases} 120, \text{ probability } 1/2 \\ 100, \text{ probability } 1/2 \end{cases}$$

415inc's equity is now trading at 100. The risk-free interest rate is 5%.

- 415inc learned from its bank that it can issue a one-year bond with principal amount of $P = 80$, at a reasonable promised yield of y.
- When 415inc fails to pay the interest in full, it incurs a cost of default $c(yP - Y)^2$, where Y is the actual interest paid ($Y \leq yP$) and $c = 1/320$.
- 415inc's tax rate is $\tau = 30\%$.

Since P equals 80, and the asset value is 100 in the bad state, 415inc will never default on the principal.

As the CEO of 415inc, you need to answer the following questions:

1. Should you issue the bond? Why?
2. If you decide to issue the bond, how should you choose y?
3. How much can you increase the value of 415inc today by doing this?

Trade-off theory

Example (cont'd).

1. Suppose that 415inc wants the bond to be risk-free.
   - In the down state, the asset value is 100. In order to guarantee the principal and interest payment, we have $(1+y)P \leq V_d$ or
   $$(1+y)(80) \leq 100 \Rightarrow y \leq 0.25$$
   - If 415inc issues the 1-year bond with principal $P = 80$ and promised yield y, the promised interest payment will be $yP = 80y$.
   - The tax shield is τyP, in both states at time 1. Its present value is:
   $$PVTS(D) = \frac{(0.3)(80)y}{1+0.05} = (22.86)y$$
   - This is positive. The value of 415inc can be increase to:
   $$V_L = V_U + PVTS(D) = 100 + (22.86)y$$
   - It is maximized by letting $y = 0.25$ (without default), yielding 105.72.
   - Can we do better? risk-free bond with yield = 25%

because of tax shields, it is profitable for the firm to do so. any risk free bond with yield higher than a risk free rate, if allowed to trade in the public market, will almost immediately be arbitraged away.

Trade-off theory

Example (cont'd). increase y, more tax shield

2. If we increase y beyond 25%, there will be default in the down state (assuming $80y \leq 40$ or $y \leq 0.5$, thus no default in up state).
   - Why do this? – In the up state, we get more tax shield: $\tau(yP)$.
   - But in the down state, we incur default cost.
   - In the down state, the actual interest payment is $(V_d - P)$, which gives a tax shield of $\tau(V_d - P) = (0.3)(20)$. This is fixed, independent of y.
   - The default amount is: $(80)(y - 0.25)$, which leads to a default cost of
     $$DC(y) = c(80)^2(y - 0.25)^2$$
   - Thus, we have:
     $$V_L = V_U + PVTS(y) - PVDC(y) = 100 + ? - ?$$
   - How do we value the tax shield and default cost, which are now risky?

Trade-off theory

Example (cont'd).

3. (Cont'd). We need to know how to price payoffs in different states.

- From the price of 415inc's assets: risk-neutral probability

$$100 = \frac{(q)(120) + (1-q)(100)}{1+0.05} \Rightarrow q = 1/4$$

- PV of tax shield:

$$PVTS(y) = (0.3)\frac{(1/4)(80)y + (3/4)(20)}{1+0.05} = 6.86$$

- PV of default cost:

$$PVDC(y) = \frac{(3/4)(1/320)(80)^2(y-0.25)^2}{1+0.05} = 0.57$$

solve OPT problem

- The optimal y is 0.45 (less than 0.5 indeed) and $DC = 0.8$.
- The value of the levered firm:

$$V_L = V_U + PVTS(y) - PVDC(y) = 100 + 6.86 - 0.57 = 106.29$$

Trade-off theory

Example (cont'd).

4. (Cont'd).

because the price is higher than the par value of the debt.

- The market value of the debt (at premium):

default cost

$$D = \frac{(q)(80)(1+0.45) + (1-q)(100-0.8)}{1+0.05} = 98.48$$

- What to do with the proceeds from bond issue? Buy back shares.
- The market value of equity after share repurchase:

$$E = V_L - D = 106.29 - 98.48 = 7.81$$

stakeholder

- Refinancing can increase shareholder value by:

$$106.29 - 100 = 6.29$$

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Trade-off theory (2)

Identifying factors affecting PV of distress costs:

- Probability (risk-neutral) of distress More precisely, the risk neutral probability.
  - Volatile cash flows:
    - industry change
    - technology change
    - cyclical industry
    - macro shocks
    - start-up
- Distress costs These costs can be large in the following situations.
  - Need external funds to invest in CAPX or market share
  - Financially strong competitors
  - Customers or suppliers care about your financial position (e.g., specific investments)...

Checklist for capital structure

A checklist for capital structure:

- Taxes
  - Does the company benefit from debt tax shield?
- PV of distress costs (using risk-neutral probabilities)
  - Cash flow volatility
  - Need for external funds for investment
  - Competitive threat if pinched for cash under financial distress
  - Customer/supplier sensitivity about distress...

Checklist for capital structure

What is the right number (for leverage)?

- No “one size fits all” formula.
- Key is to understand the factors affecting capital structure.
- Need to apply business judgment, taking into account factors discussed above.
  - Ranges and not point values: Leverage is going to fluctuate with firm performance anyway.

Trade-off theory and empirics

What can we explain?

- Good at understanding capital structure differences at broad levels.
  - E.g., Electric and Gas (43.2%) vs. Computer Software (3.5%),
  - Industries with more volatile cash flows in general have lower leverage.
- Probably not so good at explaining small differences in debt ratios.
  - E.g., Food Production (22.9%) vs. Manufacturing Equipment (19.1%).
- Probably not so good at explaining short-run time variations. short-term fluctuations
- Other factors are also important (more on that later).

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MM with personal tax

We now consider the effect of personal taxes.

Consider the following:

- Assets yield pre-tax, expected terminal cash flow X next year.
- Debt level at D with interest rate r_D.
- Corporate tax rate τ.
- Investors pay additional personal taxes:
  - Tax rate on equity (dividend and capital gain) π,
  - Tax rate on debt (interest) δ.

MM with personal taxes

Next year, the cash flow after corporate and personal taxes:

- To equity holders: $(1-\pi)(1-\tau)(X-r_D D)$, asset payoff after interests
- To debt holders: $(1-\delta)\, r_D\, D$.

The total after-tax cash flow can be written as:

$$\underbrace{(1-\pi)(1-\tau)X}_{\text{all equity firm}} \quad + \quad \underbrace{[(1-\delta)-(1-\pi)(1-\tau)]\, r_D\, D}_{\text{tax impact of debt}}$$

PV is given by after-tax CF discounted at the appropriate discount rates:

- For all equity firms, use $(1-\pi)\, r_A$, after tax return on asset
- For debt, use $(1-\delta)\, r_D$. after tax return on debt

$$V_L = PV\{(1-\pi)(1-\tau)X\} + PV\{[(1-\delta)-(1-\pi)(1-\tau)]\, r_D\, D\}$$

MM with personal taxes

Putting things together, we have:

MM I with corporate and personal taxes. The firm's value is given by:

$$V_L = V_U + [(1-\delta) - (1-\pi)(1-\tau)]\, PV(r_D D)$$

- If equity pays large dividends **and** $\pi = \delta$, we have:

  $$V_L = V_U + (1-\delta)\,\tau\, PV(r_D D)$$

  In this case, debt has a clear advantage over equity.
- If equity can avoid dividends, it does not look too bad.
  - When $\pi < \delta$, the tax shield of debt is less than $(1-\delta)\,\tau\, PV(r_D D)$.
- If capital gains tax can be avoided, equity might dominate debt:
  - When $\pi \approx 0$, we have $(1-\delta) - (1-\tau) < 0$ when $\tau < \delta$ and debt has a negative overall tax shield.

if equity enjoys a tax advantage at the personal level, it can offset the tax advantage debt enjoys at the firm level

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