Finance Lecture #5: Corporate Finance

JRE 300: Fundamentals of Accounting and Finance

Kevin Mott

Rotman School of Management
University of Toronto

Today's Roadmap

Last week: We learned how to use CAPM and WACC to evaluate projects.

This week: Capital structure, taxes, central banks, and hedging.

Part 1: The Frictionless Benchmark (MM Theorem)

- Value comes from assets, not financing: $V = E + D$
- How leverage affects equity beta and cost of equity
- WACC stays constant (in a frictionless world)

Part 2: Taxes and Bankruptcy Costs

- Interest tax shield increases firm value
- Bankruptcy costs destroy value
- Trade-off theory: balancing tax benefits and distress costs
- Corporate tax policy and equity market stability

Today's Roadmap (cont.)

Part 3: Central Banks and the Real Economy

- How the policy rate affects all interest rates
- Transmission mechanism: policy rate $\rightarrow$ WACC $\rightarrow$ investment
- Why central bank decisions affect firm valuations and hiring
- The real channel of monetary policy

Part 4: Introduction to Hedging

- Hedging vs. speculation
- Using options to manage risk (airline oil exposure example)
- Call and put options, payoff diagrams
- Preview: Options pricing next week

Big picture: Connecting firm-level finance decisions to macro policy and risk management.

Part 1

How to Value a Firm

What is a firm worth?

Fundamental principle:

Financial prices = the present value of future cash flows

For a firm, what are the cash flows?

- Cash flows to **equity holders**: dividends and capital gains
- Cash flows to **debt holders**: interest and principal repayments

How do we measure a firm's value?

- We look at the **market values** of all outstanding claims
- These market values reflect the PV of expected cash flows to each group of investors

Valuing firms with different capital structures

All-equity firm:

- Firm value = **Stock market capitalization**
- Market cap = stock price × shares outstanding
- This is the PV of all future cash flows to shareholders

What if the firm issues debt?

- This creates cash flows (interest and principal) that now go to bondholders
- These are cash flows that would have otherwise gone to the firm's owners
- So we need to account for them: How much value is this?
- Answer: **Market value of debt** (what the debt trades for)
- This reflects the PV of promised payments to bondholders, adjusted for default risk

If both equity and debt are used:

- Firm value = Market value of equity + Market value of debt
- We sum the PVs of cash flows to each group of investors

A firm's total value: $V = E + D$

Our metric for a firm's value:

$$\boxed{V = E + D}$$

where:

- V = firm value
- E = **market value** of equity (stock market cap)
- D = **market value** of debt (what bonds trade for)

Why market values?

- Market prices reflect investors' assessments of future cash flows
- Book values (accounting values) are backward-looking
- Market values tell us what claims are *actually worth* today

Key insight: A firm's value is the sum of the market values of all outstanding claims on its cash flows.

How can a firm change its value?

Question: What increases $V = E + D$?
Answer: Doing projects with **NPV > 0**.

What do firms do?

1. **Identify productive investment opportunities** (positive NPV projects)
   - New factories, R&D, product launches, acquisitions
   - These projects generate cash flows worth more than they cost
2. **Raise financing to afford these investments**
   - Issue debt
   - Issue equity or use retained earnings

The big picture:

- Financial markets link excess capital (from savers/investors) to firms with productive uses for it
- This creates **financial value** (returns) and **economic growth** (real output)

A puzzle: Does financing affect NPV?

We learned last week:

- Cost of debt $<$ Cost of equity ($r_D < r_E$)
- Debt is cheaper because it's less risky (fixed payments, paid first in bankruptcy)

Natural questions:

1. If debt financing is cheaper, would using more debt raise project NPVs?
2. Why is there even a stock market if debt is cheaper?

This seems like it should matter!

- If we can finance projects more cheaply, doesn't that increase their value?
- Should all firms just use 100% debt financing?

Preview: Financing shouldn't matter

The answer (spoiler alert):

No, financing choice doesn't affect NPV or firm value

Important: For now, assume **no taxes** and **no bankruptcy costs** (frictionless world).

Why doesn't financing matter?

- Yes, debt is cheaper than equity ($r_D < r_E$)
- But when you add more debt, equity becomes riskier
- Equity holders demand a higher return to compensate for the extra risk
- The cost of equity **equilibrates** to the debt level
- These forces exactly offset each other

Result: WACC stays constant regardless of capital structure

Let's build the intuition for why this happens.

Understanding the hurdle rate: Project beta vs. Equity beta

When we evaluate a project, the discount rate depends on the **project's risk**, not the firm's equity risk.

The project's systematic risk determines its required return (the hurdle rate). We often use **comparables** (industry averages) to estimate project beta.

But there's a complication:

The beta of the *project* is different from the beta of the *equity*

Let's see why this matters, starting with the simplest case.

Starting point: The all-equity firm

Consider a firm with no debt (100% equity financed).

All cash flows from the project go to equity holders, so they bear all the project's systematic risk.

Therefore: $\beta_E = \beta_{\textbf{Project}}$

Example: Suppose a firm's projects have systematic risk $\beta_{\text{Project}} = 1.2$

With no debt, equity holders bear all this risk, so $\beta_E = 1.2$.

Simple so far. When there's no debt, equity beta equals project beta.

Now let's add debt...

What happens when we add debt?

Suppose the firm issues debt (assume debt is risk-free: $\beta_D = 0$).

Does the project's systematic risk change? **No!** The project's risk is determined by its cash flows, not how it's financed.

But here's the problem:

- The project still has systematic risk $\beta_{\text{Project}} = 1.2$
- Debt holders now bear some of the firm's value, but *zero* systematic risk ($\beta_D = 0$)
- Regardless of project outcomes, debtholders must be repaid—no exposure to systematic risk
- Equityholders now have more downside when things go wrong, more upside when things go well
- Their exposure to systematic risk *rises*

For the project beta to stay constant, β_E must **rise**.

Beta conservation: Why β_E must rise

The firm's overall systematic risk is the weighted average of debt and equity risk:

$$\beta_{\text{Project}} = \frac{E}{E+D} \times \beta_E + \frac{D}{E+D} \times \beta_D$$

Solving for β_E:

$$\beta_E = \beta_{\text{Project}} + \frac{D}{E} \times (\beta_{\text{Project}} - \beta_D)$$

With risk-free debt ($\beta_D = 0$): $\beta_E = \beta_{\text{Project}} \times (1 + D/E)$

As leverage ratio D/E increases, β_E must increase proportionally to keep β_{Project} constant. Equity holders now bear *amplified* systematic risk.

Example: How leverage amplifies equity beta

Project beta: $\beta_{\text{Project}} = 1.2$, debt is risk-free: $\beta_D = 0$

All-equity firm ($D/E = 0$):

$$\beta_E = 1.2 \times (1 + 0) = 1.2$$

Add debt to achieve $D/E = 0.5$:

$$\beta_E = 1.2 \times (1 + 0.5) = 1.8$$

More debt, $D/E = 1$:

$$\beta_E = 1.2 \times (1 + 1) = 2.4$$

Even though the project's risk hasn't changed ($\beta_{\text{Project}} = 1.2$ throughout), equity beta doubles from 1.2 to 2.4 as leverage increases.

Cost of equity rises with leverage

We just showed: $\beta_E = \beta_{\text{Project}} + \frac{D}{E}(\beta_{\text{Project}} - \beta_D)$

Using CAPM for equity and debt:

$$
\begin{aligned}
r_E &= r_f + \beta_E \times (\mathbb{E}[R_m] - r_f) \\
&= r_f + \left[\beta_{\text{Project}} + \frac{D}{E}(\beta_{\text{Project}} - \beta_D)\right] \times (\mathbb{E}[R_m] - r_f) \\
&= r_f + \beta_{\text{Project}} \times (\mathbb{E}[R_m] - r_f) + \frac{D}{E}(\beta_{\text{Project}} - \beta_D) \times (\mathbb{E}[R_m] - r_f) \\
&= r_0 + \frac{D}{E}\left[\beta_{\text{Project}} \times (\mathbb{E}[R_m] - r_f) - \beta_D \times (\mathbb{E}[R_m] - r_f)\right] \\
&= r_0 + \frac{D}{E}\left[(r_0 - r_f) - (r_D - r_f)\right] = \boxed{r_0 + \frac{D}{E}(r_0 - r_D)}
\end{aligned}
$$

Interpreting the cost of equity formula

$$\underbrace{r_E}_{\text{Levered COE}} = \underbrace{r_0}_{\text{Unlevered COE}} + \underbrace{(r_0 - r_D) \times \frac{D}{E}}_{\text{Leverage premium}}$$

Unlevered cost of equity (r_0): The return equity holders require when the firm has no debt. This compensates them for the project's systematic risk.

Leverage premium $(r_0 - r_D) \times D/E$: The *additional* return equity holders demand to compensate for increased risk exposure from financial leverage.

As debt increases, equity holders bear amplified systematic risk (the residual claim gets riskier). The leverage premium grows proportionally with D/E to compensate for this increased exposure.

Note: With risk-free debt ($r_D = r_f$), this becomes $r_E = r_0 + (r_0 - r_f) \times D/E$.

What does this mean for WACC?

WACC is the **weighted average opportunity cost** of the pool of investors in a project.

WACC equilibrates to the risk level of the *project*, not the equity

The project has a fixed systematic risk (β_{Project}) that determines its required return. As we change D/E, we're just **reallocating risk** among investors.

Cost of equity and **cost of debt** are compensation to investors according to their *exposure*.

Higher debt $\rightarrow$ equity bears more risk $\rightarrow$ r_E rises. But debt is cheaper, and we're using more of it. These forces offset.

WACC stays constant at the project's risk level.

Capital structure doesn't change project value—it just changes how risk and returns are distributed among investors.

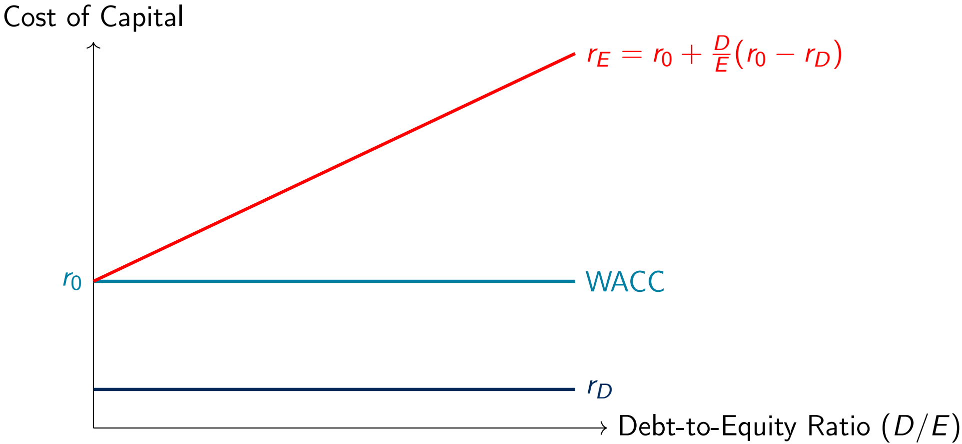
What happens when we plug this into WACC?

Start with WACC and substitute our formula for r_E:

$$\begin{aligned}
\text{WACC} &= \frac{E}{E+D} \times r_E + \frac{D}{E+D} \times r_D \\
&= \frac{E}{E+D} \times \left[r_0 + (r_0 - r_D) \times \frac{D}{E} \right] + \frac{D}{E+D} \times r_D \\
&= \frac{E}{E+D} \times r_0 + \frac{D}{E+D} \times (r_0 - r_D) + \frac{D}{E+D} \times r_D \\
&= \frac{E}{E+D} \times r_0 + \frac{D}{E+D} \times r_0 \\
&= \boxed{r_0}
\end{aligned}$$

WACC equals the unlevered cost of equity, regardless of leverage! The rising cost of equity exactly offsets the use of cheaper debt.

Capital Structure and Cost of Capital (No Tax)



Cost of equity rises with leverage, but WACC stays constant

Example: WACC stays constant as leverage changes

Setup: $r_f = 3\%$, market risk premium $= 7\%$, $\beta_{\text{Project}} = 1.2$, risk-free debt ($\beta_D = 0$) at $r_D = 3\%$

All-equity firm ($D/E = 0$):

- $\beta_E = 1.2 \times (1 + 0) = 1.2$
- $r_E = 3\% + 1.2 \times 7\% = 11.4\%$
- $\text{WACC} = 100\% \times 11.4\% + 0\% \times 3\% = 11.4\%$

Now add debt to $D/E = 1$ (50% debt, 50% equity):

- $\beta_E = 1.2 \times (1 + 1) = 2.4$
- $r_E = 3\% + 2.4 \times 7\% = 19.8\%$
- $\text{WACC} = 50\% \times 19.8\% + 50\% \times 3\% = 9.9\% + 1.5\% = 11.4\%$

Cost of equity nearly doubled (from 11.4% to 19.8%), but WACC stayed constant because we're using cheaper debt.

Summary: The Modigliani-Miller Theorem

What we've shown:

- Capital structure is **irrelevant** to firm value in a frictionless world
- Leverage increases equity beta: $\beta_E = \beta_{\text{Project}} + \frac{D}{E}(\beta_{\text{Project}} - \beta_D)$
- Cost of equity rises with leverage: $r_E = r_0 + (r_0 - r_D) \times D/E$
- But WACC stays constant: WACC $= r_0$ regardless of D/E
- Changing capital structure just **reallocates risk** among investors

This is the **Modigliani-Miller Theorem** (1958)—one of the most important results in finance.

Key assumptions we made:

- **No taxes** (no interest tax shield)
- **No bankruptcy costs**

Part 2 will relax these assumptions and see when capital structure *does* matter.

Part 2

Real-World Frictions:
Taxes and Bankruptcy Costs

What our analysis missed

In Part 1, we showed that capital structure doesn't matter in a frictionless world.

But we made an important simplifying assumption: **no taxes**.

In reality, there's a crucial asymmetry in the tax code:

Interest payments on debt are **tax-deductible**

Dividend payments and retained earnings (equity financing) are *not* tax-deductible.

This creates a significant advantage for debt financing. Let's see how.

Example: The tax shield in action

Consider two identical firms:

- Both have EBIT = \$100 per year
- Corporate tax rate $\tau_c = 25\%$
- **Firm A**: No debt
- **Firm B**: \$500 of debt at 5% interest

	Firm A (No Debt)	**Firm B (Debt)**
EBIT	\$100	\$100
Interest	\$0	\$25
Taxable income	\$100	\$75
Taxes (25%)	\$25	\$18.75
Cash to investors	**\$75**	**\$81.25**

Firm B pays \$6.25 less in taxes. This is the **tax shield** = Interest $\times\ \tau_c$ = \$25 $\times$ 0.25 = \$6.25.

Redoing the analysis: WACC with taxes

In Part 1, we had:

$$\text{WACC} = \frac{E}{E+D} \times r_E + \frac{D}{E+D} \times r_D$$

But this ignored the tax deductibility of interest. The *after-tax* cost of debt is lower:

$$\text{After-tax cost of debt} = r_D \times (1 - \tau_c)$$

So the correct WACC formula is:

$$\boxed{\text{WACC} = \frac{E}{E+D} \times r_E + \frac{D}{E+D} \times r_D \times (1 - \tau_c)}$$

The $(1 - \tau_c)$ term captures the tax shield. Since $\tau_c > 0$, this lowers WACC.

Equity beta decreases (compared to no-tax case)

The equity beta relationship changes:

Without taxes (from Part 1):

$$\beta_E = \beta_{\text{Project}} + \frac{D}{E}(\beta_{\text{Project}} - \beta_D)$$

With taxes, the effective leverage is lower because of the tax shield:

$$\beta_E = \beta_{\text{Project}} + \frac{D}{E}(\beta_{\text{Project}} - \beta_D) \times (1 - \tau_c)$$

The $(1 - \tau_c)$ term captures how the tax shield reduces equity holders' systematic risk exposure.

Cost of equity with taxes (MM Proposition II)

Starting from CAPM with the adjusted beta:

$$\begin{aligned} r_E &= r_f + \beta_E \times (\mathbb{E}[R_m] - r_f) \\ &= r_f + \left[\beta_{\text{Project}} + \frac{D}{E}(\beta_{\text{Project}} - \beta_D)(1 - \tau_c)\right] \times (\mathbb{E}[R_m] - r_f) \\ &= r_0 + \frac{D}{E}(r_0 - r_D)(1 - \tau_c) \end{aligned}$$

Result:

$$\boxed{r_E = r_0 + (r_0 - r_D) \times \frac{D}{E} \times (1 - \tau_c)}$$

The leverage premium is **smaller** with taxes because the tax shield cushions equity holders from systematic risk.

What is WACC with the new cost of equity?

We have: $r_E = r_0 + (r_0 - r_D) \times \frac{D}{E} \times (1 - \tau_c)$

Plugging into WACC:

$$
\begin{aligned}
\text{WACC} &= \frac{E}{E+D} \times r_E + \frac{D}{E+D} \times r_D \times (1-\tau_c) \\
&= \frac{E}{E+D} \times \left[r_0 + (r_0 - r_D) \times \frac{D}{E} \times (1-\tau_c) \right] + \frac{D}{E+D} \times r_D \times (1-\tau_c) \\
&= \frac{E}{E+D} \times r_0 + \frac{D}{E+D} \times (r_0 - r_D) \times (1-\tau_c) + \frac{D}{E+D} \times r_D \times (1-\tau_c) \\
&= \frac{E}{E+D} \times r_0 + \frac{D}{E+D} \times (1-\tau_c) \times [(r_0 - r_D) + r_D] \\
&= \frac{E}{E+D} \times r_0 + \frac{D}{E+D} \times (1-\tau_c) \times r_0
\end{aligned}
$$

WACC with taxes

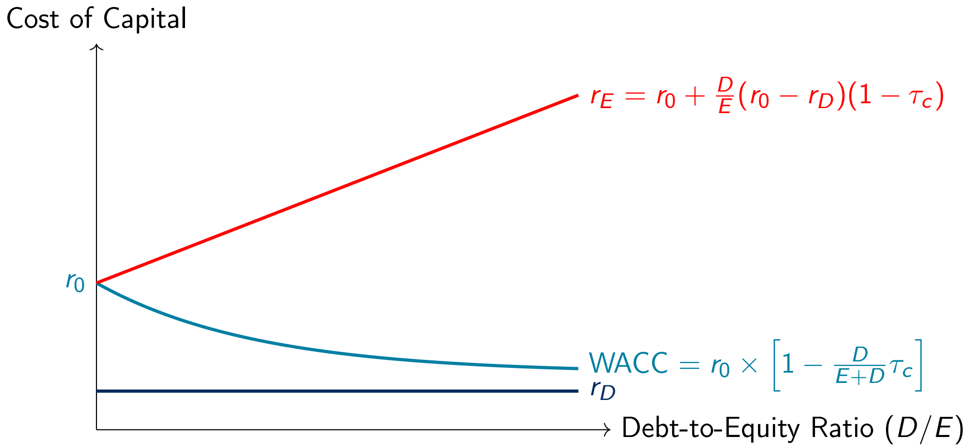
$$
\begin{aligned}
\text{WACC} &= r_0 \times \left[\frac{E}{E+D} + \frac{D}{E+D} \times (1-\tau_c) \right] \\
&= r_0 \times \left[\frac{E}{E+D} + \frac{D}{E+D} - \frac{D}{E+D} \times \tau_c \right] \\
&= \boxed{r_0 \times \left[1 - \frac{D}{E+D} \times \tau_c \right]}
\end{aligned}
$$

As leverage increases ($D \uparrow$), WACC decreases.

Why lower WACC increases firm value:

- Discount future cash flows by less $\rightarrow$ higher present value
- More projects have positive NPV (lower hurdle rate)

Capital Structure and Cost of Capital (Taxes)



Cost of equity rises with leverage, WACC falls (tax shield savings)

So why not finance with 100% debt?

We just showed: More debt lowers WACC.

This means:

- Discount future cash flows at a lower rate $\rightarrow$ higher firm value
- Lower hurdle rate $\rightarrow$ more projects have positive NPV
- Greater investment opportunities for value-creating projects

So why not use 100% debt?

Bankruptcy costs

Bankruptcy costs destroy value

Too much debt increases the probability of **financial distress** and **bankruptcy**.

These costs can destroy significant value, offsetting the tax benefits of debt.

The optimal capital structure balances the **tax benefits** of debt against the **bankruptcy costs** of too much debt.

What is bankruptcy?

Common misconception: Bankruptcy = business shuts down.
Reality: Bankruptcy is a **legal process** for handling financial distress (cash flows insufficient to pay interest obligations).

Two main types:

1. **Reorganization** (Chapter 11 in the US):
   - Firm continues operating
   - Renegotiates debt with creditors under court supervision
   - Emerges with new capital structure (often converting debt to equity)
   - Examples: General Motors, American Airlines
2. **Liquidation** (Chapter 7 in the US):
   - Firm ceases operations
   - Assets sold off to pay creditors
   - Firm dissolves

Most large firms file for reorganization, not liquidation.

How does bankruptcy risk affect firms?

The mechanism: When market participants expect higher probability of bankruptcy:

Lenders demand compensation for default risk:

- If you might not repay, lenders won't lend at the risk-free rate
- They charge a **higher cost of debt** ($r_D \uparrow$)
- Equivalently: they lend at a discount (pay less than face value for bonds)

This creates a feedback loop:

1. More debt $\rightarrow$ higher bankruptcy probability
2. Higher bankruptcy risk $\rightarrow$ lenders charge higher r_D
3. Higher r_D $\rightarrow$ harder to service debt $\rightarrow$ even higher bankruptcy risk

Key insight: The *expectation* of bankruptcy raises borrowing costs, which itself increases financial distress—even before actual bankruptcy occurs.

Two types of bankruptcy costs

1. **Direct bankruptcy costs**:
   - Legal fees, accounting fees, court costs
   - Administrative expenses of reorganization
   - Typically 3-7% of firm value for large firms

2. **Indirect costs (financial distress)**:
   - **Lost customers**: worried about warranties, future service
   - **Lost suppliers**: demand cash up front, refuse credit
   - **Lost employees**: talented workers leave for more stable firms
   - **Underinvestment**: can't raise capital for positive NPV projects
   - **Asset fire sales**: forced to sell assets below fair value

Indirect costs are often **much larger** than direct costs and begin *before* actual bankruptcy.

Example: Financial distress costs

Consider an airline with high debt levels:

When the airline appears financially troubled:

- **Customers** stop buying tickets (fear airline will shut down)
- **Suppliers** demand cash payment for fuel and parts
- **Pilots and mechanics** leave for more stable airlines
- **Lessors** refuse to lease new aircraft

Result:

- Revenue collapses, costs spike
- The firm may fail even if it would have been viable with less debt
- Self-fulfilling prophecy: high debt creates fragility

The trade-off theory of capital structure

The optimization problem (loose formulation):

$$\max_{D/E} \quad \sum_{t=1}^{\infty} \frac{CF_t}{\text{WACC}^t} - \text{PV(Bankruptcy Costs)}$$

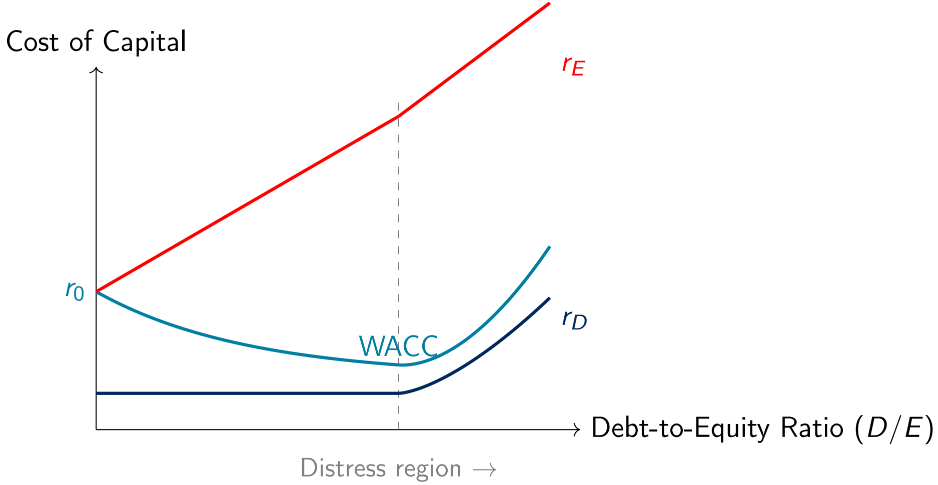
subject to:

$$\text{WACC} = r_0 \times \left[1 - \frac{D}{E+D} \times \tau_c\right]$$

Trade-off:

- Higher $D/E \rightarrow$ lower WACC $\rightarrow$ higher PV of cash flows and tax shield
- But higher $D/E \rightarrow$ higher PV(Bankruptcy Costs) $\rightarrow$ destroys value

Capital Structure and Cost of Capital (With Bankruptcy Costs)



Initially: tax shield lowers WACC. Beyond threshold: bankruptcy costs dominate

How hard is this to measure in practice?

Very hard. This is an active area of study in academic corporate finance.

The challenges:

1. **Corporate Taxation**:
   - Depends on tax rates: corporate tax code is extremely complex
   - Future tax rates and debt policy are uncertain (elections?)
2. **PV(Bankruptcy Costs)**:
   - What is the probability of bankruptcy? (model-dependent)
   - How large are indirect costs? (hard to observe, vary by industry)
   - How do bankruptcy costs vary with systematic risk and macro conditions?
3. **Other Frictions:**
   - Capital adjustment costs: it's expensive to move capital around
   - Raising additional equity: costly and negative signal

What should managers do?

Bottom line for capital structure choice:

Managers should choose the debt-to-equity ratio that balances:

1. **Reducing WACC** through the interest tax shield
2. **Bankruptcy costs** from financial distress
3. **Levered equity risk** borne by shareholders

This optimization depends heavily on:

- The firm's systematic risk (β_A)
- Industry characteristics (cash flow stability, asset tangibility)
- The macroeconomic environment
- **Corporate tax policy**

Speaking of taxes... let's dig deeper into corporate tax policy.

(Sounds boring, is actually **super interesting**.)

What do taxes do to equity holders?

Recall: $\beta_E = \beta_{\text{Project}} + \frac{D}{E}(\beta_{\text{Project}} - \beta_D) \times (1 - \tau_c)$

Higher corporate tax rate τ_c means:

1. **Lower systematic risk exposure**:
   - The $(1 - \tau_c)$ term dampens how much leverage amplifies equity beta
   - Tax shield cushions equity holders from systematic risk
2. **Lower expected returns**:
   - Since $r_E = r_0 + (r_0 - r_D) \times \frac{D}{E} \times (1 - \tau_c)$, the leverage premium is smaller
   - Less risk $\rightarrow$ lower required return (CAPM)
3. **Lower cash flows**:
   - After-tax profits are $(1 - \tau_c) \times \text{EBIT}$
   - Higher taxes mean less cash available for dividends

Corporate tax rates amplify equity market risk

A macro perspective: Since β_E contains $(1 - \tau_c)$, **higher corporate tax rates are a stabilizer for equity (stock) markets**.

When τ_c falls (e.g., tax cuts):

- $(1 - \tau_c) \uparrow \rightarrow$ equity beta rises for levered firms
- Stock market becomes **more sensitive** to macroeconomic shocks
- Equity returns become **more volatile** during recessions and expansions

Broader spillover effects:

1. **Wealth inequality**: Equity ownership concentrated among wealthy; higher volatility amplifies wealth swings
2. **Retirement stability**: Pensions hold equities; more systematic risk means less predictable retirement outcomes
3. **Financing opportunities**: Higher equity volatility raises cost of capital, making it harder to fund risky projects

Policy comparison: US vs. Canada

Corporate tax environment:

- **United States**: Lower corporate tax rates
- **Canada**: Higher corporate tax rates

Implications for equity markets:

- **US**: Lower $\tau_c \rightarrow$ higher $(1 - \tau_c) \rightarrow$ **more systematic risk** in equity markets
- **Canada**: Higher $\tau_c \rightarrow$ lower $(1 - \tau_c) \rightarrow$ **less systematic risk** in equity markets

Historical performance:

- US equity markets: Higher returns, higher volatility (more risk-taking, innovation)
- Canadian equity markets: Lower returns, lower volatility (more stability)

The trade-off:

- **Innovation**: Lower taxes $\rightarrow$ more risk-taking $\rightarrow$ growth and innovation
- **Stability**: Higher taxes $\rightarrow$ less volatility $\rightarrow$ retirement security, less inequality

Part 3

Central Banks, Interest Rates, and the Real Economy

Why do central banks matter for firms?

We now have enough understanding in place to understand why central banks adjusting interest rates is so effective for adjusting the economic growth rate.

The connection to what we've learned:

- Central banks control the **policy rate** (Bank of Canada's overnight rate, Fed's federal funds rate)
- This affects r_f (risk-free rate) and r_D (cost of debt)
- Which affects **WACC**
- Which affects firm valuations and the **NPV of investment projects**
- Which affects hiring, growth, and the real economy

Central bank policy directly impacts corporate finance decisions we've been studying.

What is the policy rate?

The policy rate is the interest rate that the central bank sets and controls.

Different names in different countries:

- **Canada**: Overnight rate (set by the Bank of Canada)
- **United States**: Federal funds rate (set by the Federal Reserve)

What does it actually control?

- The target rate for **interbank lending**
- Banks lend reserves to each other overnight to meet regulatory requirements
- The central bank sets the target for this rate

How can the central bank control this rate?

- Conducts open market operations (buying/selling government bonds)
- Adjusts the supply of reserves in the banking system
- This pushes the interbank rate to the target level

Step 1: Central bank sets the policy rate

The starting point: Central bank announces a change to the policy rate: 1pp increase to combat inflation.

Example: Bank of Canada raises overnight rate from 4% to 5%.

What is the overnight rate?

- The target rate for banks lending to each other overnight
- Banks need to borrow/lend reserves to meet daily requirements
- This becomes the **baseline cost of funds** for banks

Key point: When the overnight rate rises to 5%, banks' opportunity cost of borrowing and lending funds with each other goes up to 5%.

Step 2: Banks pass on higher costs to borrowers

Question: If banks' opportunity cost of funds goes up, what about the rate they charge private borrowers?

Answer: It goes **up**.

Why?

- Banks can now earn 5% by lending to other banks (risk-free)
- To lend to private borrowers (households, firms), they need to earn *at least* 5% + a risk premium
- Otherwise, they'd just lend to other banks instead

Result:

- **Mortgage rates** rise (households)
- **Business loan rates** rise (firms)
- **Prime rate** rises (banks' benchmark lending rate)

Step 3: Private borrowers' opportunity cost goes up

How does this affect the opportunity cost of private borrowers?

Answer: It goes **up**.

For households:

- Can earn 5% by holding government bonds (now yielding more)
- Mortgage rates are higher
- Less incentive to borrow, more incentive to save

For firms:

- **Risk-free rate** (r_f): Government bond yields rise (baseline opportunity cost)
- **Cost of debt** (r_D): Corporate bond yields and bank loans cost more
- **Cost of equity** (r_E): Also rises (through CAPM, since $r_f \uparrow$)

Everyone's opportunity cost is up $\rightarrow$ firms face higher cost of capital.

Step 4: Firms face higher cost of capital

Putting it together:

Central bank raises policy rate from 4% to 5%:

1. Banks' opportunity cost $\uparrow$ (interbank rate $= 5\%$)
2. Banks charge private borrowers more
3. $r_f \uparrow$ (government bonds yield more)
4. $r_D \uparrow$ (corporate debt costs more)
5. $r_E \uparrow$ (through CAPM: $r_E = r_f + \beta_E \times (\mathbb{E}[R_m] - r_f)$)
6. **WACC** $\uparrow$ (weighted average of r_E and r_D both rise)

The chain:

$$\text{Policy rate} \uparrow \rightarrow r_f \uparrow, r_D \uparrow \rightarrow \text{WACC} \uparrow$$

Higher WACC means firms face a higher hurdle rate for investment projects.

How policy rates affect investment decisions

Recall: A project is worth pursuing if NPV > 0.

NPV depends on the discount rate (WACC):

$$\text{NPV} = \sum_{t=1}^{T} \frac{CF_t}{\text{WACC}^t} - \text{Initial Investment}$$

When the central bank raises rates:

- WACC $\uparrow \rightarrow$ discount rate increases
- NPV of projects $\downarrow$ (future cash flows worth less today)
- **Fewer projects have positive NPV**
- Investment space shrinks $\rightarrow$ firms invest less
- Lower investment, fewer projects $\rightarrow$ economic growth **slows** (inflation reduces)

How policy rates affect firm valuations

Recall: $\text{WACC} = r_0 \times \left[1 - \frac{D}{E+D} \times \tau_c\right]$

And r_0 depends on r_f (through CAPM): $r_0 = r_f + \beta_A \times (\mathbb{E}[R_m] - r_f)$

When the central bank raises the policy rate:

1. Policy rate $\uparrow \rightarrow r_f \uparrow$ and $r_D \uparrow$
2. $r_f \uparrow \rightarrow r_0 \uparrow$ (unlevered cost of capital rises)
3. WACC $\uparrow$ (discount rate increases)
4. Firm value $= \sum_t CF_t/\text{WACC}^t \downarrow$ (present value of cash flows falls)

When the central bank cuts the policy rate:

- Everything reverses: WACC $\downarrow$, firm value $\uparrow$

This is why stock markets react immediately to central bank announcements.

Real economy effects: Investment, hiring, growth

The full transmission to the real economy:

Central bank raises rates:

1. Policy rate $\uparrow \rightarrow r_f$, r_D, WACC all rise
2. Fewer projects have positive NPV $\rightarrow$ **less investment**
3. Less capital spending (factories, equipment, R&D)
4. Firms hire fewer workers $\rightarrow$ **unemployment rises**
5. Economic growth slows $\rightarrow$ inflation cools

Central bank cuts rates:

1. Policy rate $\downarrow \rightarrow r_f$, r_D, WACC all fall
2. More projects have positive NPV $\rightarrow$ **more investment**
3. More capital spending
4. Firms hire more workers $\rightarrow$ **unemployment falls**
5. Economic growth accelerates $\rightarrow$ may fuel inflation

Part 4
Introduction to Hedging

Hedging vs. speculation

Two ways to use financial instruments:

1. **Hedging**:
   - Using financial instruments to **reduce a specific risk exposure**
   - Goal: Protect against adverse price movements
   - Example: An airline worried about rising oil prices

2. **Speculation**:
   - Using financial instruments to **increase a specific risk exposure**
   - Goal: Profit from anticipated price movements
   - Example: A trader betting oil prices will rise

Key difference: Hedgers want to *eliminate* a risk, speculators want to *take on* a risk.

Today we focus on **hedging**—how firms manage their risk exposures.

Motivating example: An airline's oil price exposure

Consider an airline:

The problem:

- Fuel is a major operating cost (20-30% of expenses)
- Oil prices are volatile
- **Rising oil prices hurt profitability**
  - Higher fuel costs $\rightarrow$ lower profit margins
  - Can't always pass costs to customers immediately

The exposure:

- When oil prices $\uparrow$, airline's costs $\uparrow$, profits $\downarrow$
- When oil prices $\downarrow$, airline's costs $\downarrow$, profits $\uparrow$

Question: How can the airline reduce this exposure to oil price shocks?

Naive solution: Buy oil company stocks?

Idea: Buy shares of oil companies (e.g., Exxon, Shell).

Logic:

- When oil prices $\uparrow$, oil company stocks $\uparrow$
- Gains on oil stocks offset losses from higher fuel costs

Why this doesn't work well:

1. **Beta exposure**: Oil stocks have systematic risk
    - Stock prices move with the market, not just oil prices
    - In a recession, oil stocks can fall even if oil prices rise
2. **Downside risk**: You can lose money on the stocks
    - If oil prices fall, you lose on both the stocks *and* your core business doesn't benefit as much as stocks lose
3. **Imperfect correlation**: Oil stock returns $\neq$ oil price changes

A better solution: Oil call options

What if we could design an instrument that:

- Pays us when oil prices rise (offsetting higher fuel costs)
- Has limited downside when oil prices fall

This is a **call option** on oil.

Formal definition of a call option:

- Gives the holder the **right** (not obligation) to **buy** an asset at a specified price K (called the **strike price**)
- **Expiration date** (T): When the option expires
- **Premium** (C): The upfront price paid to purchase the option

Exercise decision at expiration:

- If oil price $S_T > K$: Exercise the option (buy at K, savings $= S_T - K$)
- If oil price $S_T < K$: Let the option expire (walk away, savings $= 0$)

Payoff vs. profit

Important distinction: Payoff $\neq$ Profit.

Payoff at expiration:

$$\text{Payoff} = \max(S_T - K, 0)$$

- This is what you receive at expiration
- Ignores the upfront premium paid

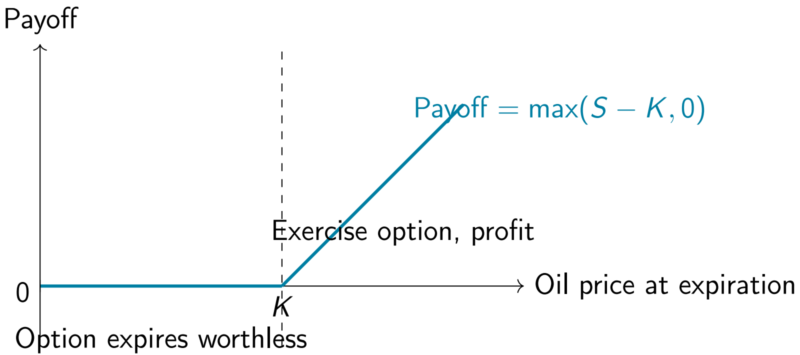
Profit at expiration:

$$\text{Profit} = \max(S_T - K, 0) - C$$

- This accounts for the premium C paid upfront
- Can be negative (you lose the premium if option expires worthless)

Key feature: Payoff is asymmetric—you benefit from upside, but maximum loss is limited to the premium C.

Call option payoff: The hockey stick



The "hockey stick" shape:

- If $S < K$: Payoff $= 0$ (don't exercise)
- If $S > K$: Payoff $= S - K$ (exercise and profit)

For the airline: This caps downside exposure to oil price increases.

How the airline uses call options to hedge

Hedging strategy:

Airline's position:

1. **Underlying exposure**: Rising oil prices hurt profits
2. **Hedge**: Buy call options on oil for premium C with strike K

Outcome:

- **If oil price rises above K**:
  - Fuel costs increase, hurting profits
  - Call option pays off $(S - K)$, offsetting the loss
  - Net effect: Capped exposure to oil price increases
- **If oil price stays below K**:
  - Fuel costs remain manageable
  - Call option expires worthless (sunk cost of premium)
  - Net effect: Small loss (premium paid), but no major impact

Next week: Options pricing

Today: Introduction to hedging and options (hockey sticks, protective puts, covered calls)

Next week: How do we *price* these options?

The fundamental challenge:

- Pricing is about computing present value: $C = \text{PV}(\text{Expected Payoff})$
- But there's **so much uncertainty** in the payoff!
- Payoff depends on future stock price: $\max(S_T - K, 0)$
- Estimating the expected PV is extremely difficult

The solution: We need new tricks:

- **No-arbitrage arguments**: If two portfolios have the same payoff, they must have the same price
- **Replicating (synthetic) portfolios**: Build an option payoff using stocks and bonds

Conclusion: Connecting the Pieces

1. **MM Theorem**: Capital structure doesn't matter in a frictionless world (the benchmark)
2. **Taxes & Bankruptcy**: Real-world frictions create optimal leverage
3. **Central Banks**: Policy rates affect WACC, investment, and the real economy
4. **Hedging**: Options let firms manage specific risk exposures

The big picture:

- Firm-level decisions (capital structure, hedging) are deeply connected to macro conditions (tax policy, monetary policy)
- Systematic risk is the common thread: it affects optimal leverage, equity market volatility, and central bank effectiveness
- Corporate finance isn't just about individual firms—it's about how the entire economy allocates risk and capital

Next week: Options pricing (put-call parity, binomial trees, Black-Scholes).

Thank you!

Questions?